

Edinburgh Health Society.

HEALTH LECTURES

FOR THE PEOPLE.

FIFTH, SIXTH, SEVENTH, AND EIGHTH SERIES.

Edinburgh:
MACNIVEN & WALLACE.

1888.

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Illustrated.

FIFTH SERIES.

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1885.

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PREFATORY NOTE.

THE attention of the readers of this Series of Lectures is directed to the Fourth Annual Report by the Committee of the Edinburgh Health Society, presented to the Meeting of Members on 31st January last, which is appended to this volume.

EDINBURGH, *April* 1885.

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30	2 1 6*	2 15 4	40	2 14 9	3 7 5†	50	4 1 7	4 12 1

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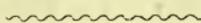
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ON CERTAIN SOCIAL ASPECTS OF INSANITY.

BY DR J. BATTY TUKE, M.D., F.R.C.P.E., F.R.S.E.

IN the two Health Lectures I have had the pleasure of delivering under the auspices of the Edinburgh Health Society, I directed attention to the structure of the brain, to its functions, and to certain perversions of its functional activity. I insisted very strongly on the fact that insanity was *a disease of the brain with mental symptoms*. This is a short succinct definition, which like most definitions fails to include and exclude all that should be included or excluded. At one time it was my intention to go more deeply into this subject to-night, and to have shown you our reasons for believing that it would be more accurate to say that insanity was a symptom of many morbid conditions of that organ. But I soon found that the subject was far too complex to deal with in one lecture addressed to a popular audience, and that no tangible good would be likely to result. It would be a mere tickling of public curiosity which might be actually harmful. For after my last lecture, in which I took up some details connected with the natural history and symptoms of insanity, I received a large number of visits and a perfect shoal of letters from persons who thought they could trace some connection between my remarks and their personal experiences and symptoms. For the most part the connection was entirely imaginary. For this and other reasons I do not deem it wise to put up butts for nervous people to shy at, and will therefore confine myself to-night to certain general questions connected with insanity. And besides all this the subject is such a sad one. Taken over all I

know of no more dire and distressful diseases than those which are comprised under the generic term of insanity. Of course all disease brings more or less acute misery in its train, misery to the sufferer and misery to friends and relatives. But insanity entails even more poignant anxiety and trouble. The affected person is a changed being, shut off mentally from the home circle. In ordinary disease, as a rule, the sufferings of the patient can be relieved by the cheering influences of home, whereas in the case of insanity the patients are, for the most part, debarred from such alleviations. The nature of the disease is such that in the large majority of cases it is absolutely necessary to remove the man or woman mentally afflicted from the family, and submit him or her to the treatment of strangers. I repeat, I know of no more melancholy disease, or one that demands greater sympathy. And yet is it not curious that there is a certain savour of the comic and grotesque associated in the public mind with mental disease and defect? If, in proof of this assertion, we turn to the comic papers, we constantly find paragraphs supposed to be dated from lunatic asylums, or communications from our "Insaneitary Correspondent," and so on. Insanity serves as a peg on which to hang jocular remarks, without consideration for the feelings of many mentally afflicted persons who are quite able to appreciate the cruelty of the proceeding, or without thought for the sensibilities of their connections. No one makes a jest of cancer or consumption; and I feel certain that if the professional joker would but reflect how helpless his butt is, and how sad his condition, he would refrain from expending his wit in such a direction. I freely admit it is often impossible to repress a smile as one listens to the incongruous statements of the insane; but this is a very different thing from sitting down deliberately, pen in hand, to make capital out of the peculiarities of the maniac or idiot. I do not choose to run the risk of being accused of making capital out of the details of this distressing subject, even for the purposes of a Health Lecture, and therefore will keep myself to the general question. In so doing, I cannot injure individual susceptibilities.

I cannot attack any of the many social aspects of lunacy unless I give you a brief sketch of the history of the treatment of insanity, for, of course, out of it have originated all social aspects. The history of the treatment of the mentally afflicted has been well stated to be divisible into three epochs—the barbaric, the humane, and the remedial. But this does not take into account the very humane and probably highly remedial system of treatment which obtained in very ancient times. In Egypt the temples of Saturn, and in Greece the Asclepian hospitals, were resorted to by those mentally afflicted, and the treatment there adopted was identical in principle (and perhaps superior in practice) with that of the present day. The directions given by all the classical medical authors, and especially by Hippocrates, who flourished 400 B.C., and by Galen, who practised a century B.C., are of the soundest character. How long their influence existed it is difficult to say, but in the middle ages little or no attention was paid in Great Britain or elsewhere to the care or cure of the insane. In 1537, a house in Bishopsgate Street, London, fell into the possession of the Corporation, and was appropriated for the reception of fifty lunatics. This, the first Bethlehem Hospital or Bedlam, was removed in 1675 to Moorfields, and in 1814 the present magnificent hospital was erected in St George's Fields. Another hospital, St Luke's, was instituted in 1751. Bedlams, or houses of detention for lunatics, appear to have existed in other cities, but with these exceptions no provision was made for the insane, who were allowed to wander at large. There is only too good reason for believing that many hundreds, I fear I am not exaggerating when I say many thousands, were executed as criminals or witches during this barbaric period. About 1750 the condition of the insane attracted some amount of public attention, and the incarceration in mad-houses of a considerably larger number than formerly followed; not on account of any philanthropic sympathy with their condition, but as a measure demanded for the public safety and comfort. But this measure by no means brought about the termination of the barbaric period. The houses misnamed Asylums were in the hands of private parties, under

little or no supervision, and were in fact merely prisons of the very worst description. The unhappy inmates were immured in cells, chained to the walls, flogged, starved, and not unfrequently killed. It is almost impossible to believe, but it is none the less true, that this condition of matters existed far on into the present century. According to Conolly, "there is clear proof of the continued existence of these abuses in 1827; and it cannot be denied that not a few of them survived in some public and private asylums in 1850." I myself, and I am not an old man, have seen maniacs restrained by shackles and manacles, and confined in cells of the most sordid description. Matters were no better in France when the brave Dr Pinel was appointed in 1792 to the charge of the Bicêtre, the great hospital of Paris for male lunatics. In that establishment, and in the Salpêtrière (another great hospital), the condition of the inmates was as degraded as in the British mad-houses. This great philanthropist adopted the bold step of striking off the chains and other engines of restraint from those under his care. About the same time, the most gross abuses having been brought to light in connection with the management of the City of York Asylum, William Tuke, a member of the Society of Friends, was mainly active in instituting the York Retreat for the care and cure of the insane members of the Quaker sect. This was the first Asylum instituted in Great Britain conducted on real non-restraint principles. The names of these two men are indissolubly connected with the humane treatment of the insane, and to their efforts must be ascribed the awakening, not only of the public but of the medical profession to the true principles of management of the insane and to the proper system of studying insanity. Various Committees of the House of Commons were appointed, the first being in 1806, from the reports of which emanated the various Lunacy Acts and their amendments, which aimed at the regulation and control of all constraint applied to the insane. As a consequence County Asylums were established for paupers in England, power being given to the magistrates to charge the expense upon the county rate. It was not till 1855 that a Royal Commission was ap-

pointed to investigate into lunacy matters in Scotland. This tardiness was due to the existence of chartered Royal Asylums at Edinburgh, Glasgow, Perth, Montrose, Dundee, Dumfries, and Aberdeen, which had been established at various periods between the years 1798 and 1840. But the resources of these institutions being overtaxed, and doubts having arisen as to the proper management of private pauper asylums, a Royal Commission was issued, on whose recommendation a Lunacy Board for Scotland was established, the country divided into districts, each of which was compelled to build accommodation for the pauper insane, and all private asylums for paupers were gradually abolished.

I must ask you to accept this resumé of the history of the treatment of the insane, brief and imperfect as it is, as time will not permit me further to elaborate it. But I think enough has been said to enable me to approach those aspects or phases of popular opinion springing from it, to which I desire particularly to direct your attention to-night. I will endeavour to treat of these under three heads. The first is the feeling of doubt and suspicion which still lurks in the public mind as to lunacy administration and lunatic asylums. In the second place I intend to combat certain popular errors which have arisen out of the action of legislation; and thirdly, we shall inquire whether in certain matters we are not too well satisfied with the management of the insane as it at present exists.

The feeling of doubt and suspicion as to lunacy matters is, I am happy to say, distinctly on the wane. In whatever strength it exists, it is the natural outcome of the popular recollection of the stories of cruelty, wrong, and inhumanity which startled the public mind in times gone by, and called forth much powerful and painful feeling. Such feelings die hard. But apart from this the Briton ever jealously watches over the liberty of the subject; and he watches all the more jealously when misfortune, not crime, tends to deprive the citizen of freedom. Now I think I am justified in saying that this feeling of doubt and mistrust exists much more strongly in England than in Scotland, and I believe this part of our subject will be best

opened up if we inquire into the reasons for this difference of intensity of feeling between the two countries. My own impression is that this phase of popular belief was never deeply rooted in Scotland, in consequence of the long existence of those noble institutions—the Royal Chartered Asylums. It is true somewhat similar hospitals existed in England, but these, for the most part, were administered by close corporations. In Scotland, however, the Committees of Management of the Royal Asylums have always been largely representative, consisting of delegates from the municipal, clerical, legal, and medical bodies connected with the cities or towns in the neighbourhood of which these institutions are situated, of county magistrates, and of other eminent citizens. In some instances Committees of Management are very numerous, in one instance numbering over a hundred, and in another forty. Such large memberships, although somewhat cumbersome, have had the good effect of keeping the public mind at rest, and the administration of these institutions has always been characterized by liberality and judgment. The Royal Asylums of Scotland came out of all official enquiries with unsullied, nay enhanced reputation, and as a consequence their original constitution has never been interfered with. Another important agent, which has kept down doubt and mistrust in Scotland, is the legal procedure by which an insane person is received and detained in an asylum. In this country, when such a step becomes necessary, a responsible person, such as the Inspector of Poor, or a relative of the patient, must obtain two medical certificates that the person proposed to be confined is insane; which having been obtained, he must present a petition, accompanied by a statement of particulars and the medical certificates to a Sheriff, who, if satisfied, grants an order to the superintendent of an asylum to receive and detain. This is a calm judicial process, which is applied alike to pauper and to private patients—the rich and the poor are detained on identical legal instruments. In England matters stand otherwise. In the case of private patients it is necessary to have what is termed an “order,” signed by any one having a reasonable right to inter-

fere, accompanied by two medical certificates. The schedule is not laid before a judge, or any other legal authority, and the patient is received and detained on the strength of this order and the medical certificates. In the case of pauper patients only one medical certificate is demanded, accompanied either by the order of a Justice of the Peace, or by an order signed conjointly by the relieving officer (who corresponds to our inspector of poor), and an officiating clergyman of the parish. I am very far from saying that this system is abused in England. I am certain in fact it is not. All I say is that it is much more open to suspicion than the Scotch procedure, and that the judicial element does not enter sufficiently into it. Nor do I mean to say that the Scotch procedure entirely precludes the possibility of the improper transmission of a person to an asylum. It is impossible for a Sheriff to criticise each case as it presents itself; still he has the power to do so, and does do so, when anything informal appears on the face of the schedule, or when he considers the medical certificates unsatisfactory. Moreover, the public knows that it is extremely unlikely that any two medical men would combine with a third and a fourth person for a nefarious purpose, when the necessary instrument must receive the signature of an important magistrate. It is a wise and satisfying procedure, in the working of which no difficulty is found. Perhaps the best evidence of its usefulness is the fact that not a single case involving the question of improper or illegal detention in an asylum has been originated before our courts for upwards of twenty years, and that since this procedure has been instituted no instance has occurred in which the charge has been substantiated. But Scotland possesses another important safeguard; it is a small country, with a limited population, and its lunacy matters are under the control and supervision of a well constituted General Board of Lunacy. This Board consists of an unpaid chairman, two unpaid legal and two paid medical commissioners, who supervise 29 asylums, 10 poorhouse wards for the reception of pauper lunatics, and 3 training institutions for imbecile children. These various institutions contain about 6500 patients.

Each of the medical commissioners visit each asylum at least once a year. Now the practical result of this is that these officers become personally acquainted with every case of any particular importance—important I mean as regards the propriety of detention. In England there are 6 commissioners, 3 of whom are lawyers, and all of whom receive high salaries. In visiting the various asylums a legal and a medical commissioner hunt in couples: What practical use this is I fail to understand, nor have I ever received a reasonable answer from any one competent to judge whom I have consulted on the subject. It would sound simply ridiculous to us in Scotland were it proposed to start an advocate or a writer to the signet in company with a doctor to make tours round our hospitals. The 3 medical commissioners have to visit something like 140 asylums, each pauper institution being visited once, and each private one twice a year, but not by the same men time after time. I submit that considering the enormous size of many of the institutions, the immense number of patients to be seen, and the great extent of their peregrinations, it is impossible for the English medical commissioners to have the same individual knowledge of patients as ours have. Three such officers have to inspect some 50,000 lunatics, whereas in Scotland something like 6500 are inspected by two commissioners. It has been suggested that our officials are not overworked, that in fact one medical commissioner would be sufficient; but apart from all other considerations, if these two officials maintain public confidence their not extravagant salaries are well expended public money. At the present moment in England there is a general feeling of uneasiness regarding the whole subject of lunacy administration, excited by various recent trials, and other investigations conducted within the last few years; and it is highly probable that the question in some form or other will be brought up before the next session of Parliament. My humble opinion is, that the line reform should take in England is in the direction of the adoption of the Scotch system. In the first place the legal instrument for the reception and detention of the lunatic should be made identical with our Sheriff's order, the county court judge exercis-

ing the function of our Sheriff. Secondly, that the General Board of Lunacy should be improved by the conversion of the legal into medical commissioners, the number of whom should be increased to 10 or 12. Third, that England and Wales should be broken up into lunacy districts each of which should contain not more than 10,000 lunatics. Fourthly, that two medical commissioners should be appointed to each district, which they should visit regularly twice a year. And lastly, that honorary legal commissioners should, as with us, be appointed, whose duties should be confined to advising at meetings of the General Board on cases submitted by the medical officials. I believe by this means public confidence in England would be established, and that the same elasticity of management as exists in Scotland would be obtained. Our Board having the whole of our institutions immediately under its eye, can and does allow great latitude of action in the management of individual asylums, which is impossible under existing circumstances in England, where there is a much greater tendency towards officialism and red tape.

I trust I have said enough on this subject to show you that in this country not only is the liberty of the subject most carefully guarded, but also that the interests and well-being of the insane are sedulously attended to.

Passing to the second head—popular errors arising out of the action of legislation—the error which I particularly wish to combat is the somewhat wide spread one that lunacy has become considerably more prevalent during the last quarter of a century. This opinion is based on the fact that in the year 1859 the returns made to the office of the Commissioners of Lunacy for Scotland showed 6072 lunatics, whereas in 1880 they showed 9624. There is thus a ratio of 157 per 100,000 of the population in the former year, as against 217 per 100,000 in the latter. These figures are somewhat startling, and it is not unnatural that they should have suggested the conclusion I allude to, which has also been fostered by the greatly increased expenditure on asylums and their inmates laid upon the ratepayer. Time will not

serve to-night to go into any great detail on this important subject. I can only state to you that there is a pretty general consent of all authorities, that if there has been an actual increase of lunacy over the whole population it is but very slight, and that the apparent increase is due, first, to the improved systems of registration instituted by the Board of Lunacy, which have brought under its cognizance a great mass of cases which were formerly neglected, "who would not have been dealt with as paupers in 1858, but who are now dealt with as such, so as to obtain for them the advantage of accommodation in pauper asylums." Secondly, a further and far more powerful reason is to be found in the increasing tendency among all classes, and especially among the poorer class, to recognize the less pronounced forms of mental disorder as being of the nature of insanity, and requiring to be dealt with as such. Thirdly, the grant of four shillings per week per head which in 1876 was made by Parliament from imperial sources for the maintenance of pauper lunatics has induced parochial authorities to regard as lunatics a large number of weak-minded paupers, and to force them into asylums in order to obtain the benefit of the grant and to relieve the rates. This I believe to have been a very evil piece of legislation, which has tended to glut most of our public institutions, and, to a certain extent, to have impaired their efficiency. It is impossible at present to go further into this question; but anyone specially interested in the subject will find ample justification of the opinion in the Commissioners' reports, and in the annual reports of the superintendents of most public asylums. The views just advanced receive support from the fact that the increase of private patients, *i.e.*, patients who are provided for out of their own funds or those of the family, has advanced in a vastly smaller ratio. In their case the increase, small as it is, can be accounted for by the growing disinclination on the part of the community to tolerate irregularities of conduct due to mental disease, and the consequent relegation of its victims to asylums for the sake of family convenience and comfort. And again, careful inquiry has failed to show a proportional increase of

admissions into asylums of cases of certain well marked and definite forms of insanity. The main cause of the increase of registered lunatics is thus to be sought for in improved registration and parochial and family convenience. If there is an actual increase, and there is reason for believing that there is a slight actual increase, it is due to the tendency of the population to gravitate towards towns and cities, where the conditions of health are inferior to those of rural life, and where there is therefore a greater disposition to disease of all kinds.

But a loud cry has arisen in England, which within the last few months has increased to a shriek, that another baneful influence is rapidly sapping the foundations of public health. Dr Crichton Browne, in a report to the Education Department upon the alleged over-pressure of work in Public Elementary Schools, informs us as the result of his investigations that the seeds of disease are being sown broadcast by the schoolmaster. We are led to infer from this report that water on the brain, various diseases of the kidney and heart, insanity, and suicide are increasing year by year, and that the main cause of this increase is over-pressure in Elementary Schools. This authority, I should premise, asserts that there is no over-pressure in Scotland ; but I deny that his experience is such as to warrant any expression of opinion as regards this question ; for his experience in Scotland is confined to five small schools in a purely agricultural district in Dumfriesshire, attended by children of Scotch parentage, belonging to the farming and peasant class. It is quite unfair to collate such experience with that derived from observation of schools situated in the lowest parts of London, attended by children drawn from the substratum of society. I repeat Dr Crichton Browne's experience in Scotland is of no value as affording a standard of comparison with the state of matters in England. In order to have gained anything like equivalent experience he should have visited Board Schools in the large Scotch cities. In London he examined 6500 children, most of whom were resident in the poorest and most squalid districts of the metropolis, and the results of his investigations are of the most sensational

character. As regards his remarks on the increase of the various diseases just mentioned, I will not occupy your time long. He certainly shows, from the reports of the Registrar-General, a gradual progressive increase of hydrocephalus and inflammation of the brain since 1861. This, in all probability, is merely the result of changes in medical terminology. For when we turn to the statement lately made by Sir Lyon Playfair, based on a paper in the Journal of the Statistical Society (June 1883) by Mr Noel Humphreys, we find Dr Crichton Browne's figures blown to the winds. Sir Lyon Playfair stated then, as the result of his statistical enquiries, that since the Board Schools have been in thorough working order there has been a diminution in the death-rate of children between 5 and 15 to the extent of 22 per cent. I am by no means prepared to believe that this great decrease is entirely due to educational influences, but I think the statement of so much importance that I shall add as an appendix to this lecture that portion of Sir Lyon Playfair's speech which bears on the subject. His figures being demolished, the real interest of Dr Browne's report centres in the statement that out of 6500 children whom he examined, 3034, or 46·1 per cent., suffer from habitual headache, or as he puts it in the only cautious sentence in the report, "*professed* to suffer from headache habitually." Now I must read to you how Dr Browne arrived at this conclusion.

"It may of course be objected that my results are not trustworthy. Children, it may be argued, are at once imitative and reckless, and will readily assume a headache, if they have it not, whenever that ailment seems to be fashionable amongst their companions. To ask the victims of headache in a large body of children to declare themselves, is really, it may be said, to invite malingering. But such objections to my results, however specious in appearance, could not be advanced by any one who had witnessed my method of inquiry, and my own conviction is that the figures which I submit as representing the prevalence of headaches amongst metropolitan school children fall short if anything of the truth. There seemed often to be a reluctance on the part of the children to admit their liability to headaches.

In some cases in which my professional title had been emphasised in my introduction to the standard, the idea got abroad that any admission as to headaches, in reply to my questions, would be followed by the administration of physic on the spot. In other cases it appeared that confused notions as to human responsibility led to the belief that headache was a moral delinquency, the confession of which would be followed by caning or keeping in. And in still other cases it was evident that an apprehension existed that the acknowledgment of headache would be regarded as a reflection on the teacher, whose agency in their production was obscurely recognised. I had to do my utmost to gain the confidence of the children, and to secure the co-operation of the teachers, before any fair census of headaches could be taken. My impression is that after all some wary little London urchins thought it prudent to keep their cephalgias to themselves, and that my figures are therefore rather under than over the mark. Great pains were however taken to secure accurate returns. In each standard some of the children were themselves asked to explain what was understood by a headache, and when this point was satisfactorily settled, the whole number present were exhorted to think carefully whether they ever suffered from headaches. It was impressed on them that an occasional headache, that is to say a headache at Christmas time, or after a Bank holiday, once in six months, or once a month, was of no account, and the question was then put, How many boys or girls here suffer from headaches often, or now and then? In answer to that question a little grove of hands was invariably held up, and the promptness and simultaneity with which the hands were raised, certainly created the presumption that they revealed a genuine experience. In any presumption of that kind, however, I did not rest. Having pointed out that headaches might occur in the morning, afternoon, or evening, or that even if they lasted all day they might be worst at one of these periods, I begged the children in all the schools which I examined to think when their headaches troubled them most, and then proceeded to count the hands that were held up for morning, after-

noon, and evening respectively. And it is a remarkable fact that in seven or eight cases out of ten the sum of hands held up for these three periods exactly agreed with the total number of hands held up in the first instance by the children who professed to suffer from headaches ; and in the two or three cases out of ten in which any discrepancy occurred, it always turned out on further investigation that this arose from the difficulty which a few children felt in determining to which division of the day they should refer a long-continued headache. When out of a class of 60 girls, 30 confess to habitual headache in the first place, and when on further investigation it is found that 6 complain of morning headache, 14 of afternoon headaches, and 10 of evening headaches, there are surely good grounds of believing that we are dealing with facts and not with vain imaginations.

“But further tests were frequently applied. A localisation of the headache was insisted on in most of the schools examined latterly, and after it had been pointed out that the pain might be in the forehead, or on the top, or at the back of the head, a show of hands was demanded for each region. And, again, I may remark that it was a striking fact, and one to me very illustrative of the good faith and accuracy of the children, that in a large majority of instances the sum of the frontal, vertical, and occipital headaches corresponded exactly with the number of headaches originally noted.”

I appeal to you, does not this sound very much like a page taken from Mark Twain? Dr Browne says on a previous page that from 20 to 30 per cent. of the London elementary school children are bright and clever, 40 to 60 per cent. of average intelligence, and 20 to 30 per cent. are stupid or backward. Now from my point of view this cannot be correct, as I cannot refuse the inference that 46·1 per cent. are singularly acute children who are able on the spur of the moment to determine, not only whether they have had headaches within the month, but to state definitely the period of the day at which the pain occurred, and to localise its position as regards the forehead, the top, or the back

of the head. And then those 30 girls, 6 of whom had a headache in the morning, 14 in the afternoon, and 10 in the evening—none of them, mind you, having a headache extending over the whole day—offer one of the most extraordinary clinical experiences ever reported by a physician.

In order to see for myself whether anything like the same condition of things existed in our own city, I lately took the opportunity of visiting four of the Edinburgh Board Schools in which 3500 children were receiving instruction. I paid special and particular attention to the condition of the children in those schools which derive their pupils from the poorest and most squalid parts of the city. Of course I found evidence of disease in a proportion of the children,—it was borne on their faces,—and if I had gone over them all with my stethoscope, doubtless I would have found further evidence, but I found no evidence of habitual headache. One test I frequently applied was, I think, quite as trustworthy as that employed by Dr C. Browne. All the children who had been absent from school during the previous fortnight were told to stand up, and were then separately interrogated as to the cause of absence. In certainly not 1 per cent. was a “sair head” assigned as the cause. I also applied Dr Browne’s test to several classes with a similar result. I will only give you the details of one such experiment, which seemed to me to be the most crucial, as the children forming the class were, for the most part, drawn from the rookeries and cellars of the Canongate or Cowgate. The master explained the nature of a headache most elaborately to a class of 110 children, and then ordered all who had suffered from such symptoms within the last month to stand up. Of 56 boys, 2 rose, one of whom stated that his pain was caused by falling down stairs while playing; of the girls, 3 stood up, one of whom was evidently suffering from headache, the other two were the subjects of occasional epileptic fits. In other classes submitted to this test, similar numerical results were obtained. My own belief is that the results of these experiments were not one whit more trustworthy than those of Dr C. Browne’s.

The only impression conveyed to me was that Scotch Board children had not such a keen sense of humour as the London Arab is reported to have. I appealed to many of the teachers as to whether they had any reason for believing that headache was a common school complaint. All of them knew of individual instances, but the disease newly invented in London called "Board headache" was unknown. It was admitted that a certain amount of extra pressure, or, as I should call it, kindly tutorial teaching, was applied to backward children in order to prepare them for examination; but I saw no evidence of what is thus described by Dr Browne:—"Knots of children may be found standing in the playground, neglecting hop-scotch and skipping-rope, and speculating like precocious gamblers on their chances of passing, and the questions that are likely to be asked them. The supernatural terrors of the past have given place to dread of the School Board. The infantile lip that would curl with contempt at any reference to a witch or a ghost, quivers with anxiety at the name of a Government inspector, and the examination day has appropriated to itself much of the foreboding which used to be reserved for the Day of Judgment."

As regards London, Dr Crichton Browne has made the unfortunate mistake of proving too much, and as regards Scotland, from lack of experience, he has proved too little. I believe in both countries there is a certain amount of over-pressure in elementary schools, but that in the former the cry is much louder than there is any ground for. The case against over-pressure is summed up in a sentence of the Report of the Edinburgh Committee for Feeding and Clothing Destitute Children:—"If there is any danger of over-pressure in our elementary schools, it is mainly, if not wholly, due to the presence in these schools of the half-starved ill-clad children to be found in every large town where attendance is enforced under the compulsory provisions of the Education Acts, and whose progress is measured by the same standards applied to the well cared for children of the artisan classes." To this extent we admit the existence of over-pressure, and there is no reason for believing that the amount of

pressure differs materially in London, Edinburgh, Glasgow, and Manchester. It is a palpable blot on our educational systems, to the wiping out of which it would have been well if Dr Crichton Browne had directed his attention instead of stimulating by extreme statements the general popular dislike of education which exists in England, and out of which has sprung the main root of the agitation. There is nothing in the various standards but what any fairly nourished, not mentally deficient, child can easily overcome. If over-pressure does ever occur amongst children of the artisan class, the fault lies with the parents in not making representations to the head-master that their children are not able to overcome their tasks, and suffer in the effort. It is a little too much the custom of parents of all classes to consider that their duty to their children is finished when the school fees are paid. Any representation to the proper authority is carefully considered, and, if found reasonable, exemption from examination is granted. But, as a matter of fact, I am assured by all the Scotch teachers whom I have consulted, the most common complaint is that children do not get enough to do.

The most enthusiastic admirer of our educational systems does not maintain that they are perfect,—he will even admit that certain of the principles of the codes are open to criticism. But to be told that the State is educating the people into insanity is one of those wild expressions which defeats its own aim and object. Speaking as a physician, I assure you that day by day I meet with hysteria, hypochondriasis, insanity, nervous disease in endless forms, springing out of idleness and ignorance. The risks to public health of over education are far less than those of under education. Thanks to John Knox and the other formulators of the parish schools, thanks to our universities, which are truly universities for the people, Scotland has been for centuries a highly-educated country. Can it be said that nervous disease is more prevalent here than in England, where the standard of general education has been much lower? It is not, as a matter of fact, either in kind or degree; and you need have no fear that education will tend to deterioration of nerve force.

I fear you will think I have spent too much time on this incidental subject: but I could not resist the impulse of entering a protest against statements made by a medical authority of reputation tending to discredit the great work of the Educational Department, statements which although supported by specious statistics and biassed observation are none the less dangerous.

I will treat of the third head as shortly as I can. It is contained in the question, Are we not too well satisfied with the management of the insane as it at present exists? I think we are, and the following are my reasons for my belief.

Following on the action of legislation and the consequent greatly increased number of pauper lunatics, there came of course at once a demand for increased asylum accommodation. This was met by the erection of county and district asylums and by the addition of new departments to old establishments. The demand was not only originally great, but it became continuous and constant, so much so that within a few years of the erection of a county or district asylum it was found in almost every instance absolutely necessary to make extensive additions. It passed into a common saying that it was only necessary to build an asylum in order to get it filled, and that the more you built the more you might build. This process of constant additions produced in a comparatively short space of time many monster asylums. There are in England at the present moment several such gigantic institutions, containing over two thousand patients, and in Scotland we have at least two, accommodating from six to seven hundred patients. Now, notwithstanding the admirable administration and active supervision of the governing bodies and medical superintendents of large institutions for the insane, I am by no means sure that they afford scope for the best and most scientific system of treatment, or that the earnest and energetic physicians at their heads are afforded full opportunity for exercising their function. Having myself been connected with such institutions as a subordinate and as a head, I feel no delicacy in criticising what I believe to be their defects, or in suggesting measures for their amendment. If we review the statistics of

insanity of fifty years ago, and compare them with those of the present day, we will find that there has been no sensible increase in the percentage of recoveries. Referring to Dr Thurnam's book on the statistics of insanity, published in 1845, we find him stating:—"Examination will, I think, justify the conclusion that, as regards the recoveries in asylums which have been established during any considerable period,—say twenty years,—a proportion of much less than 40 per cent. of the admissions is, under ordinary circumstances, to be regarded as a low proportion, and one much exceeding 45 per cent. as a high proportion;" and turning to Dr H. Tuke's History of the Insane in the British Isles, we find him stating:—"The number of patients discharged cured in County and Borough Asylums during the ten years 1871-1880, was 40·30 per cent. on the admissions." In the face of the fact that during the period intervening between these two statements great improvements have been effected in the treatment and accommodation of the insane, it is surely justifiable to endeavour to seek for a cause why these improvements have not been productive of better results. The causes, I believe, are two-fold: 1st, overgrowth of old asylums, and 2nd, deficient accommodation in both old and new institutions for hospital treatment. The larger an asylum grows the more rigid must discipline become, and the greater must be the tendency for the individual to be merged in the mass. In the treatment of the insane, we apply medicinal measures, and we apply moral treatment, and it is difficult to say which of these measures is the more important. The position may be not inaptly compared to a class in a school in which teaching and discipline run hand in hand, and we all know that the larger the class the smaller, as a rule, the results. In an asylum, discipline or moral suasion—call it what you will—ought to be applied as far as possible to the individual; and there, as in the school class, the more it is distributed, the less powerful its effects. You will perhaps be told that when a person becomes insane his or her individuality becomes changed; that may be so, but all the more must that changed individuality be submitted to particular and individual moral influences.

That our pauper patients do receive a considerable amount of such attention is not denied, but it stands to reason that the amount of this individual attention must be in inverse ratio to the size of the asylum. In our best public institutions, a good deal has been done in this direction : hospital blocks having been erected, in which recent cases and the sick from the general wards are submitted to treatment. But this does not to my mind fulfil all the conditions of a perfect hospital for the treatment of the insane. It is said to be unwise to prophesy unless you are sure of what is going to happen ; but I do not feel imprudent in saying that I feel sure that the pauper asylum of the future will differ in many respects from that of the present. It will consist of at least two departments ; one, a hospital in which new cases will be treated to recovery, or for such length of time as reasonable hope for recovery exists. This hospital will stand by itself, in grounds of its own, to which the chronic patients will not be admitted ; it will be conducted on principles identical with those of a general infirmary ; it will have a large staff of physicians and numerous nurses of the highest order. The other department will consist of an institution for the care and management of the chronic insane, where all the kindly influences which are at present applied, such as amusements, exercise, and work, will ameliorate the condition of its inmates, and may even in some cases procure ultimate recovery. On such a system the asylum physician will be able to apply medical treatment untrammelled by his present great difficulty, the intermixing of new and old cases. It may be said that this plan is utopian on account of expense ; but the British public has not as yet been found parsimonious in great questions of public health. It is only necessary to instance the ready assent given by our citizens to the great city improvements of Edinburgh, and to the readiness with which £10,000 was subscribed when it became known that our old infirmary was behind the requirements of the day. Alongside of humanitarian considerations, economics may exercise their influence. Regarding the position from the lowest point of view, a pauper recovered from his lunacy means a

saving of many hundreds of pounds. A patient attacked by insanity at 20 years of age, and not recovering, will, if he lives to 60, cost his parish at least £800, and a great deal more if we reckon interest and compound interest ; so that if by any reasonable means the public can afford the asylum physician the machinery of procuring even 10 per cent. more of recoveries than he at present can do, for he does all that he can, the speculation would be a good one.

But it will be said, can nothing be done with the great institutions which at present exist? The answer is distinctly in the affirmative. As soon as it happens, as surely it will happen, that each of them will require extension ; let that extension be made in the direction of *lunatic hospitals*, not in the direction of new wings joined to the original buildings. Let a curative establishment be built remote from the asylum ; the existing hospital wards can be used for chronic patients, and the separate establishment for recent and curable cases. With such a machinery ready to the hands of the enthusiastic and accomplished physicians who rule over the public asylums, I firmly believe you would soon find a steady diminution of chronic lunacy, consequent on an increased percentage of recoveries in hospital.

I have left myself but very little time to speak of a subject to which I desire to direct more particular attention. As regards it, I will merely read to you a sentence taken from a report which I submitted to the District Lunacy Board of Fife and Kinross many years ago:—"there is yet one other subject which I am desirous of bringing under the notice of your Board, and, through its influence, before the public. It is that some provision should be made for the assistance of patients discharged recovered, and who, being in good health and able-bodied, have no claim on their parish for relief. I have known of many cases for whose future welfare great anxiety has been experienced, consequent on their being unprovided with employment, and the difficulties they were sure to meet with in obtaining it as patients lately discharged from an asylum. Societies exist for the aid of discharged prisoners.

Surely the recovered lunatic's case appeals much more strongly to the sympathy and charity of the public. I have good reason for knowing that not a few of the relapsed cases which occur are the result of want of employment when they are restored to society, which restoration throws upon the individual the onus of self-maintenance, a burden he is ill able to bear." In England a society called the After Aid Society has been started. I offer a suggestion to the piously charitable in Scotland.

It is always a disappointment to a lecturer when he finds he has not left himself time for a peroration or exordium; but if his lecture is worth anything it needs no rhetorical conclusion. If I have been able to show you that lunacy administration in Scotland is creditable and above suspicion; if I have reassured your minds that insanity is not on the increase, and that the school-master's influence is not in the direction of overcrowding our asylums; and if I have offered any suggestions which in time to come may be adopted for the benefit of the lunatic, my object has been attained.

APPENDIX.

SIR LYON PLAYFAIR, M.P., ON OVER-PRESSURE IN SCHOOLS.

From "SCOTSMAN," Nov. 21st, 1884.

If I have not entirely exhausted your patience, there is one subject, which is already before Parliament, and must be seriously considered during the next session, that I think I ought to bring before you. It is the alleged over-pressure of children in schools. This subject may appear below our academic level and unnecessary to be discussed by your representative. But that is not so, for our Universities depend wholly upon the people; and if their education in the primary or secondary schools be overstrained, the most damaging effects may be produced as to their intellectual development in future life. The allegation is that the standards in the primary schools are above the capacities of children of this age, so that their health and mental powers break down in their overstrain to reach them. Many medical men show this fear, and some of them have the highest capacity for forming a correct judgment. Among these I need only mention my constituent and esteemed friend Dr Crichton Browne, who is one of the highest authorities on the subject of mental diseases, and whose opinions deserve to be treated with respect. I at once accept

his evidence that there are, in poorer schools in England, children who are physically and mentally unable to grapple with the standards to which they are put. He confines his observations to England, and says that there are no signs of over-pressure in Scotland. Certainly it is remarkable that the complaints do not come from Scotland, where the pressure ought to be higher, if we judge from the greater number of passes both among children and pupil-teachers. Neither do complaints come from Ireland, where they profess to have the same standards and pass a high percentage. But I do not doubt that cases exist in both these countries as well as in England, where miserable, sickly, half-fed and half-clothed children are unequal to tasks which may be suited to the average children in a school. I think that the discussion of the question has been most useful by drawing attention to such cases, which the Education Code now allows to be withdrawn from examination. Still it is possible that there has been a tendency to deduce extensive generalisations from exceptional cases. The standards of the code vary according to the age of children, and are considerably lower in their demands than the standards of any other country in Europe. They are far lower than those laid down by John Knox in his time, and yet our Scottish brains have still some substance left. The true principle is to lay down standards suitable to the large bulk of children of a certain age, and to make exceptions for stunted, sickly, and ill-fed children who are unable to reach them. I have tried to examine the subject on this principle, and to ascertain whether the standards are above the capacities of the great bulk of the young population at school. The health of children is a very sensitive barometer, for it rises or falls in immediate response to the condition of their environment. If we find a general increase in mortality among children since education became national and compulsory, depend upon it there is something essentially wrong in our educational systems. If, on the contrary, we find the health barometer rising, we may be satisfied that education is not deteriorating the masses, though it may still have unfavourable effects on individuals. But there are two factors in the question. Since 1870, the date of the English Education Act, there has been a great increase in school life; but there has also been a considerable improvement in public health, and due consideration must be given to each factor. This is easy to do, because bad sanitary surroundings tell most upon the life of children under five years of age, who are not at school; so that improvement in public health will show its largest result among these infants. As a fact, the mortality among children under five years of age has decreased since 1870 by 10 per cent., and this decrease must be credited to hygiene, including the improved habits of the people. If we now take the Registrar-General's returns of mortality for the decade ending in 1870, and compare that with the five years 1876-80, when the Education Act had got into play, the decreased mortality among school children between five and fifteen is $23\frac{1}{2}$ per cent. In the ten years preceding the Education Act, 1870, there was much activity in voluntary schools. A more striking comparison, therefore, comes out if we take the average of a longer period, when education was less prevalent—viz., 1838-54. This has been carefully done in the *Statistical Journal* for June 1883, to which I would refer you for details. The general results are these: that in the case of children of school age between five and ten, boys have a lessened mortality of 30 per cent., and girls of 33 per cent.; while between the ages of ten to fifteen

boys have a lessened mortality of 32 per cent., and girls of 35 per cent. If you deduct from these the 10 per cent., which give the maximum due to general hygienic improvement, you have to account for at least 22 per cent. lessened mortality among children of school ages. What has come into existence in the life of the nation to produce such a remarkable reduction in juvenile mortality? I know of nothing except the introduction of a universal school system. You have gathered the children of the poor from the streets and alleys of our large town, and from their overcrowded and insanitary homes, and you have placed them in well-heated, large, and well-ventilated school-rooms. You have enforced upon them cleanliness and habits of order, and the result has been, although you only intended to give them education, you have also given to them greatly increased health. To my mind these results are conclusive that, to the great mass of school children, our educational system has not only no deteriorating influence, but a powerfully ameliorating one. Still this does not remove from us the need of dealing with the exceptional cases in which evils have been shown to exist. Almost all the cases which have been made public—and we must remember that they are only a few instances among the $4\frac{1}{2}$ millions at school—are breakdowns of children in the lower standards. As they get higher, the improving influences of the schools begin to tell. If I read aright the valuable medical warnings which we have received, they lead to these conclusions. A moderate amount of exercise of the body and of the brain are undoubtedly good for children as a whole. Thus a walk of one mile may not be too much exercise for ordinary children, but a walk of 100 yards may be too rickety or under-fed children. So exercises in Standards I. and II. may be excellent for ordinary children, but they may be too much for under-fed weaklings. How is this to be met? It has been met in some cases admirably. In the city of London there is a Jewish school of 3400 children. They are of all nationalities, and are derived from the very poorest of our population. Yet the passes in the standards are very high, although a foreign language—viz., Hebrew—is added to their education. No complaints of over-pressure come from this school. The reason is that charity comes to the relief of the ill-clothed and half-fed children. Clothes are provided for the indigent, and a supplementary meal of bread and milk is given to all those who seem under-fed. The result has been to make all the children happy and eager for this school work. I am glad to say that this example is being now extensively followed, as an act of charity, among schools of the poorest kind, and with admirable results. You cannot do this at the cost of taxation, or of the rates, because that would be a large step towards Socialism; but charity can undertake to meet the exceptional cases in our schools. My excellent University colleague, Mr Campbell, who is always zealous in the promotion of education, described to us in Parliament a school in Scotland in which he was interested, and showed how, by giving food to under-fed children, the school passes became greatly augmented. The general result to which I have arrived, by a careful consideration of this question, is that we must be guided by medical experience in bringing charitable influences to bear upon the condition of ill-fed and ill-clothed children, so that the ordinary mental exercises, which are not too much for the great mass of our young population, may not bear too heavily on the feeble frames of the sickly and nervous weaklings.

DISEASE: WHAT ARE ITS CAUSES; HOW IS IT TO BE PREVENTED?

DERANGEMENTS OF NUTRITION.

BY BYROM BRAMWELL, M.D., F.R.C.P. Edin.

MR CHAIRMAN, LADIES, and GENTLEMEN,—The balloon is an important instrument of modern warfare, for it enables an observer to obtain a bird's-eye view of an enemy's position, and so affords most useful information both for the purposes of attack and defence. Now, disease is an enemy with which we have all at times to battle, and the object of my lecture this evening is to give you a broad and general, or a balloon-view, so to speak, of this enemy's position, to tell you some of the ways in which his assaults are made, and to show you some of the chief means by which they are to be guarded against and prevented.

The subject is of vast extent, and I shall not be able, in the brief limits of a single lecture, to enter into details. I shall have to confine myself to the most important points, and endeavour to sketch an outline for you, rather than attempt to draw a highly-finished picture; and remembering that these lectures are chiefly intended for those who are ignorant of anatomy, physiology, pathology, and the laws of health, I shall avoid technical terms, and shall endeavour to make the matter as simple and intelligible as possible.

Definition of Disease.—The first question which necessarily

meets us is, What is disease? I have spoken of disease as an enemy, but the comparison is not strictly and scientifically speaking accurate, for disease is not an entity—that is to say, a something which is separate and distinct from the body. The cause of disease often is an entity, but the disease consists of the functional and structural alterations which result from that cause. Let me give you an illustration: the introduction of a thorn under the skin of the finger may be followed by distinct disease. Now it is not the thorn but the inflammatory changes in the tissues due to the irritation produced by the thorn which constitute the disease.

Speaking generally, we may define disease as the opposite of health. This definition is a negative one, and in order to understand its meaning we must know what is meant by the term health. Absolute or perfect health is that condition in which every tissue in the body is absolutely perfect in structure and capable of functioning with absolute perfection. Health of this description is comparatively rare, and we are in the habit of speaking of health as that condition in which the vital functions are performed in a manner which experience has taught us to regard as normal; *vice versâ*, by the term disease we mean any deviation from the standard which we regard as normal. Practically, it is difficult or impossible to draw an absolutely sharp line of demarcation between health and disease; the two conditions may, speaking practically and not theoretically, be said to run insensibly one into the other. The beginnings of disease are often very insidious and gradual, slight infringements of the laws of health, which at first produce little or no appreciable disturbance, may, if frequently repeated, ultimately lead to organic disease; in fact, the innumerable little external and internal irritations which are constantly producing mere passing derangements of function in the healthy organism often ultimately become the causes of serious disease.

The definition of disease which I have just given you only takes into account the health of the individual as an individual, it entirely ignores the facts that we are all but units in a great

community, that the blessings of life and health are given us not merely for our own personal and selfish enjoyment, that life and health involve duties and responsibilities, and that each of us has work to perform. You will perhaps better understand my meaning if I read to you the following passage from an address delivered at the inauguration of the Juries of the International Health Exhibition by Sir James Paget, one of the greatest living representatives of the medical profession. He says: "In consideration of his own self, a man may be deemed healthy who lives idly, comfortably, and long; who enjoys every day of his life, and satisfies every natural appetite without consequent distress. And when such an one dies of old age with a timely, uniform, and painless decay of every part, he may be deemed to have been completely healthy; and yet it is possible he may have enjoyed his own health in the midst of a poor, unhealthy, and unhappy nation, to which he has done no good whatever. If we could find a nation composed of people such as this man, we might be bound to speak of them as healthy; but we should be right in calling the whole nation utterly unsound, and might safely prophesy its complete stagnation or its quick decline and fall. It is not health such as this—idle, selfish, unproductive—that we want to promote either in the individual or in the multitude. Comfortable idleness, such as that of some vagrants and some fine gentlemen, is a despicable result of good health; it is what no thorough man would ever wish for. In view of the national health and welfare, the pattern healthy man is one who lives long and vigorously; who, in every part of his life, wherever and whatever it may be, does the largest amount of the best work that he can, and when he dies, leaves healthy offspring. And we may regard that as the healthiest nation which produces for the longest time, and in proportion to its population, the largest number of such men as this, and which, in proportion to its natural and accumulated resources, can show the largest amount and greatest variety of good work."

This evening I shall only direct attention to the health of the individual as an individual, and shall say nothing with regard to

the many other interesting points to which I have thus briefly alluded.

Now, in order to understand the nature of disease and the manner in which it may originate, it is essential to start with a clear notion of the more elementary points in the mechanism of the human body, and of the manner in which that mechanism acts. Let me endeavour, then, to give you such a general idea of the structure and functions of the human body as is essential for our present purpose.

BRIEF SKETCH OF THE STRUCTURE AND FUNCTIONS OF THE HUMAN BODY.

The human body is a highly complex piece of animal mechanism, but if we analyse its individual parts we find that it is composed of *cells* or of structures derived from cells, *cell derivatives* as they are termed.

These cells (see fig. 1), which are too small to be seen by the naked eye, and which have to be studied by means of the microscope, are the active constituents of the human body. *The cell is in fact the organic unit.*

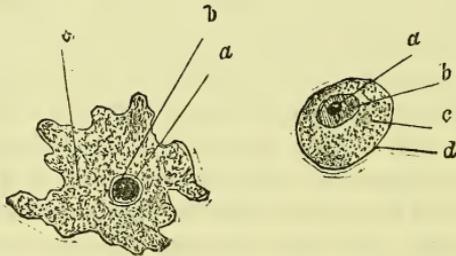


Fig. 1. The cell; it is composed of a jelly-like material called protoplasm; it is surrounded by a condensed outer coating (the cell wall, *d*); in its interior is an oval structure (the nucleus, *b*); within the nucleus is a highly refractive granule (the nucleolus, *a*); *c* = cell contents.

Fig. 2. The amoeba. *a* = nucleolus; *b* = nucleus; *c* = cell body.

In some of the lower forms of animal life, such as the amoeba (see fig. 2), a single cell represents the whole organism, captures nutritious particles which come in contact with it, digests them,

expels the waste products, exhibits active movements, reacts to external stimuli and produces other cells, in fact performs a variety of functions. In man the innumerable cells of which the body is composed are divided into separate masses or cell groups. Each of these cell groups or organs, as we term them, has a separate and distinct function ; the liver cells, for instance, secrete bile, the stomach cells gastric juice, the kidney cells urea, and so on ; there is, in short, in man a *division of labour* amongst the cells, which is associated with a *differentiation of structure* for the arrangement of the cells in the different organs, and in many instances the form and appearance of the cells themselves are different.

But although the different organs of the body have each their separate and distinct functions, they are all more or less mutually dependent one upon the other, and are brought into intimate connection by means of the fibres of the nervous system and by the network of blood and lymph vessels in the midst of which they lie.

In order to understand the nutrition of the whole organism and the derangements to which it is liable, it is necessary to be acquainted with the life history, so to speak, of the organic units or cells of which it is composed. I may perhaps make this part of the subject more interesting, and possibly at the same time more clear, if I make use of an illustration.

The human body may be compared to a huge organic citadel, surrounded on all sides by a marvellously constructed wall (the skin), thickly peopled in its every part by innumerable active workers (the individual units or cells), and governed by an all-powerful commander (the intelligence and the will). The individual workers are arranged in many groups, each with its special function (the different organs of the body). The commander, himself invisible and inscrutable, occupies the highest tower in the citadel. He is surrounded on all sides by an immense number of staff-officers (the nerve cells of the brain, see fig. 3). It is the duty of some of these officers to receive telegraphic messages from the different parts of the citadel and its groups of workers, and to communicate them to the commander (these

are the sensory nerve cells of the brain, the nerve cells composing the perceptive cerebral centres as we technically term them). One large group of these officers (the nerve cells composing the centres for sight) is in telegraphic communication

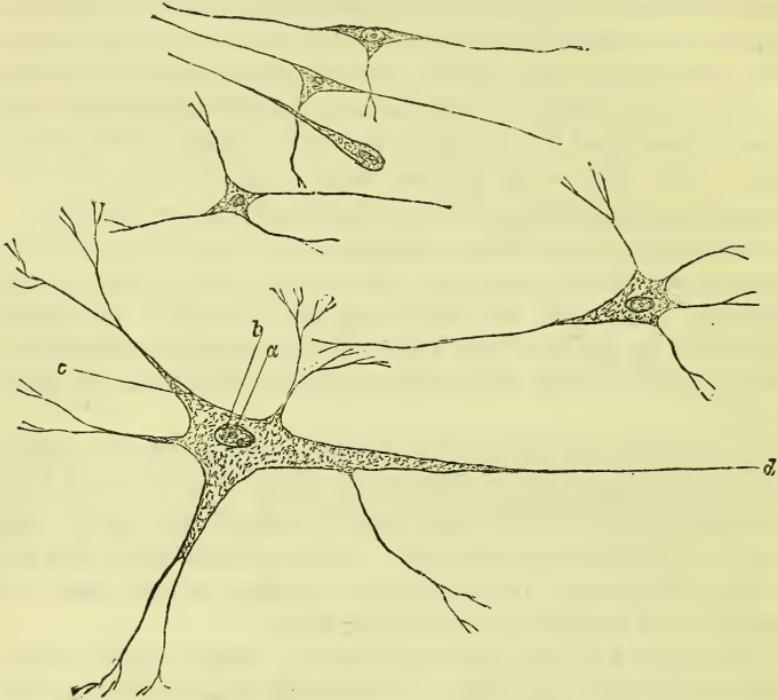


Fig. 3. Various forms of nerve cells from the brain. (After Klein.)
a = nucleolus; *b* = nucleus; *c* = cell process; *d* = axis cylinder process.

with two large organic telescopes (the eyes), which sweep the horizon in all directions, the connecting telegraphic wires being represented by the optic nerves ; another group is in communication with two large ear trumpets (the ears) ; other groups with the receiving apparatuses or end-organs as they are technically termed, of taste and smell ; others (the centres for touch and temperature sensations) are in communication with every part of the outer wall or skin, and are at once "wired" when anything comes in contact with it, or when it is made too hot

or too cold ; others receive messages from the many groups of workers or cells distributed throughout the building. It is the function of other members of the staff (the motor nerve cells of the brain) to receive orders from the commander and to transmit telegraphic messages to the machines which maintain the citadel in the erect position, which move its different parts, propel it from place to place, capture its supplies, defend it from attack, which do its work, which express the feelings of the general, and by means of which he communicates with other citadels (the muscles of the trunk, limbs, expression, and organs of speech) ; other nerve cells—but these are subordinate officers, and situated at a lower level, corporals or sergeants we may term them—are less directly in communication with the general, and are constantly sending encouraging messages to the different groups of workers, stimulating them in their work (these are the so-called trophic nerves) ; other subordinate officials regulate the supply of nourishment which is being sent to the individual workers and organs (these are the vaso-motor nerves) ; others again are constantly stimulating the important machines which propel the nourishment through the body (the heart), and which move its great ærating machine (the lungs).

In such a citadel there must, of course, be arrangements for manufacturing and distributing rations to the garrison and workers, for supplying it with fresh air, for removing its waste products, for heating it, and for protecting it from external atmospheric conditions.

The food-preparing apparatus.—At one part of the wall there is a stoke hole, communicating with a large chamber (the mouth, see fig. 4), into which the raw material necessary for the preparation of the food is shovelled at the command of the governor. In this cavity the raw material is chopped up and ground down (by the teeth), and mixed with the products of the first great digestive manufactory (the salivary gland). It is then passed through a long straight tube (the gullet) into another large cavity (the stomach), where it is thoroughly mixed with the product (juice) of another most important manufactory (the

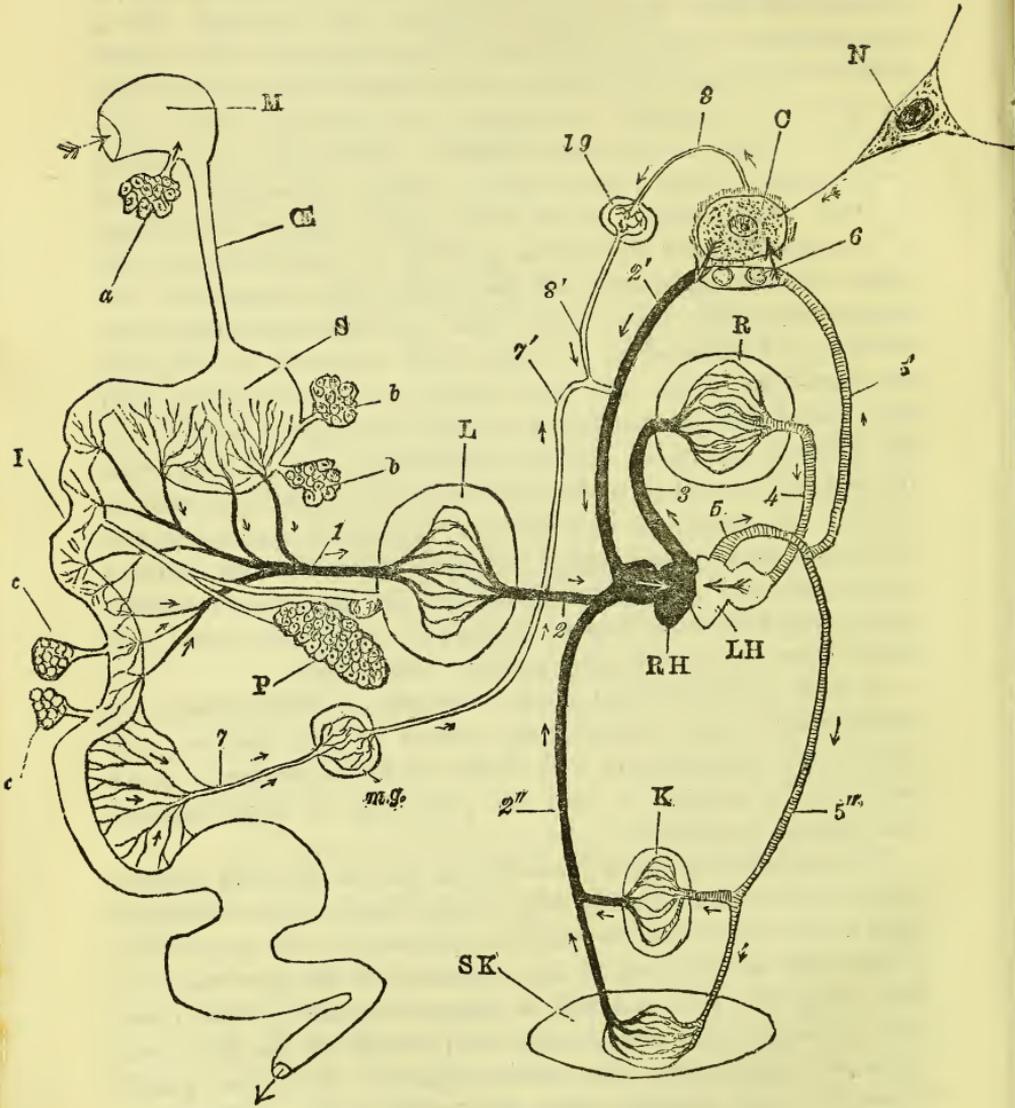


Fig. 4. Diagram of the nutrition of the body.

gastric glands); finally it is passed on to a long and tortuous chamber (the intestines), in which it is mixed with the products of other important manufactories (the liver, the pancreas, and the intestinal glands). By these various mechanical and chemical processes a food (or fluid containing nutritious matters in a state of solution or suspension) which is suitable for the nutrition of the individual organic units or cells is prepared. The refuse products are separated and passed on to the lower part of the intestinal tube, from which they are finally expelled.

The food-distributing and aerating apparatuses.—The food which has been prepared in this manner is taken up partly by a set of tubes, the blood-vessels, which ramify in all directions in the walls of the stomach and intestines; partly by another set of vessels, the lymph vessels, which have their origin in the intestinal walls. The veins pass through the large and important organ, the liver, in which the fluid food (or blood plasma) is still further elaborated; thence it is carried to the right side of the heart. That which is absorbed by the lymphatics in the walls of the intestine is also passed through a preparing manufactory (the lymphatic or mesenteric glands), and is poured into the veins and likewise carried to the right side of the heart. From the right heart the blood is pumped through the lungs, in which it absorbs large quantities of oxygen. The blood, I may explain, consists of two parts, the blood plasma and blood corpuscles, which are of two kinds, white and red (see fig. 5); the oxygen is absorbed by the red blood corpuscles or oxygen carriers, as they are termed. From the lungs the blood passes to the left side of

DESCRIPTION OF FIG. 4.

- | | |
|---|---|
| M = mouth. | 2, 2', 2'' = great veins proceeding to the right side of the heart. |
| CE = oesophagus or gullet. | 3 = pulmonary artery. |
| S = stomach. | 4 = pulmonary vein. |
| I = intestine. | 5 = aorta. |
| P = pancreas. | 5', 5'' = arteries of the body. |
| L = liver. | 6 = capillary vessel containing blood corpuscles. |
| a = salivary, b, b' = gastric, and c c = intestinal glands. | 7, 7' = lymphatic vessels passing from the intestine. |
| R H = right heart. | m g = mesenteric gland. |
| R = lungs. | 8, 8' = lymphatic vessels of tissues |
| L H = left heart. | l g = lymphatic gland. |
| C = organic unit or cell. | K = kidneys. |
| N = nerve cell. | Sk = skin. |
| 1 = portal vein. | |

the heart, by which it is pumped through the arteries into the delicate thin-walled capillary vessels which pass in all directions through the different organs, and which lie in close contact with the individual organic units or cells (see fig. 6).

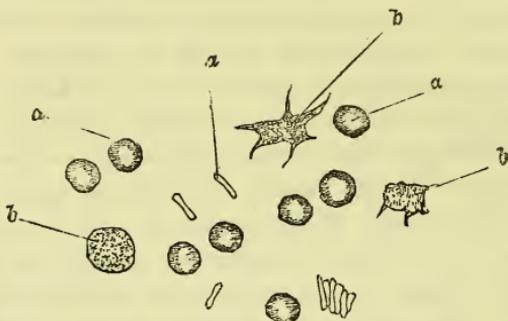


Fig. 5. Blood corpuscles, magnified.

a , a = red blood discs; a' , the same seen sideways; b , b , b = white blood corpuscles.

The changes which take place between the blood and the individual organic units or cells.—Each cell may be regarded as a small chemical laboratory, under the direction of the vital force which

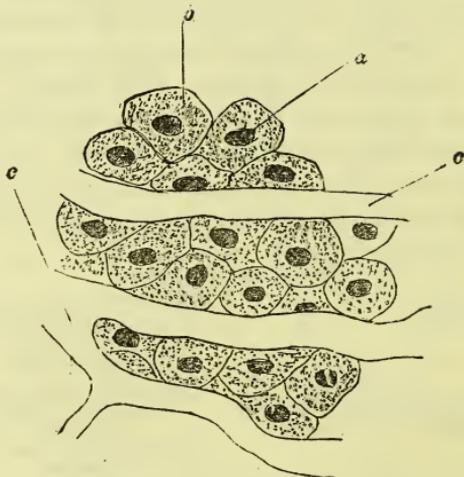


Fig. 6. Liver cells and capillary blood-vessels. (After Klein.)
 a = nucleus; b = cell body; c , c = capillaries.

is inherent in every living tissue. Under the direction of this vital force each of these little laboratories abstracts the materials which it requires for its own nutrition and special work, from the blood plasma, and oxygen, from the red blood corpuscles. The nutrient materials are split up and rearranged, and the waste products are discharged and carried away in the manner I shall presently describe. Some of the cells simply abstract materials for their own nutrition; others, such as the fat cells, store up materials within themselves; others manufacture or secrete new products, such as the bile and gastric juice; others excrete or separate the waste products, such as urea and sweat; others again, such as the nerve and muscle cells, store up force which is set free or discharged under the command of the will. Such are the arrangements by which the blood plasma or food of the garrison (the cells) is manufactured and distributed. Let us now consider the arrangements by which the surplus and waste products are got rid of.

Arrangements for the removal of the waste products.—The waste products which result from the chemical changes within the cell are restored to the blood. Carbonic acid is one of the most important of these products; it is discharged into the capillaries and removed by the veins. The other waste products, which vary with the nature and function, we may suppose, of the individual cell, are partly removed by the same means, *i.e.*, absorbed by the capillaries and carried away by the veins; partly by another set of vessels, the lymphatics, which drain away the surplus blood plasma, which has, as it were, been used by the cell, and which has not again been absorbed by the capillaries. These lymphatic drains ultimately discharge their contents into the veins (see fig. 4).

From this description it will be seen that there is a constant interchange of material between the blood and the tissues, each cell abstracting materials from and returning materials to the bath of blood plasma, so to speak, in which it lies. It is obvious, therefore, that each individual cell must modify to some extent, however small, the composition of the blood; it will readily, therefore, be perceived that each tissue and organ materially modifies the composition of the blood and exerts an influence upon the nutrition of the whole body.

Arrangements for the purification of the blood.—The great scavengers or purifiers of the citadel are (1) the kidneys, whose special function it is to separate and discharge the waste nitrogenous products in the form of urea and other compounds ; (2) the lungs, which are the chief discharges of carbonic acid ; and (3) the skin, whose great function it is to separate and discharge water in the form of sweat.

Water is also discharged by the kidneys and by the lungs ; carbonic acid by the skin ; animal matters are also given off in the breath ; and in disease, at all events, urea may be discharged by the sweat glands, but to this interchange of function between the three great excretory organs or scavengers of the blood I need not further refer.

The heating apparatus.—The heat of the body is chiefly produced by the chemical changes which are constantly taking place in the cells, more especially in the liver cells and muscles. Heat is being constantly lost by radiation from the surface, in heating the expired air, by the driving off of moisture from the skin and lungs, and in warming the discharged products (urine and fœces). The balance between the production and loss is regulated by a beautiful nervous mechanism which it would be out of place to attempt to describe here.

Such is a brief sketch of the more important points which it is necessary to be acquainted with in order to understand the derangements of nutrition. I have said nothing, you will observe, of the perfection of these arrangements, but I may remark, in passing, that the more one knows of the structure and functions of the human body the more one must admire its marvellous beauty. It matters not whether you look with high powers of the microscope at these little cells, whether you regard the wonderful mechanism by which the different parts are brought into relationship, whether you look at the perfect manner in which the different organs and parts are packed for protection and for economy of space, or whether you look at the finished whole as you see it, for example, in the person of a little child, a lovely girl, or in the god-like countenance of an intelligent and intellectual man or

woman, from whatever point of view you regard it you cannot but be lost in respectful admiration at the singular beauty of the completed whole, and at the absolute perfection of its every individual part.

Now let us turn to the pathological side of the picture and try to understand the manner in which derangement, disease, and death may arise in this citadel or in its different parts

DERANGEMENTS OF NUTRITION.

Derangements of the nutrition of the garrison may be due to a variety of causes, amongst which the following are some of the chief:—

Firstly, An insufficient supply of rations.—This of course might depend upon the fact that the citadel was placed in such a barren country that supplies could not be procured; or upon the circumstance that the commander was too stupid or too lazy to make the necessary exertions to capture supplies; or upon incapacity or derangement of the digestive manufactories. It is unnecessary to insist upon the immense influence which disease of the digestive organs necessarily exerts upon the nutrition of the whole body, and it would be out of place for me to go into details. I shall, however, presently point out some of the causes of deranged digestion and the ways in which they may be prevented. Again, there may be plenty of raw material (food), it may be properly prepared by the digestive organs, but owing to incapacity or disease on the part of those whose duty it is to distribute it (the prepared food or blood plasma), the nutrition of the garrison or of some part of the garrison may suffer. Malnutrition, the result of disease of the heart or blood-vessels, is common. We find, for instance, that as the body grows old the arteries are apt to become degenerated or diseased, and it sometimes happens that the channel of an artery becomes completely obstructed and the supply of nourishment completely shut off from some part of the body; local death of the part may then result; gangrene or death of the foot and leg is not unfrequently

produced in this manner in old people. Then, again, it often happens that a little clot of blood which has formed at some part of the circulation, say, for example, on a valve of the heart, becomes detached and carried by the blood to some distant vessel, in which it sticks, obstructing the blood channel and shutting off the supply of nourishment from some part of the body. The results which follow depend upon the function of the part which is thus deprived of its nourishment ; when, for instance, the artery supplying the group of nerve cells comprising one of these so-called motor centres in the brain is obstructed, the nerve cells die, the will can no longer influence the muscles which are put into action by those nerve cells, and paralysis or loss of motor power in those muscles results. I may perhaps take this opportunity of alluding to another way in which local destruction of a part may be produced, though it does not exactly occur in the present connection. It occasionally happens that one of these little arteries bursts, and blood is poured out into the surrounding tissues. You can readily understand that when this occurs in the midst of a delicate and important tissue, such, for instance, as the brain, very serious results must necessarily follow. You will better appreciate the importance of this accident if you compare each of the nerve cells of the brain to a small electric battery, and each nerve tube to a conducting telegraphic wire, the director or guider of all the batteries being the intelligence and the will. Now realise if you can that there are calculated to be 1,200,000,000 of these nerve cells or batteries, and 4,800,000,000 of these connecting wires, all condensed into the small compass of the human brain, and you can imagine the tremendous effect which will necessarily be produced by a very small extravasation of blood into their midst. Many of the batteries may be at once discharged, in other words, a convulsion may be produced ; a tremendous shock will be communicated to the commander (the intelligence and the will), insensibility will in fact probably be produced ; the after effects will be very serious, for the communications from the surface of the body will be more or less interfered with, and the commands of the general (the will) will no longer be transmitted outwards ; in other words,

sensory and motor paralysis will be produced. The two conditions which I have just mentioned (sudden plugging of a blood-vessel of the brain by a clot detached from the heart, and rupture of an artery in the brain,) are, in fact, the causes of the condition which you all know under the name of apoplexy.

Disease of an artery only interferes with the supply of nourishment to a limited part of the body, but disease of the heart may interfere with the nutrition of the whole body.

Secondly, An over-supply of rations.—Over-eating is a common cause of derangement of the digestive functions and sometimes of disease. It must be remembered that anything over and above the quantity of nutriment which is required to replace the waste which is constantly going on in the body is not only unnecessary but is apt to do harm, and that in several ways. Every organ benefits by a certain amount of work, but if the exercise of its functions is excessive it becomes exhausted and is apt to become diseased. Over-work of the stomach or other parts of the digestive apparatus is a common cause of dyspepsia. Again, if too much food is supplied to the body, and more particularly if it is too rich in quality—but to this point I afterwards will more particularly allude—the blood becomes as it were over-saturated with nutritious materials, with the result that those organs which have to deplete or purify the blood are over-worked and are apt to become exhausted, irritated, and diseased. As a matter of fact we find that derangements of the liver and kidneys, gout, dyspepsia, and other conditions, to which I need not particularly refer, are sometimes produced in this manner.

Thirdly, Inappropriate rations.—Derangement and disease of the garrison might be produced by the fact that the raw material (or food) was not suitable for the manufacture of appropriate nutriment, or that some deleterious material was contained in the food. Both of these conditions, but more especially the latter, are frequent causes of actual disease. When, for instance, fresh vegetables, or some substitute for fresh vegetables, are omitted from the dietary, scurvy is apt to be produced. The outbreak of scurvy has been the cause of failure of many of our Arctic expedi-

tions. The affection is comparatively rare in this country, but it is every now and again met with. I have known it not infrequently produced amongst poor people, who had been obliged to live for some time on bread and tea. Many substances might be mentioned which are taken with the food, and which are apt to cause irritation, derangement, or disease. Amongst those the most common is, perhaps, alcohol. In considering the subject, I may at once say that I am not a total abstainer, and that the position which I take up in regard to this matter is very much that of Sir Andrew Clark. In a lecture which he recently delivered in London, and which you have probably seen noticed in the papers, he stated amongst other things that so far as is at present known, a small, or as it has been termed, a physiological quantity of alcohol does not produce disease in the healthy adult. I say the adult, for it is more likely to produce disease in the young growing organism. There can, however, be no doubt that alcohol is quite unnecessary for healthy persons. It is one of those substances, such as tobacco, which we term luxuries. Many articles of food are luxuries, in fact, few if any persons unless under compulsion restrict themselves simply to the amount of plain fare which is necessary for health. If alcohol is taken as a luxury, it should be well diluted and taken along with food. In health, then, alcohol is unnecessary, but it does not, so far as is at present known, when taken by the adult in small and suitable quantities, and at proper times, produce disease. But further, there are many persons doing good work in the world who are not quite healthy, and to some of them alcohol is distinctly beneficial. I am speaking, you will observe, of the use and not of the abuse of alcohol. I now pass to the abuse, and I would most strongly urge you to remember that any excess is most injurious. No one can have practiced medicine for any length of time without becoming convinced of the fact that a whole host of diseases—to say nothing of accidents and crimes—are due to over-indulgence in alcoholic liquors ; and it would be very much better for mankind, as a whole, if they cannot restrict themselves to the purely and strictly moderate use, that they should not

take any alcohol at all. When taken in excess, but as small quantities spread over a long time, alcohol acts more especially on those organs with which it comes in contact,—on the stomach, on the liver through which it passes in order to reach the general circulation, and on the kidneys; but the nervous system, and in fact every organ and tissue, is more or less affected by it. When taken in large quantities it acts more especially as a poison to the brain, and may, as you doubtless all know, produce not only insensibility but even death. I need not specify in detail the many different affections and diseases (such, for example, as delirium tremens, convulsions, “gin-drinker’s liver,” Bright’s disease of the kidneys, &c.), which may be caused by it. But not only does excess in alcohol produce distinct and well marked disease, but it lowers the whole tone of the system, and prevents recovery in many acute and chronic affections. There is, for example, no fact better established than this, that persons who have been given to alcoholic excess almost invariably succumb to an attack of cholera. Again, as I have elsewhere pointed out, the habitual over use of alcohol robs us doctors of one of our most important means of treating disease. In fevers and some forms of heart disease, for example, alcohol is a most valuable remedy; persons who have taken alcohol habitually in excess do not respond or react to the stimulating action of the drug, and in some cases this makes all the difference whether the patient will die or will recover.

I may here perhaps also allude to the influence which the proper cooking and preparation of the food exercises. There is, for example, a disease called trichinosis, in which the muscles

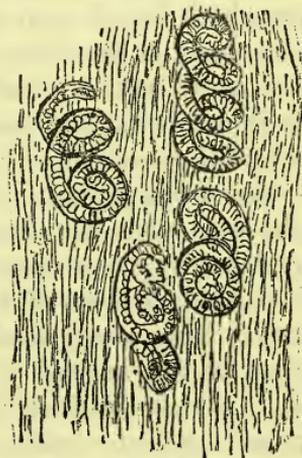


Fig. 7. Section of muscle showing the *trichina spiralis in situ*. Magnified.

become filled with little living organisms, small worm-like bodies, (see fig. 7) ; the condition which is comparatively rare in this country, but common in certain parts of Germany, is produced by eating badly cooked pork. The parasite infests the pig, and in some parts of America a large proportion of the pigs are affected by it. The living organism in the pork can fortunately be killed by a sufficient amount of heat. The pork should not only be roasted,—for when roasted a crust or hard coating is apt to be formed on the outside of the joint and the organisms in the inner parts of the mass to be unkilld,—but should be first thoroughly boiled and then roasted. The preliminary boiling does not, as you might suppose, spoil the dish ; in fact, to my taste, it improves it.

I have thus briefly alluded to some of the more important derangements of nutrition which are produced by an insufficient or injurious dietary. I must now briefly mention some of the derangements which are due to a deficiency of oxygen.

Derangements due to an insufficient supply of oxygen.—The organic unit or cell requires, as we have seen, a sufficient supply of oxygen both for its own nutrition and for its work. When the living body is suddenly deprived of all oxygen death from asphyxia, as we term it, results. Examples of this form of death are seen in drowning and strangulation. “ But the deprivation of oxygen and the accumulation of carbonic acid cause injury long before the asphyxiating point is reached. Uneasiness and headache arise when less than one per cent. of the oxygen of the air is replaced by other matters ; while the persistent breathing of such air tends to lower all kinds of vital energy, and predisposes to disease.” Even a very small diminution in the necessary supply of oxygen to the individual tissues—a result which occurs in anæmia, in which condition the red blood corpuscles or oxygen carriers are deficient—leads to disease. Fatty degeneration, as we term it, of the heart and other tissues may be produced in this manner. From these considerations you will at once perceive the immense importance of proper ventilation. Time does not permit me to go into details on this point ; probably most of

you are already familiar with the subject, for many of you no doubt enjoyed Professor Maclagan's lecture on the subject. I must, however, emphasize the very great importance of attention to ventilation, not only during the day but also during the night. After dark the gas, which most of us use as our source of light, consumes a large portion of the necessary oxygen, and in addition pollutes the atmosphere by discharging into it the waste products of combustion. During sleep we pass a large portion of the twenty-four hours in one room ; it is very necessary therefore that our sleeping apartments should be of sufficient size and well ventilated. I may mention in this connection that every adult person ought to have at least 800 feet of cubic space to himself, and that space must not be a hermetically sealed chamber, but must have free access, either direct or indirect, with the external air. A cubic room 9 feet high, wide, and long, only contains 729 cubic feet of air. You will now perceive the immense advantage of a large bedroom. Further, the greatest care must be taken to prevent noxious substances getting into the atmosphere which we are in the habit of breathing. The escape of foul air from drain pipes is, as you all know, very poisonous. The escape of coal or common gas is also very prejudicial. Badly made common gas contains 20 or 30 per cent. of carbonic oxide, a substance which acts as a deadly poison by taking the place of the health-giving oxygen in the red blood corpuscles, and forming a compound with a substance called hæmoglobin which they contain ; this compound of carbonic oxide and hæmoglobin is with difficulty decomposed by oxygen. If, therefore, a large portion of the red blood globules are occupied by carbonic oxide, and thus rendered useless as oxygen carriers, the animal may die from asphyxia. The slightest escape, therefore, of common gas into a room or house should be at once attended to and rectified. I might mention many ways in which the tissues may be deprived of their full supply of oxygen, such, for instance, as disease of the lungs, diminution in the number of red blood corpuscles, defects in the heart and other organs of circulation which propel these red blood corpuscles or oxygen

carriers through the body. I cannot go into details. I may, however, take this opportunity of alluding very briefly to the immense importance of a sufficient amount of muscular exercise.

The importance of muscular exercise.—The contraction of the muscles materially aids the blood flow in the veins, and the flow of lymph in the lymphatic vessels. During muscular exercise the action of the heart and lungs is increased in frequency ; more oxygen is absorbed by the blood ; more oxygen is pumped through the tissues ; the stagnant corners of the circulation are, as it were, washed out and purified, for oxygen is a great burner up and purifier of waste products ; the circulation through the kidneys and skin, and the excretions from these important scavengers, are increased ; the greatly increased consumption of nutrient materials which takes place during active muscular contraction demands an increased supply of nourishment, the appetite is consequently increased ; the increased flow of highly oxygenated blood through the nerve centres produces a stimulating and invigorating effect on the whole body ; and lastly, there is a greatly increased production of animal heat. In all of these ways muscular exercise proves most salutary.

Derangements due to defective removal of the waste products from the body.—This is a subject of the greatest practical importance, for many diseased conditions arise from defective removal of the waste products.

When, for example, the waste products, which are not required for nutrition, are allowed to accumulate in the alimentary canal, the process of digestion is apt to become deranged, and dyspepsia produced, a foul tongue, headache, and the group of symptoms which are commonly termed biliousness, are frequently due to this cause ; foul gases are absorbed into the blood from the intestine, the blood is rendered impure, and the nutrition of all the tissues is apt to suffer. Then, again, when the action of the kidneys is defective, urea and other compounds, which ought to be excreted by the kidney, are retained in the blood. The most injurious results, and even death itself, may be due to this cause. It is of the greatest importance, therefore, to attend to the condition of

these scavengers, and to avoid all conditions which are likely to derange their action. Over-eating, more especially too much nitrogenous food, the waste products of which are excreted chiefly by the kidneys, is to be avoided. Alcohol in excess also irritates and ultimately may produce disease of the kidneys; and there are many other substances which may act in the same manner. Persons, for example, who have been for a long time exposed to the action of lead, such as workers in white lead factories, plumbers, and painters, sometimes suffer from disease of the kidneys produced by the irritation of the lead which they (the kidneys) discharge from the body. Defective action of the skin is also apt to be followed by injurious consequences. The skin is one of the great channels through which water is expelled from the body; carbonic acid gas is also given off from the skin, and in conditions of disease, at all events, urea is sometimes excreted in the sweat. Then, again, the skin is the chief means by which heat is given off from the body. It is of the utmost importance, therefore, to attend to cleanliness and to keep the skin in a healthy active condition. This is more especially the case when the action of the kidneys is defective, for under such circumstances the function of the kidneys is partly carried on by the skin. Then, again, if the action of the skin is allowed to become defective, an increased strain is thrown upon the kidneys. Defective action of the lungs, the third great scavenger of the body, has previously been alluded to, and the importance of ventilation insisted upon. If time permits, I will afterwards refer to some diseases of the lungs which are due to the inhalation of irritating materials.

Derangements due to defective influence of the nervous system.—It is impossible to over-estimate the influence which the nervous system exercises over the nutrition of the body. This influence is exerted on every tissue and every organ, and is apparent both in health and in disease. I have likened the nervous system to a commander surrounded by his staff of officers, who are in communication with the individual organic units in the human citadel, and I may perhaps best illustrate the all-important

influence for good of this commander by comparing it to the influence which our noble and gallant countryman General Gordon has for so many months exercised over the citizens of the besieged town Khartoum. The meanest citizen in Khartoum, though he may never himself have been in direct communication with General Gordon, has doubtless had his drooping spirits raised, and has been stimulated to renewed vigour and exertion by Gordon's influence. Now just such a healthy trophic influence is exercised by the great nervous system on all the tissues and individual organic units in the human body. Again, the nervous system affects nutrition by calling into play the functional activity of the different organs and parts. Just as we may suppose General Gordon has by repeated and regular drills raised the troops under his command to a high state of efficiency, so does the systematic use of any tissue and organ, and indeed of the brain itself, improve its working and increase its functional power. The largely developed arm of the blacksmith is a familiar example of this truth. Then again the supply of nourishment to the individual tissues and organs is under the control of a special part of the nervous system, the vaso-motor nerves as they are technically called. The nervous system, too, maintains the balance between the production and loss of animal heat ; and upon the action of certain parts of the nervous system, the continued working of the heart and lungs, the organs above all others which are essential for life, depends.

From this brief statement you will see how important it is to keep the nervous system in a healthy state of nutrition, and to see that it is not exhausted by over-work or worry. It is especially important to regard the condition of the nervous system during the period of active development and growth. You may perhaps in this connection expect me to refer to that question, which is so largely at present occupying public attention, viz., over-pressure in elementary schools ; but time, and I may also add, my own want of knowledge, for I have no special experience which warrants me in giving an authoritative opinion on this point, warn me that I must pass on. I must,

however, briefly refer to the all-important influence which a properly conducted system of education—and by the term education I mean the whole training of the body and mind during the period of development and growth from childhood until adult age—necessarily exercises upon the health of the body. Now it may be stated broadly that no system of education is sound which in any way interferes with the robust development of the body. It is unnecessary to insist upon the importance of robust health for those who have to work with their hands ; but good health is no less essential for those who work with their heads. It is, of course, perfectly true that much good brain work is accomplished by those who are very far from healthy and strong. It cannot, however, be denied that for great success a certain measure of good health is indispensable. In these days of keen competition rapid success is comparatively rare ; it is the “staying” horse which most frequently wins the race. You must remember, too, that good mental work is impossible without healthy brain structure,—the one is directly dependent upon the other. The nutrition of the brain cells is conducted in exactly the same manner as the nutrition of all the other cells in the body, and anything which interferes with the nutrition of the body necessarily interferes with the nutrition of the brain, and so impairs its function and functional products (mental work, &c.). Now the question which naturally occurs here is, Is the system of education which is at present in operation in this country calculated to produce the highest possible state of bodily as well as of mental development ? There is probably little if anything to complain of in most of our great public schools for boys. It is, however, very much to be doubted whether the same thing can be affirmed of many of our best schools for girls. But on this point I have no time to enter into details. With regard to the health of children in our elementary schools, the statistics which Sir Lyon Playfair quoted in his recent address to his constituents show that there has been a lessened mortality since the present system of national education came into operation, of from 30 to 35 per cent.

amongst children of school age, and he gives good reasons for supposing that 22 per cent. of this lessened mortality is directly due to the conditions associated with our present system of national education. This result is of course satisfactory in the highest degree, but it does not show that the best possible results, which this system can afford, have been obtained ; it does not show that there is no over-pressure. It must be remembered that over-pressure rarely kills. There is a wide-spread feeling amongst medical men, and it would appear also amongst many teachers, that there is a certain amount of over-pressure. There is no doubt that in the upper and middle classes the disastrous results of over-pressure are frequently met with, and, if other things were equal, we should naturally expect these disastrous results to be very much more frequent amongst the ill nourished, badly fed, badly clothed children of the lowest class. There seems, too, to be a pretty general idea that the present system of payment by results has much to do with the alleged over-pressure, and certainly to the medical mind it would appear that any system which necessitates cram and over-time work should be avoided. I do not mean to suggest that the system of examination and payment by results is itself bad, probably it is the best means of stimulating both teachers and scholars that can be devised, but it ought to be so arranged that there is no over-time, and that the results depend upon the work done in the ordinary school hours. Possibly it is difficult to avoid punishment by keeping-in. Now, if by private charity or any other means, a meal of milk and bread could be offered as a daily reward of work and diligence, you would at once offer the most powerful means of stimulating the child to work, and at the same time give it as the reward of its work the very thing which it most requires. The only objection which I see—provided that such a plan could be carried out in practice—is that it would press cruelly on children who are naturally deficient. Possibly some means of overcoming that objection might be devised.

One of the greatest objects of any properly conducted system of education is to instil into the child habits of cleanliness and

order, to teach it how to work, to call forth its reasoning and thinking powers, and to strengthen and stimulate its powers of self-control. These results are much more important than the greatest amount of fact-knowledge which can be crammed into it. Time does not permit me to enlarge upon this point, but I must briefly say that the derangements and diseases of nutrition, which we have been considering, are due chiefly to two things, viz., *want of knowledge and want of self-control*. A properly conducted system of education and training will obviously, therefore, do much to prevent many of the diseases and derangements to which I have referred.

I had hoped to have been able to speak of the necessity of a proper amount of rest and sleep, of the important tonic influence of recreation and holidays, and of the derangements which may arise from errors in clothing and fashion.

Most of the derangements which we have considered may be said to arise from causes within body—from the neglect of the elementary rules or laws of health. Each man and woman has to a very large extent the power of preventing these derangements. There are other diseases, which are due to external conditions, such for example as the introduction into the system of some of these little invisible organisms which produce the infectious fevers. Many of these affections cannot be prevented by the individual as an individual, though they can be materially controlled by the community acting as a whole. There are other causes of disease which are indirect or predisposing. Some of these are inherited, others acquired. Had time permitted I would have directed attention to these predisposing causes ; I would have shown you how important it is for everyone to endeavour to realise the special affections to which he is liable. A wise general who knows the weak points in his defence takes the greatest care to guard them against attack. This is what I would have each one of you do both for yourselves and for your children. I would also have wished to have impressed all those of you who are not quite well with the most comforting assurance that even after disease has effected a lodgment and the outer line of defence is broken,

there is still hope, and that, like a brave commander, nature still in most instances holds out. It is, indeed, impossible to over-estimate the importance of the fact, that though when handicapped with disease these bodies of ours may fail to reach the post which marks the average span of human life, yet they seldom fail to make a gallant struggle, and even when heavily weighted with disease they comparatively rarely break down and utterly collapse quite at the commencement of the course.

THE BATH: HOW AND WHEN TO USE IT.

BY JAMES RITCHIE, M.B., M.R.C.S. ENG.

OUR medical text-books tell us that hydrophobia is a somewhat rare disease, but if we consider the condition indicated by the literal etymology of the word, then I am afraid we must confess that that condition, viz., the dread of water, is not by any means uncommon.

We trust that the aggravated forms of it are rare, such, for example, as that recently portrayed by the great censor of our country, Mr Punch. The illustration represented a much-be-grimed countenance and hands, the owner of which would have required freely to use a potsherd before the softest of waters and the most detergent of soaps would have sufficed to produce much cleansing effect. The cause was at once explained by the legend, "Two years ago I used your soap, since then I have used no other." But the minor degrees of the condition are much more common, and they are not confined to any particular age or class. When the administration of chloroform was still in the days of its infancy, a gentleman who offered himself as a subject to be experimented upon had his boots taken off and put on while under the influence of the anæsthetic. When he had recovered consciousness he would not believe that such manipulation had been accomplished. He was again chloroformed, and on this occasion both boots and stockings were removed. On awakening the visible evidences of a woeful want of the use of the bath caused him bitterly to regret his unbelief. Were we to judge of the principles of some people from their practice, we should conclude

that they believe the skin to be an ornamental covering, of which only the exposed portions should be kept clean for appearance sake.

But if some are too sparing of the use of water and soap, others go to the opposite extreme. Hydrophilists, we might call them. Their frequent ablutions would lead one to believe that they are afflicted with some stain as hard to erase as was that dreadful spot on Lady Macbeth's hand. They pay the penalty in rough skin and chapped fingers. Some pride themselves upon their breaking the ice in order to have the daily bath, or that they bathe in the sea all the year round, till cric in the neck or rheumatism in one of its many forms binds its iron fetters around them. Or they insist upon their young children being bathed in the open sea in summer, or else in cold water in the dead of winter, giving as their reason that the ancient Gauls hardened their children in the frozen floods, forgetting that in the hardening process only the hardy survived.

Now we shall be more likely to avoid these extremes, and to know both *how* and *when* to use the bath with discretion, if we understand—

1st. Certain facts regarding the structure to be bathed, particularly the skin.

2nd. The general effect of different kinds of baths upon these structures.

1st. The structures to be bathed, particularly the skin.—The skin presents a very large superficial area—from 12 to 18 square feet. The average may be stated at about 15 square feet. It is not simply a tough elastic wrapper for the purpose of enclosing the delicate underlying structures, and protecting them from injury and from the vicissitudes of temperature. It is that, but it is much more. It is richly endowed with *nerves*, and therefore extremely sensitive to external impressions; it is highly vascular, containing networks both of *blood-vessels* and of *lymphatics*, and it is an extensive secreting and excreting apparatus, containing many thousands of *glands* of two kinds—the sweat glands and the sebaceous glands.

Were we to remove a piece of skin, then to cut from its edge a very thin slice embracing the whole thickness of the skin, and were we to examine this slice with the aid of a microscope, we might observe an appearance such as that depicted in fig. 1.

The skin we consider to consist of two layers—the cuticle or scarf-skin, and beneath it the true skin. The deeper part of the true skin is open in its structure, containing more or less of fat. Above this it is more dense, and on the surface it is covered with little eminences called papillæ, which fit into corresponding recesses in the cuticle. The portion of the cuticle next the true skin is softer and more opaque than the outermost layer, which consists of hard flattened scales. These, when they have fulfilled their function, are cast off from the surface of the body in the form of fine scales or dust. These two layers vary in thickness in different parts of the body. They are thicker

and stronger on the more exposed portions, thickest on the palms of the hands and on the soles of the feet.

If we use the proper means for bringing into view the *nerves* of the skin, we find that they are very numerous. They terminate in three ways specially adapted for the reception of sensory im-

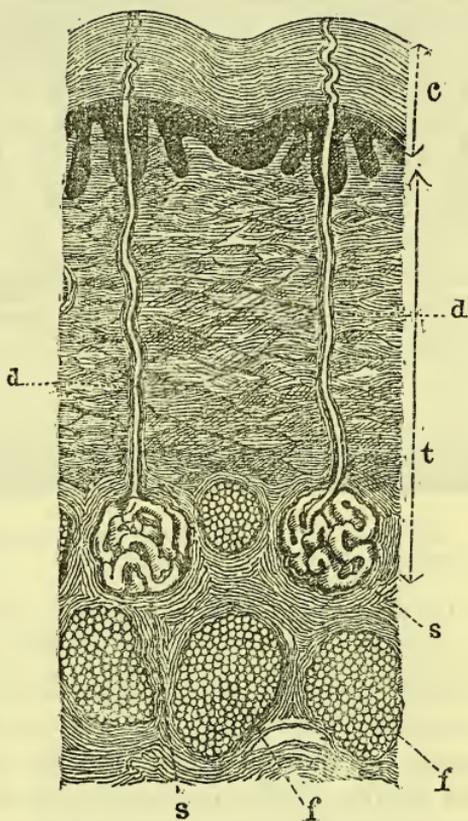


Fig. 1. Vertical section through skin of finger; (*t*) true skin; (*p*) papillæ of true skin; (*c*) cuticle or scarf-skin; (*f*) fat; (*s*) sweat glands; (*d*) duct of sweat gland.

pressions :—In the deeper layer of the skin by small seed-like bodies attached to the branches of the nerves, on the surface of the true skin by small bodies called touch-bodies in certain of the papillæ, (*b*), fig. 2, and lastly, by bulbous swellings in the cuticle.

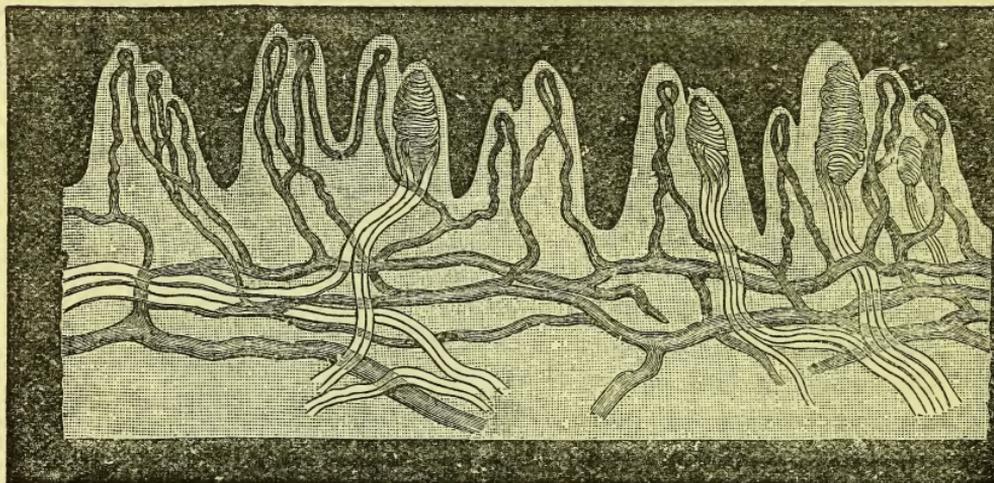


Fig. 2. Diagram of papillæ of true skin showing loops of the blood-vessels; touch-bodies or nerve endings; and nerves.

By being placed in the papillæ, these touch-bodies are under more favourable conditions for the reception of certain kinds of impressions than if they were imbedded in a flat surface. Impressions made upon the surface are, by means of these terminations, and the nerves, rapidly conducted to the spinal cord and brain. There is therefore in the skin an extensive apparatus by means of which we may soothe or stimulate either a part or the whole of the system. The sensitiveness of this apparatus you all know from the effect of heat, cold, and various kinds of stimuli, not the least memorable of which, perhaps, is that stimulus to application to study inflicted by the schoolmaster at his discretion.

Of *blood-vessels* there are extensive networks both in the superficial and in the deeper parts of the true skin, those of the superficial layer sending loops into many of the papillæ (*a*), fig. 2, thus

bringing close to the surface of the body a great extent of blood-vessels, just as in mountainous Scotland there is a much greater superficial area for streams and water-courses than if our country were a level plain.

There are also networks of vessels surrounding the glands and hair roots. The blood-vessels are not equally full at all times. They contract under the influence of cold, and dilate when heat or irritants are applied. They are still further emptied of their contents when they are constricted in consequence of contractions of the involuntary muscular fibres in the true skin. The effect of nervous influence also upon them is great. The flush of shame, the pallor of fear are caused by opposite conditions of these vessels effected directly through the nervous system. As fluids are very good conductors of heat, we have in such an extensive system of blood-vessels, so near the surface and communicating with all parts of the body, a ready channel for applying heat to, or of abstracting it from the system.

There is another extensive system of vessels--the *lymphatics*. These accompany the blood-vessels more or less closely. The latter convey to the skin the requisite nourishment, but the lymphatics are associated with them in conveying from it waste material produced in the performance of its functions. If the skin is healthy the waste products are normal, but if the functions of the skin are interfered with, these products may be morbid, and sometimes are hurtful to the system.

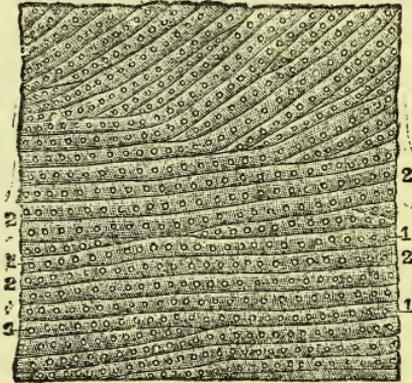


Fig. 3. Magnified view of the point of one of the fingers showing ridges and furrows. The round spots are the openings of sweat glands.

If with an ordinary pocket lens we examine the point of one of the fingers we may observe on the ridges of the skin a number of small dark spots (fig. 3).

These are the orifices of the sweat glands. With the unaided

eye we may, in warm weather, see the points of the fingers studded with minute drops of sweat proceeding from these orifices. The glands are situated in the deeper part of the true skin, (s), fig. 1. They communicate with the surface by means of small tubes or ducts. Were these tubes placed end to end they would extend miles in length. As they pass through the scarf-skin the ducts are twisted like a cork-screw, and at this part the walls of the ducts have no special limiting membrane, but are formed by the cells of the scarf-skin. The sweat may thus be easily diffused through the scarf-skin. It is estimated that in a square inch on the palms of the hands there are about 2800 of these glands, on the back in the same area 400. Scattered over the whole surface of the body there are upwards of two millions of them. Their function is to discharge from the body a quantity of water and organic matter. They are not at all times equally active. Under certain conditions, such as excitement, exposure to great heat, &c., they secrete the sweat very abundantly. There is constantly a certain amount being secreted. Under ordinary circumstances this passes into the cells of the cuticle, and thence from the surface, and is called "insensible perspiration." The amount in twenty-four hours is from 2 to 4 lbs. Although we are not ordinarily aware of its existence we become conscious of its absence by the dry harsh skin when the function of these glands is in abeyance, as during feverish conditions. It is the existence of this copious insensible perspiration which makes it so unhealthy to wear constantly any kind of waterproof clothing. Such clothing is useful in heavy showers, but ought not to be worn constantly. This evaporation from the skin plays a very important part in regulating the temperature of the body, and in maintaining it, even under very different and varying conditions, at a constant point, viz., about 98·4. Of the whole heat given off by the body about 77·5 per cent is lost by the skin.

The *sebaceous* glands (l), fig. 4, are also very numerous ; they are found wherever there are hairs, viz., over the whole surface except the palms of the hands and the soles of the feet. They

are minute sacs, usually several in connection with each hair, and they open close to where the hair comes to the surface. Their function is to secrete an oily fluid in order that the skin and hair may be kept soft and pliable.

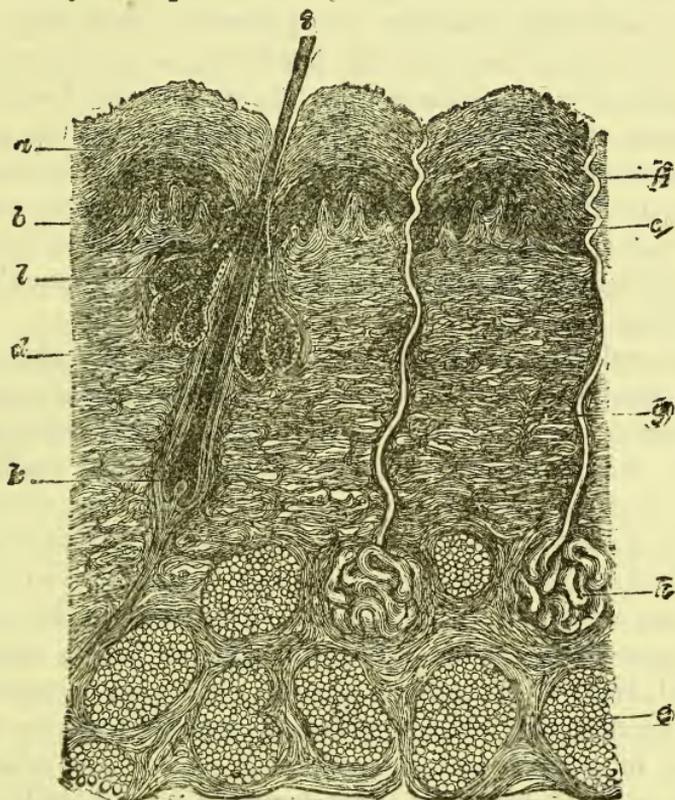


Fig. 4. Section perpendicularly through the healthy skin. (*a*) Epidermis or cuticle; (*b*) mucous layer, with pigment; (*c*) finger-like projections of true skin; (*d*) true skin; (*e*) fatty masses; (*f g h*) sweat gland and tube or duct; (*i k*) hair, with its follicle and papilla; (*l*) sebaceous gland attached to hair follicle.

The human body is a very wonderful chemical laboratory, in which even waste products are made to do useful work, but if these secretions which are also excretions are pent up in the body instead of being allowed freely to escape, the blood and the system become more or less loaded with some deleterious material, in consequence of which the health suffers. We are told that if an animal have the surface of the skin varnished it soon dies. At the coronation of Pope Leo X., a child in order that it might

represent an angel was coated with gum and covered with gold leaf. The poor child did duty at the coronation, but after a few hours it died ; the symptoms were those of blood-poisoning.

The skin is thus a most important structure. A tough wrapper enclosing subjacent structures and protecting them from injury and from changes of temperature, presenting a great expansion of nerve-endings by which the system may be stimulated or soothed, maintaining the temperature of the body at a nearly constant point, associated with other organs, specially the kidneys and lungs as Dr Bramwell recently told you, in excreting from the system water, carbonic acid, and organic matter, and possessing an extensive glandular apparatus for preserving its own elasticity and softness.

In the ordinary performance of its function, the skin is continually shedding worn-out scales of scarf-skin—there are also accumulating on the surface the solid refuse of the sweat, and the secretion of the sebaceous glands. To these waste products are added the smoke, dust, and other impurities of the atmosphere, which are tolerably copious in all large towns. If these are not removed, the cells decompose, the sweat sours, the oil becomes rancid, the orifices of the glands may be blocked up, the function of the skin is interfered with, the general health suffers, an increased amount of work is thrown upon other organs, and locally the skin may become inflamed, especially where two surfaces are in contact, and have blotches on it. The artisan who works hard, perspires freely, and changes his underclothing regularly, really suffers less from want of the bath than do those engaged in sedentary occupations, because by copious perspirations his sweat ducts are flushed and the skin more or less cleansed by the friction of the clothing.

2nd. The general effects of the different kinds of baths.—These are, in ordinary health, mainly of three kinds. Cleansing, stimulating, and soothing. Perhaps the most important is the cleansing of the skin. The cleansing effect is best attained by the use of tepid or of warm water with soap.

The kind of soap.—Unless in special cases *soft soap* is too caustic

and irritating. A good quality of yellow soap can be borne by most skins. White Castille soap, white curd soap, are both good. Transparent soaps are usually pure and not irritating. Sanitas soap is good and agreeable. Dark coloured and highly scented soaps, except those of the best makers, ought to be avoided, because colouring matter and perfume are frequently added to hide the inferior nature of the material used. Red and violet soaps are occasionally coloured with deleterious pigments. Low-priced soaps are not necessarily cheap, often the reverse; they are often made from very objectionable materials, are adulterated, and contain an excess of water.

The amount of soap to be used, and the frequency of its use, ought to be regulated by the character of the skin and the kind of exposure. Greasy skins and dirty work require a more liberal allowance of it than the converse conditions. To harsh dry skins it should be used sparingly, seeing that the oil of the skin is already too scanty. Some irritable skins resent the use of any kind of soap. For applying soap the hands are better than a sponge; they adapt themselves more perfectly to irregularities of surface. In all cases the soap ought to be washed off with a copious supply of water. Some persons have a superstitious, or perhaps it should be called, a traditional, dread of washing certain parts of the body, such as the opening of the head in young children, or of using soap to the face, &c. For these fancies there is no good reason; it is as necessary to keep one part of the skin clean as another. The feet should be as daintily clean as hands or face.

THE COLD BATH,—Immersion in cold water produces more or less of shock to the nervous system, as evidenced by the gasping breathing and the tremor of the muscles. The blood-vessels on the surface contract, the blood is driven to the deeper organs—the temperature of the surface is lowered, but that of internal parts is elevated. If the bather is of good constitution and in good health, and if the immersion be of short duration, on leaving the bath reaction quickly takes place. The blood-vessels in the skin dilate in excess of their former condition, the dilatation being

usually aided by the friction used in drying. The blood having gained an accession of heat in the deeper organs, flows from them to the skin, and its temperature is comparatively raised.

The effect of such a bath, if taken with proper care, is a pleasant glow over the surface so soon as the reaction has taken place, and a feeling of exhilaration. The glands in common with all the other structures of the skin are stimulated to perform their functions more briskly, and a healthy tone is imparted to the whole system. The circulation is quickened, the respiration deepened, the digestion and nutrition are improved, there is an increased production of heat, and the nervous system is braced. The body also becomes more accustomed to variations of temperature, so that those who attend to the daily bath are much less liable to catch cold than those who do not indulge in this luxury.

The colder the water the greater the stimulating effect, provided the warm reaction is thoroughly established and persists. Excessive stimulation must, however, be guarded against. When, even although the reaction has been good, the bath is followed by languor and inability for work, the stimulation has been too great for the nervous system, that is to say the bath has been too cold.

If the bath have not been properly taken, if it have been too cold for the bather, or if the immersion have been too long, the effect may be very different. The reaction may be imperfect or wanting, and congestions of internal organs may persist, the temperature may continue lowered, and the whole vital functions be depressed. If the bath be very cold and the constitution feeble, the shock may be so great as even to be fatal.

What we aim at in taking a cold bath is to stimulate the skin, and through it all the functions of the body. Unless a good glow is produced the bath is useless or worse, and a good wash in warm water with soap would be much better.

TEPID AND COOL BATHS produce the same kind of effects as the cold bath, but less in degree.

THE WARM BATH.—When moderate heat is applied to the surface of the body the nervous system is soothed, the vessels of

the skin relax, there is an increased flow of blood to it, the action of its glands is increased, the functions of the skin are *assisted*, and the general circulation is slightly increased. The flow to the skin may draw so much blood from the brain as even to cause faintness.

When the temperature of the bath is higher the circulation is more quickened, the breathing becomes more rapid, interrupted by frequent deep inspirations, and perspiration is copious.

Should the bath be very hot there is a powerful stimulation both of vascular and nervous systems, and in infants even convulsions may be induced.

On leaving the warm bath the capillaries of the skin contract, and the heat of the surface is lowered, the vessels remain for a time in a state of atony, and unless care is taken a chill may follow, with the unfavourable results described to you by Dr Affleck.

The general effect of a moderately warm bath is sedative to the nervous system and moderately stimulant to the circulation. But if the temperature of the body be raised, as in feverish conditions, and the nervous and circulatory systems be in a state of excitement, then the warm bath, by abstracting heat from the body, is very soothing. The stimulant effect of a warm bath is proportionate to the heat. Hot baths frequently repeated are enervating.

Delicate and wearied persons are very sensitive to variations of heat in different parts of the body. The warm bath, by causing an equable temperature throughout, soothes such a delicate or wearied organization.

A healthy person, specially one who has not much exercise, is stimulated by the use of the cold bath, but if he be fatigued, his muscles tired, stiff, and painful, he will derive most benefit from a warm bath. Cold refreshes by *stimulating* the functions, heat by *facilitating* them.

SEA-BATHING.—Cold salt-water baths have the same general effect as the cold bath, but in virtue of the contained salt they are more stimulating, and as the sea is in constant motion, it is

more stimulating than a bath in still water of equal temperature. There are also certain salutary adjuncts to sea-bathing which play a most important part in producing the favourable result. These are fresh air, change of scene, and, to most bathers, relaxation from business cares.

Warm salt-water baths are more stimulating than ordinary warm baths, consequently, by the use of warm salt water, the same amount of stimulation may be obtained as by a fresh-water bath of lower temperature.

RUSSIAN AND TURKISH BATHS are combinations of the hot and cold bath. The effect is the same, namely, to stimulate the functions of the skin, causing copious perspiration, with the removal of impurities from the surface, and to brace it up afterwards by the use of cold affusion. The RUSSIAN is a hot vapour bath, after which the Russians used to rush out and roll themselves in the snow. We are satisfied with the cold douche instead, perhaps because our supply of snow is limited. The TURKISH is a hot-air bath. It is the same in principle as the *Thermæ* established in Britain 1500 years ago for the comfort of the Roman legions. The Romans adopted the idea from the Greeks, and under the Empire wherever there was a Roman colony there were baths. But the fact that they were introduced by their conquerors was a sufficient reason to our forefathers for not using them. Of late years we got the system from the Turks, who, when they took Constantinople, adopted the Roman system of baths.

Having given this short sketch of the skin and its functions in relation to the subject before us, and having noted the general effects of different kinds of baths, we will now consider *How* and *When* to use the bath.

One of the first attentions conferred upon a child is the order of the bath, and we propose to describe the ceremony in detail. Its delicate little organism will not bear rough treatment without harm, and as its power of compensation is not so good as that of the adult, slight causes elevate or lower the temperature, and it does not quickly recover its normal standard. During the few first weeks of its life the temperature of the bath should be just a

little below blood heat, 92°-98°. Before the child is undressed everything should be got in readiness. There should be a fire in the room, unless in the case of older children in warm weather. The fire ought to be sufficiently good to permit of the bathing being conducted at a distance from it, with a screen in front, on which should be hung a large soft bath towel to be in readiness. The bath ought not to be small ; a basin should not be used, but a round or oval tub or bath, say of 24 to 30 inches in diameter. All the requisites for bath and dressing having been placed within the nurse's reach, and she having donned her waterproof and flannel aprons, seats herself on a low chair with the child on her knee and undresses it with the exception of the flannel binder. The child is then laid on the knee with its head over the bath. The head is washed with soap, then with a large sponge the soap should be thoroughly removed. After the head has been carefully dried the binder is taken off and the body soaped, then the child is gently lowered into the bath, its shoulders supported by the nurse's left hand, while with the right she washes off the soap by means of a full stream of water from the sponge. For this purpose a sponge is better than the hand, the work is more quickly accomplished—a matter of importance. The child is lifted out of the bath, the whole body enveloped in a warm soft towel, and the surface very thoroughly dried as gently and as rapidly as possible. Every fold and crease should be dusted with powder. Fuller's earth is good but unsightly ; prepared starch, or starch and oxide of zinc, are also useful but tend to cake ; sanitary rose powder is perhaps the best. Till the child is a few weeks old the morning and evening bath should be of the same temperature, but by-and-bye the morning bath may be cooler. For healthy children at three or four months old the temperature may be reduced to 70° or 80°. The head should be washed with rather cooler water than the rest of the body, the bath being cool at first and a little hot water added before the child is put into it.

It is impossible to state definitely any temperature which will suit all children at any given age, but the following rule may be

taken as a safe guide. The colder the bath the more invigorating its effects will be, provided the reaction is good, but if on any occasion the child is pale, blue, or even chilly after the bath, the water has been too cold and should be used warmer in future.

Some children take to the water like spaniels, others are timid, and with these considerable care may at first be required. Such children should not be frightened or forced into the bath, otherwise a permanent dread of it may be established. Occasionally by lowering the child into the water in a towel the dread may be overcome, or by placing a piece of blanket over the bath, the child may be gently immersed in the water without being at first conscious of it.

During the early years of child-life a bath should be given night and morning. The morning one as a tonic and stimulant should be cool or tepid, the evening bath as a sedative and for cleansing purposes should be warmer, and the dust of the day removed with soap before the child is put to rest.

The morning bath should be given immediately the child rises out of bed while its body is warm. It should not be allowed to play about in the nursery in its night-dress, as by so doing the body cools, and is more likely to be chilled by the bath.

The necessity for careful drying of the surface has been already noted in relation to very young children. In older children the skin ought to be well rubbed in order to aid the warm reaction. Hurry ought to be no excuse for sending off a child only half dried. The more delicate the child and the weaker its circulation, the more care ought to be observed in this respect, otherwise cold hands and feet, general discomfort, chapped skin and chilblains may be the result.

In the event of illness, specially of cold in the chest and of inflammatory affections, the morning bath should be omitted, and the evening bath given warm, or warm sponging substituted.

After the child leaves the nursery the evening bath may be discontinued, but the morning tonic bath should be taken regularly if the general health permit, and a warm cleansing bath once a week in the evening.

If I have succeeded in conveying to you correct ideas regarding the skin—its complex structure and its functions—and the influence of the daily morning tub upon the general health, it were hardly necessary to say more with the view of emphasizing the importance of continuing the habit throughout life. I might, however, remind you of the extra duty which is thrown upon the system by the artificial mode of life in the present day, and upon the nerves and vessels of the skin in consequence of sudden alterations of temperature in going from warm rooms to the open air and the reverse, in consequence of which greater care is required to preserve all these structures in a healthy condition.

The cold bath ought to be taken early in the day, because then the vital functions are most active, and the reaction is consequently more likely to be good.

Those who have not been accustomed to it must not straightway go and plunge themselves into cold water, much less to bathe in the open sea unless in very mild weather. The sensation would probably be unpleasant, and the shock too great. But those of good constitution, by gradually accustoming themselves to the use of cool water, may very quickly be able to enjoy even a perfectly cold bath. In order that the cold bath may be used with benefit, there is required a certain strength of constitution, a certain power of reaction.

It is not suitable for the weak and debilitated, specially for the very young and the aged, it should not be taken by those who suffer from internal congestions, nor should it be taken when one is much fatigued, nor during certain recurring periods of more delicate health.

Delicate people may have to content themselves with tepid sponging. To begin with, the temperature of the water may be from 85° to 95°, only a part of the body exposed at a time, and that only in a warm room. Those less delicate may begin with the water cooler, and get a very good effect by rubbing the whole body with a damp towel, then drying carefully. Cold sponging is the next step.

THE SPONGE BATH may be used when the system has become

somewhat accustomed to the shock of cool water. This is the kind of bath most likely to be serviceable to the majority of people of average constitution in our climate during the winter months. The bather stands in a large flat bath or tub containing a small quantity of water, and with a sponge he causes a stream of water to flow over the shoulders and down the body. By this means it is possible to obtain very decided stimulation. Those with weak circulation, and a tendency to chilly feet, should have warm water in the bath. The body may first be washed with this, then cool or cold water, contained in a basin previously placed ready for the purpose, may be dashed over the body with a sponge. This is a very good way of giving a cold bath to children. Those who have a shower-bath, and who have not a good power of reaction, should first take a tepid bath, or warm shower, and then brace themselves with a few seconds of the cold shower.

THE NEEDLE BATH is well adapted for those who are not robust, but unfortunately it is rarely to be had except in Hydro-pathics. The bather enters a small circular cabinet, surrounded on all sides by vertical and horizontal pipes, from which thousands of minute jets of water are thrown upon the body with considerable force. When this bath is taken warm, followed by a short time of cold, the reaction is very satisfactory and the bather is warm and invigorated.

For the majority of people in our climate water from 50° to 70° is cold enough, but it is impossible to fix any temperature as suitable for a cold or tepid bath for everyone. The rule already given for children applies equally to adults. The colder the bath the more stimulating it is, provided the reaction takes place and persists; but should the bather be chilly or languid afterwards, then it has been too cold for that individual, or too long time has been spent in it.

Those persons who have very limited accommodation need not deny themselves the bath on account of want of privacy. By attaching loops to the adjacent corners of a sheet, blanket, or bedcover, and hanging it across a corner of the room,—and if there be not a suitable corner, one can easily be made by opening

a door,—it is possible completely to isolate oneself, and behind the curtain to conduct the bath as if in a different apartment altogether (fig. 5).

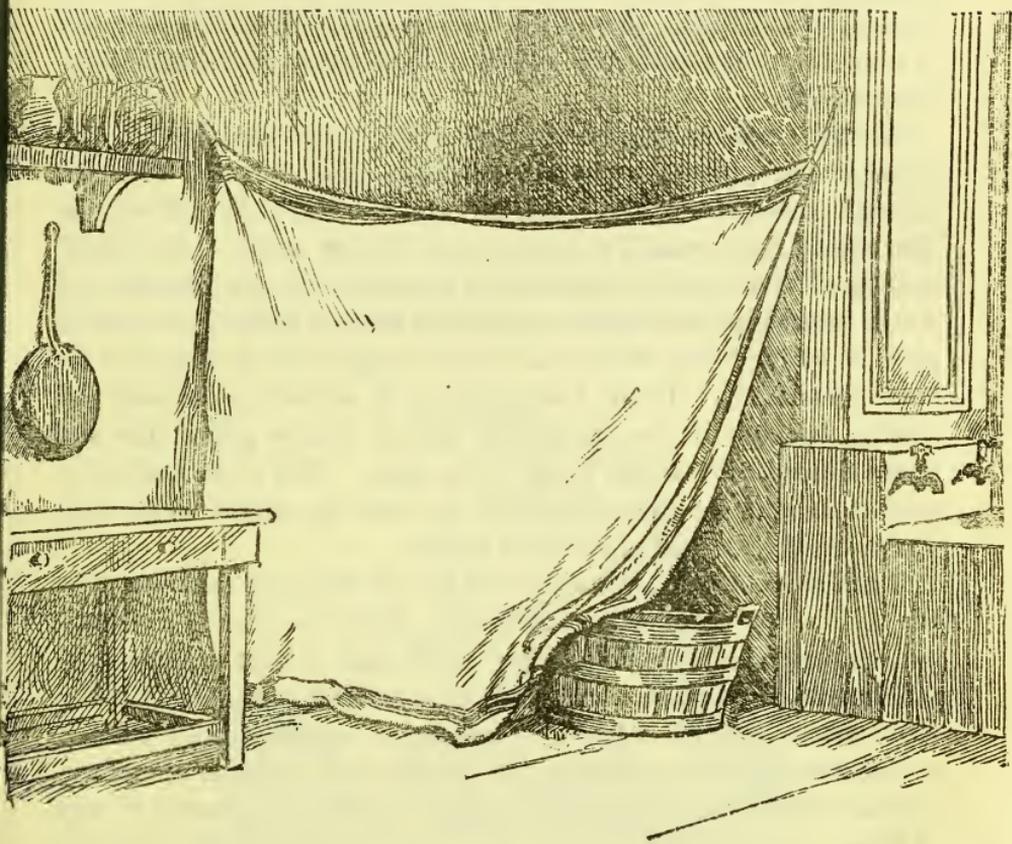


Fig. 5.

SEA BATHING.—The very robust may bathe in the open sea before breakfast, but the best time for those of moderately strong constitution is about two hours after breakfast. Weakly adults, the aged, and children under two years of age, should never bathe in the open sea. It is best not to bathe with an empty stomach, and not soon after a meal (about two hours), not if one is much fatigued, nor if there be emotional excitement. Neither should sea bathing be indulged in by those who are bloodless, or

who have weak circulation, or heart disease, or chronic lung disease, or congestions of internal organs such as stomach or kidneys. The caution not to bathe soon after a meal should be specially observed by swimmers. They have sometimes a tendency to sickness, should the food be ejected from the stomach it may be drawn into the windpipe and cause an immediately fatal result.

The tyro bather should undress quickly, go rapidly into the water at once, over the head several times, then out and dry with a rough towel, dress rapidly, and take a brisk walk afterwards. The robust may remain a longer time in the water. As inflammation of the ears is occasionally produced by the entrance of water into them, it is better to prevent this by putting in a small piece of cotton wool, which the bather ought not to forget to remove afterwards. If the body is warm it is best not to wait for cooling, because if the surface is chilled before going into the water the reaction is less likely to be good. But if the bather be subject to cramp he ought not to go into the water while very warm, or at least not beyond his depth.

BATHER'S CRAMP is often caused by the shock of cold water to the surface under certain conditions. There is usually a constitutional peculiarity predisposing to it, and robust middle-aged males seem to be more liable to it than others. The body being very warm, fatigue, prolonged muscular exertion, and sudden severe muscular effort, favour its production. Those, therefore, who are subject to cramp ought not to go into deep water if any of these conditions be present. One who is frequently troubled with cramp ought not to go into deep water at all.

If a bather is seized with cramp he must endeavour to retain his self-possession, if he lose this his case is hopeless. If the cramp be in one leg, it ought to be maintained extended at rest, and by means of the arms and the other limb the swimmer may make way, or by the hands only he may maintain himself erect until it has passed off. It has also been recommended that the bather throw himself on his back and kick out vigorously. For general cramp of the chest muscles there is no treatment available.

Should a bath in the sea be followed by chilliness, headache, feeble digestion, or sluggishness of the liver, the immersion has been too long, or the bath is unsuitable and ought not to be repeated. It is cruelty to force nervous children into the sea; the emotional condition of terror will most likely prevent that reaction upon which benefit from the bath depends.

I hope that many of you may become very frequent bathers, but so careful that no danger will arise to yourselves. As, however, you may see others in danger from drowning, you ought to know how to afford aid to the drowned. You may send for medical assistance, but if this is all you do the medical aid will probably not be of much avail. Howard's plan of treating the drowned is, I think, the most efficacious and the simplest.

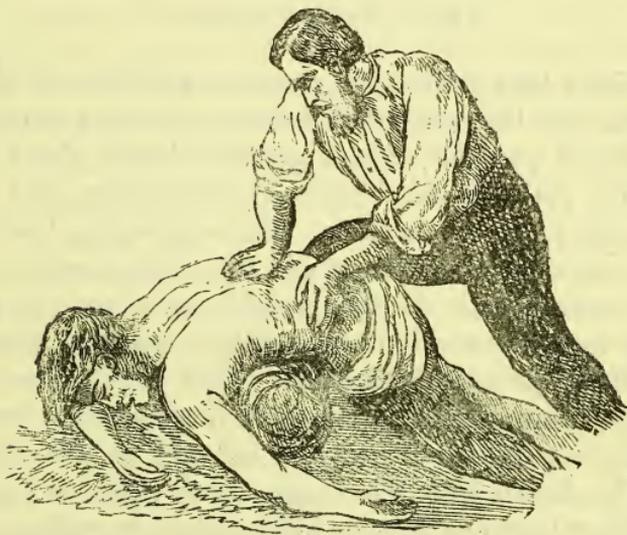


Fig. 6. To press the water out of chest.

“1. *Instantly* turn the patient downwards with a large firm roll of clothing under stomach and chest. Place one of his arms under his forehead, so as to keep his mouth off the ground. Press with all your weight two or three times, for four or five seconds

each time, upon patient's back, so that the water is pressed out of lungs and stomach and drains freely out of mouth. Then,

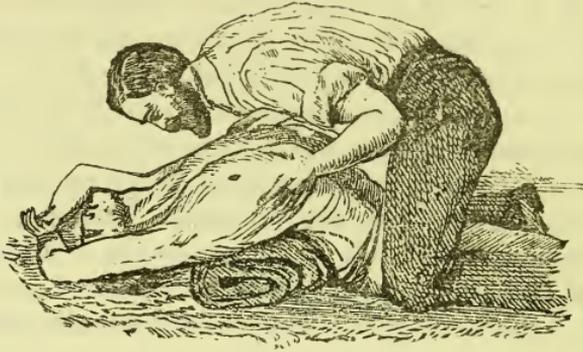


Fig. 7. To initiate respiration.

“2. Quickly turn patient face upwards, with the roll of clothing under back, just below shoulder blades, and make the head hang back as low as possible. Place patient's hands above his head. Kneel with patient's hips between your knees, and fix your elbows firmly against your hips. Now—grasping lower part of patient's naked chest—squeeze his two sides together, pressing *gradually* forward with all your weight, for about three seconds, until your mouth is nearly over mouth of patient; then, with a push, *suddenly* jerk yourself back. Rest about three seconds; then begin again, repeating these bellows-blowing movements with perfect regularity so that foul air may be pressed out, and pure air be drawn into the lungs, about eight or ten times a minute, for at least one hour or until patient breathes naturally.

“*Note.*—The above directions must be used on the spot, the first instant the patient is taken from the water. A moment's delay—and success may be hopeless. Prevent crowding around patient; plenty of fresh air is important. Be careful not to interrupt the first short natural breaths. If they be long apart, carefully continue between them the bellows-blowing movements as before. After breathing is regular let patient be rubbed dry,

wrapt in warm blankets, take hot spirits and water in small occasional doses, and then be left to rest and sleep."

THE WARM BATH is not nearly of such general application as the cold and cool bath. For the purpose of thoroughly cleansing the skin it is more useful than the cold. The warm bath should be taken in the evening, and those who have not the means of bathing at home, but who go to a public bath, ought to take a cool or cold shower afterwards, in order to brace up the skin and so to avoid the danger of a chill from the effect of cold upon the skin while the vessels are still in a partially paralysed condition. As the warm bath is sedative in its action, it should not be used very frequently unless followed by the cold affusion.

The very warm bath is enervating, and it was in consequence placed at one time under the ban of the Church. It should not be used by those who have tendency to faint. If after a day of great fatigue the muscles are tired and stiff a warm bath in the evening for twenty minutes or half an hour will, by facilitating the transformation in the tissues, remove the sense of fatigue much sooner than it could be done by rest alone. Napoleon after a day of fatigue, instead of seeking rest in sleep, so refreshed himself by a warm bath that he was able to continue a march overnight and, if need be, to engage the enemy the next day.

Those of rather delicate constitution, and those recovering from some debilitating illness may, by sponging with warm or tepid salt water, obtain an amount of stimulation which could only have been attained by the use of fresh water of a cooler temperature. Such a bath is very useful for delicate children the subject of frequent cold in the head and chest, who cannot bear even the milder form of cool sponging without catching fresh cold. By the persistent use of tepid or salt water sponging they may become much less like hot-house plants.

THE HOT BATH can only be borne for a very short time. It powerfully excites the action of the heart.

THE RUSSIAN BATH ought not to be taken by those affected with palpitation of the heart, heart disease, or fulness of head.

THE TURKISH BATH should not be taken very frequently,

especially by those who are not very robust. In the hot chamber the reclining posture should be maintained, and very little conversation allowed.

Those with heart disease or palpitation should not indulge in the Turkish bath, and those who cannot perspire in dry air should not take it unless there is a vapour chamber in the baths.

In the SWIMMING BATH we recognise one of the best means of obtaining active exercise for all the muscles. If the chill be taken off the water there are few of moderately good constitution who may not indulge in it. Every child ought to be taught to swim. One never knows when this accomplishment might be turned to use, either for self-preservation or to save the life of another.

THE BATH IN THE TREATMENT OF ILLNESS.—If it be of importance to attend to the skin in health, it is equally important to do so in many diseases, specially in those of kidneys and of lungs. Although the employment of baths in the treatment of disease is too extensive and too difficult a subject to be treated of in detail in a course such as the present, I ought to mention its use in a few of the more frequent ailments.

Some young children are very liable to become feverish from slight exciting causes. The irritation of teething (not always a slight cause), too much food, indigestible food, constipation, are quite sufficient to make some children very hot and restless, specially towards evening and at night. Frequently the first named cause predisposes to and acts in conjunction with one of the other causes. If the exact cause is known it should be removed, but it may be unknown, or it may be impossible at once to remove it. In any case a quiet night may often be obtained by immersing the child in a warm bath, not a hot bath, but one about 98°, the whole body to be kept under water for seven or ten minutes. On removing the child from the bath it should be quickly dried and put in a warm bed. In this case it is not necessary to remove every trace of moisture from the skin.

When a child is feverish, it is sometimes afraid of the bath, although it is not so at other times. In such an event the bath

may be covered with a piece of blanket in the way already described.

You may remember that the effect of a warm bath is sedative ; by means of such a bath the fever is reduced, the skin begins to perspire, and often the child drops off quietly to sleep.

Under precisely similar conditions some children are very liable to convulsions. In such a case the plan of treatment just described should be adopted, and if the head be very hot a single or double fold of rag (not a thick pad) moistened with cold water may be placed on the head and moistened from time to time. The medical attendant in this case should be sent for without delay.

When convulsions arise in consequence of exhaustion from diarrhoea this treatment will not avail.

Sometimes in an emergency there is difficulty in obtaining a sufficient supply of warm water for a bath. A deep can, such as is often used for keeping bread in, may be made serviceable with a small quantity of water.

Headache accompanied by a feeling of fulness in the head and throbbing may be relieved by means of the foot-bath. A deep vessel should be used, the water as hot as can be borne, with a little mustard in it, and the feet immersed therein for 20 minutes. The same may be found serviceable at the commencement of cold in the head.

After fatigue or a chill a warm bath 100° to 102° may be taken at bed-time. Should there be no regular bath available a tub may be used, the bather sitting in the warm water with a blanket enclosing both bath and bather, only the head being left exposed.

At the commencement of a cold the following method of using the vapour bath may be tried. Mr Grantham's directions :—
“Boil two gallons of water ; at the same time put into the fire half a brick, which must be heated to redness ; have a cane-bottomed chair and a hot bath to the feet, with a large blanket in the room ; put the boiling water into an earthen pan, and place it under the chair, then put the red-hot brick into the pan.

The patient is to be seated on the chair in a state of nudity, with the feet in the foot-bath, and then to be covered, excepting the head and the face, by the blanket. By these means the steam is kept up on the surface of the body for the space of fifteen or twenty minutes ; after which the patient is to be well dried, and be placed between blankets."

In such a case the following simple plan is often efficacious. Two or three large smoothing irons are heated at the fire ; when very warm each iron is wrapped in several folds of damp flannel, then placed upon a flat plate, and put under the bed clothes at a little distance from the patient's body. A warm drink is administered. The result is usually copious perspiration.

PUBLIC BATHS.—The customs as to washing and bathing are extremely various in different countries and at different times. Our countrymen, when in warm climates, use the bath more frequently than when at home. Speaking generally, it would appear that the frequent use of the bath has at all times accompanied the progress of civilization. The difference is seen between the less and the more refined, even in the same country (in naming refinement I do not refer merely to a difference constituted by pounds, shillings, and pence) on the outskirts of civilization the bath may be little known. A gentleman travelling in the far west passed the night at a wayside tavern ; he found in the room no arrangement for washing, and on applying to the landlord he was told, "Folks generally wash outside the door if they want to wash at all." The traveller ordered a basin and water to be taken outside the door, and while he performed his ablutions several of the inhabitants "hung raound," watching with interest what seemed to them to be a most novel proceeding.

As in our own country so in early Rome the weekly bath was a national custom, but later, and during the empire, the daily bath was considered to be almost a necessary of life. It was taken before the evening meal, the time for which was not later than three o'clock, frequently earlier. The baths were favourite places of public resort, in some respects resembling our clubs, at which politics and other questions of the day were discussed. In

addition to numerous private adventure baths there were magnificent *Thermae* or public baths erected by Agrippa and by various of the emperors. Those who have not visited Rome can have very little idea of the enormous scale of these monuments of the emperors, for such they were in reality. The baths of Caracalla were nearly a mile in circumference—770 ft. long, 325 ft. wide ;—they accommodated 1600 bathers, but those of Diocletian were still more extensive. Forty thousand Christians are said to have been engaged upon their construction. They covered an area of 150,000 square yards, and could accommodate 3200 persons. They are now occupied as studios, granaries, prisons, two churches. The church of *Sta Maria degli Angeli*, built by Michael Angelo, is shapen out of the *Caldaria* (hot air chamber). In it one still sees the massive columns of Egyptian granite ; from the vaulted roof still hang the metal rings from which were suspended the lamps which shone upon the Romans of those days as they enjoyed their bath. Where was formerly the swimming bath (200 feet long by 100 feet wide) is now the cloister of the Convent of the *Certosa*. In the earlier days admission to the baths cost the enormous sum of less than a farthing of our money, but to the *thermae* of the emperors with their gymnasia, conversation-rooms, theatricals, races, &c., admission was free. The bath became such an institution that wherever a Roman colony was planted baths were established. The English town of Bath owes its origin to the Romans, and in Strand Lane, London, till a recent date, were remains of the old Roman baths.

But the Roman of to-day has not preserved the proclivities of his forefathers. Not very long ago the recommendation to take a cold bath elicited from one of them the reply, "What? Wash me from head to foot in cold water I shouldn't dare to do it! I never did it in all my life."

But let us inquire what facilities for bathing are provided nearer home.

Bradford has baths and washhouses in Thornton Road, which, during the year ending 31st August 1884, were patronised by

125,770 bathers. The year previous the number was only 110,180. For that year the—

Expenditure was,	£2126
The receipts,	1742
	<hr/>
Leaving a deficit of,	£364

The cost of establishing the baths was £7500, exclusive of site, which previously belonged to the Corporation.

A year ago Turkish baths for ladies only were opened at Lister Terrace.

The experience of these two sets of baths has been so satisfactory that orders have been given for the erection of another set at a cost of £7000, and it is proposed if these be successful, still further to increase the facilities for bathing.

Liverpool, with a population of 552,425, has seven public baths and four public wash-houses (one wash-house, three baths and wash-houses, and three baths only). The number of bathers during the year ending 31st August 1883 was 527,941; the number of washers for the same period, 150,545, equal to the large number of 2895 washings every week in the year. The total annual

Expenditure was,	£11,814
Income,	9540
	<hr/>
Leaving a deficit of,	£2274

The smallest loss on an individual house was on the baths in Cornwallis Street—£61; the largest was on the baths and wash-houses in Burroughes Gardens—£549.

Birmingham, with a population of 400,757, has five sets of public baths (one of them an open-air swimming-bath). There are in all 209 hot and cold baths, 3 suites of Turkish baths, and swimming baths covering an area of 3017 square yards.

During the year 1883 there were—

Male bathers,	306,839
Female bathers,	18,236
Children,	60,896
	<hr/>
Total,	385,971

These baths were established at a cost of £75,000 (including cost of sites).

The working expenses, 1883,	.	.	£5438
Receipts,	.	.	5428
Deficit,	.	.	<u>£10</u>

exclusive of interest, or of provision for extinction of capital charge, both of which fall upon the rates.

Glasgow, with a population of 674,095, has four public baths and wash-houses open to the public, and a fifth is nearing completion. During the year ending 30th September 1884 they were patronised by—

Male bathers,	.	.	327,196
Female bathers,	.	.	10,184
			<u>337,380</u>

The number of washings—

Public,	.	.	30,735
Private,	.	.	11,182
			<u>41,917</u>

Equal to 806 washings every week in the year. The private washings are done for private families by the washing-house attendants.

For that year the

Expenditure was,	.	.	£7938
Revenue,	.	.	5891
Deficit,	.	.	<u>£2047</u>

The item expenditure includes interest on capital, but no deduction for depreciation nor for diminution of capital charge. No charge is made for water.

The four baths in operation cost for sites, buildings, and furnishings, £80,000. They contain 1855 square yards of swimming baths and 330 bathing-boxes, 141 hot baths and 264 washing-stalls. The baths which are nearing completion have 2 swim-

ming baths, 413 square yards in area, with 67 bathing-boxes. They have also 33 hot baths, and 54 washing-stalls.

Edinburgh, with a population of 236,002, has no public baths, and the private adventure baths at Pitt Street and elsewhere are insufficient for the community. Fortunately the facilities are soon to be extended by the opening of a complete set of baths at Drumsheugh, which will no doubt help to meet a want which has been much felt in our city.

It becomes us to discuss on its own merits the question whether there be any necessity for such institutions, and if so, under what conditions they may be expected to be useful, lest we find ourselves striving to follow a course simply because it has been taken by others.

Practically it is possible for every one to have his morning tub at home. How this may be managed, even in houses of very limited accommodation, we have already shown; but though in many even of the smaller houses of recent construction there is a fitted-in bath, much the larger portion of our population cannot obtain the luxury of a warm bath comfortably and properly except at public baths. Then we must recognise that a large portion of the juvenile members of our population cannot have household arrangements to suit their convenience even if they desire the bath. Of course, Turkish baths can only be had at public institutions; and as regards swimming-baths, the sea is too far distant, and during a great part of the year too cold for most constitutions.

If public baths are a necessity, under whose auspices should they be established? It is not desirable that municipal authorities should undertake that which can be equally well done by private enterprise. But under the most favourable conditions the smallest charge which would be remunerative to the proprietors of private adventure baths would exclude a large mass of our population too poor to enjoy the luxury of a bath at these establishments who ought to have it placed within their reach.

But to go further. If private enterprise fail to supply a want, and if it can be shown, from a sanitary point of view, that the

establishment of public baths would be beneficial, then it becomes a matter to be undertaken by the municipal authorities.

The association of poverty and dirt is so general that it will be universally admitted that they are related in some very intimate way. The association is so general as to exclude the idea of its being accidental. But it is not an inseparable connection. We have seen the houses of the poor in which everything was as clean as rubbing and scrubbing and soap could make them—in which everything about the person was equally clean. Poverty is not a necessary cause of dirty and untidy habits. A careful investigation will reveal the fact that dirty and untidy habits are a frequent cause of poverty—or, at least, that they are the common offspring of laziness and idleness. Dirty houses, dirty clothing, dirty companions, certainly lower a man both morally and physically; they lower him in his own estimation, as well as in the opinion of others (of course, I do not refer to the honest sweat and dust of work hours). Personal cleanliness and a tidy house increase a man's self-respect, companions of a like mind are calculated to stimulate to a similar course of action. The old-fashioned tub-night is a most healthful and important national institution, and along with the clean linens and better clothing worn on the Sabbath-days, does much to maintain the self-respect of our people.

There is another associate of dirt which must not be overlooked while considering the propriety of municipal baths. The associate referred to is *disease*. It is a not very uncommon consequence of want of cleanliness. Specially in large communities is it of importance that the health of all the members should be cared for in consequence of the tendency of disease to spread. Apart from this, sickness means a loss not only to the individual but, more or less, to the whole community.

Bacon says "that cleanliness of body was ever esteemed to proceed from a due reverence to God." It is as true now as ever it was that "cleanliness is indeed next to godliness." Now that we are learning more of the influence of minute organisms in the processes of decay and disease, we can better

appreciate the wisdom of the Mosaic injunctions in the Ceremonial Law relating to washing and bathing, all the more important seeing they were written for the inhabitants of a warm climate.

The opportunity to wash and be clean should be placed within the reach of all. Probably many are too old to learn, but we may adopt the plan so strongly recommended by the founder of our ragged schools, and by teaching the children the next generation will be benefited. Children are usually fond of the water, especially if they think that they ought not to go near it. Education ought to be not only a training in language or science, but also in cleanliness, self-control, and politeness. These branches can usually be better undertaken by the parents, but when parents are incapable of giving this training the schools should initiate and in any case endeavour to carry it on. If in some of the public schools in England too much time is bestowed upon the muscularity of the pupils, in Scotland too little attention is paid to that soundness of body, upon which in some measure the healthy thinking faculty depends. Our School Board seems recently to have become convinced of this, seeing that they have arranged to provide baths and a gymnasium at the Royal High School. Baths are, however, really more required in connection with schools for the poorer classes, who have fewer facilities for bathing at home. To supply this want would involve the erection of baths in connection with each Board School, for which, of course, the ratepayers would be taxed. It is deserving of careful consideration whether it would not be less costly to erect public baths, under the care of the municipal authorities, which would be available for all the public, and to which Board School children could be admitted at a very small sum. To induce them to use the baths there might be prizes for competition among the members of each school as well as inter-scholastic competitions.

In a paper read at the Social Science Congress, 1883, Dr Norman Porritt stated that at Bradford boys use the Corporation Baths at a reduced charge. In all the new schools at Liverpool

plunge baths are provided, while at Birmingham last year 31,202 bath tickets were issued to Board School children at a charge of a halfpenny each, a prize being given to all who learned to swim one length of the bath in a season, special prizes being offered for competition between the schools.

In 1884 the number of school children using the public baths at Birmingham was 60,896, nearly double that of the previous year.

It will be observed that in all the instances cited the public baths were not a financial gain to the town, at least directly, but how far they were a gain indirectly there is no means of estimating. Public parks do not pay financially, but by improving the sanitary and social condition of the people they are indirectly beneficial. So public baths are in like manner a gain, probably not less in quantity.

I have no doubt but that our municipal authorities are quite ready to enter heartily into this matter so soon as the ratepayers indicate their desire to pay the small extra sum which would be required for the purpose. Were it possible to have baths adjoining some manufactory in which steam power is employed, the waste hot water and steam might be had without cost, perhaps in sufficient quantity to supply all the heat which would be required.

THE HAIR.

By D. J. CUNNINGHAM, M.D., F.R.C.S.I.,

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I HAVE chosen "the hair" as the subject of my lecture to-night. It is true that the hair is in a great measure merely an appendage of the body, and one the condition of which does not affect us to such a degree as many of the organs which have been described to you in previous lectures, yet at all times and in all countries man has instinctively attached the highest importance to his crinal decoration. When I tell you that to make up for the ravages that time effects upon the head, more than a hundred tons of human hair are imported every year into Paris alone, and that white elderly hair of good quality sells for one guinea an ounce, you will understand the value set upon nature's covering. You will also understand the anxiety which we all feel to retain that which nature has provided for us free of cost. But this is a minor point. A wholesome condition of the hair is absolutely essential to our comfort and health. It behoves us, therefore, to give some attention to its structure and mode of growth, in order that we may thereby place ourselves in a position to care for it in a right manner.

Distribution of the hair upon the body.—With the exception of the palms of the hands and the soles of the feet the skin is almost everywhere studded over with hairs. In few localities, however, does the hair attain any degree of thickness and length. These regions are the scalp, the eyebrows, the margins of the

eyelids, and in man the cheeks, chin, and upper lip. Elsewhere the hairs, as a rule, are fine, short, and scanty, and in the female they are usually so extremely delicate that the skin appears perfectly naked.

Arrangement of the hair.—A very superficial examination is sufficient to show that the hairs do not proceed perpendicularly from the surface. They emerge from the integument in an oblique or slanting direction. It would occupy too much time were I to attempt to describe to you the manner in which the hairs are arranged over the entire surface of the body. I shall therefore merely allude to the hair of the head, face, and limbs. Look at the scalp of a boy, or, still better, of a newly born infant, and you will notice that the hair is disposed in vortices or whorls which have their centre on the crown. The hair-whorls sweep round this centre from right to left. A nurse is well acquainted with this arrangement. If you watch the manner in which she soaps and washes the head of a child you will observe that she carries her hand in the direction of the hair-whorls, and therefore describes with the sponge a series of circles around the centre on the crown.

The hairs of the eyebrows describe a fine arch above the orbits, and have a general direction from the root of the nose outwards. The more gentle the curve which is thus formed, the more pleasing is the expression given to the face, and frequently art is called in to help in giving a result which nature has denied—not always, however, with the best effect, because the arch corresponds with the arch described by the margin of the orbit, and, if the artist neglect this, the result may not be altogether happy. The individual hairs of the eyebrows are short and stiff, and terminate in a fine point. Further, the upper hairs incline downwards, whilst the lower hairs incline upwards. They thus oppose one another like sheaves of corn set up against each other in a harvest field.

It is sometimes stated that the possession of eyebrows constitutes a point of difference between man and the apes. This is hardly correct. In the chimpanzee there are certain hairs which

spring from the naked skin above the orbits, which undoubtedly represent the eyebrows of man ; and even in the hairy face of the baboon there are long hairs which rise beyond the others in this region.

The eyelashes are arranged in rows along the margins of the eyelids. In the upper lid the hairs are longer than in the lower lid, and in some cases they may be seen to constitute as many as four distinct rows.

The moustache is formed by a stream of hair which passes outwards on each side upon the upper lip. Corresponding currents of hair pass out from the middle line of the lower lip, and these meet the downwardly directed hairs of the cheek and chin to form the whiskers and beard.

The disposition of the short hairs on the limbs presents some curious and interesting points. In the upper limb the general direction of the hair is towards the point of the elbow : in other words, it inclines downwards upon the upper arm, and upwards on the forearm. In the lower limb the arrangement is just the reverse, as it is directed away from the knee-joint, viz., upwards on the thigh and downwards on the leg. This corresponds in every respect with the disposition of the hair on the limbs of the orang, chimpanzee, gorilla, and a number of other apes. How is this curious arrangement to be explained? Certain naturalists hold that the hair is thus enabled to act as a watershed. In the midst of the pelting rain, the gorilla is seen to sit in a crouching attitude with his legs drawn in, his knees up, and his hands clasped over his head. So posed, the water runs easily off his limbs from the everywhere downward inclination of the hair. Are we to conclude from this that man's remote ancestors have sat in a similar attitude, and under similar circumstances? Some say that they have.

Size and number of hairs on the head.—The number of hairs which are implanted upon the head is in a great measure determined by the diameter of the individual hairs. The greater the diameter of the hair shafts, the smaller will be the number of these springing from a given area. Now the diameter of a

hair shaft varies very greatly, and the factors which determine this variation are sex, age, colour, and, above all, race. But before going into this point, let it first be clearly understood that uniformity of diameter never occurs in the same head of hair. Thus in the same individual the thickest hairs on the head may sometimes be found to be at least six times the diameter of the finest. They vary as much as the trees in a forest do in girth of trunk.

It is a curious point that the range of diversity of size in the same individual appears to be more marked in our own civilized heads than in certain less civilized races, such as the New Zealanders and South American Indians. This alone might be considered as indicating that we belong to a more mixed race?

But what is the average thickness of a human hair taken from the head? It has been calculated by Sir Erasmus Wilson to be about $\frac{1}{400}$ th of an inch, or as he puts it, if 400 such hairs were laid side by side, they would cover an area of one inch in length. But as I have said, the diameter of the hair is affected by many circumstances. We are in the habit of regarding man as being altogether a coarser animal than woman. This is not the case, however, in every particular, because female hair is, as a rule, not so fine as that of man, and this in spite of the frequent cutting to which the male hair is subjected. As might naturally be expected, the hair of the child is more delicate than that of a grown person.

The effect of the colouration of the hair in determining its diameter corresponds very much with the popular belief on the subject. Flaxen and chestnut hair is the finest; light-brown, and especially black hair, is the coarsest; whilst red and dark-brown hair hold an intermediate position.

The beard and whiskers show the coarsest hairs on the body, the average diameter being $\frac{1}{200}$ th of an inch; next in point of thickness comes the hair of the eyebrows, with a diameter of $\frac{1}{250}$ th of an inch, and then the eyelashes, with a diameter of $\frac{1}{300}$ th of an inch.

Several observers have undertaken the tedious task of counting

the number of hairs growing from the scalp. According to Sir Erasmus Wilson the average number is 120,000. But this is greatly influenced by the colour of the hair. Thus another observer has shown that a square inch of scalp will hold 728 flaxen hairs, 678 chestnut hairs, and only 588 black hairs.*

It follows from this that our blonde beauties have a distinct advantage over our brunettes in so far as the number and fineness of their hairs is concerned. In fact, a lady with a good endowment of flaxen locks, combs out and disentangles each morning she performs her toilet somewhere between 70 and 90 miles of hair. This is a doubtful advantage, however, and one which I am sure she would gladly dispense with, when I tell her, that there is reason to believe that she is at a slight discount in the matrimonial market. Statistics would seem to show that brunettes are more successful in obtaining husbands in the proportion of about three to two.† Poets have a proverbial preference for fair hair; no poem is complete without a flaxen-haired maid, but prosaic mortals in search of a wife seem, upon the whole, to prefer the brown and the black. According to Dr Beddoe, the result of this "conjugal selection" appears to be that in some parts of England fair hair is slowly disappearing, whilst dark hair is becoming more prevalent.

* The results obtained by counting the hairs over the entire extent of scalp in four heads of different colours are very similar to the above, viz.—

Red,	.	.	.	88,740
Black,	.	.	.	102,960
Brown,	.	.	.	109,440
Blonde,	.	.	.	140,409

† Table copied from Dr Beddoe's article "On the supposed prevalence of dark hair in England."—(*Anthrop. Rev.*, vol. i.)

Social Condition.	Colour of Hair.				
	Red.	Fair.	Brown.	Dark-Brown.	Black.
Married, .	67	55·5	60·5	69·5	79
Single, .	30	37	30·5	22	18
Doubtful, .	3	7·5	9	8·5	3
Totals, .	100	100	100	100	100

Purposes fulfilled by the hair.—A very important question now comes to be discussed—Is the hair on our bodies subservient to any useful purpose, or has it been retained simply as an ornament? With regard to the eyebrows and eyelashes there is little difficulty in coming to a decision on this point. Socrates was fully cognisant of the use of these when he said, “Think you not that it looks like the work of prescience, because the sight is delicate, to have guarded it with eyelids to have fenced these lids with eyelashes which, like a sieve, strain the dusty wind and hinder it from hurting the eyes; and over the eyes to have placed eyebrows, as eaves, to carry off the sweat of the brow from disturbing the sight.”

The hair of the head has also its function. Hair is a bad conductor of heat. It therefore tends to equalise the temperature of the head, and in this way acts as a protective covering to the subjacent brain, sheltering it on the one hand from cold, and on the other hand from the heat of the sun’s rays. Nowhere will you see hair of more luxuriant growth than upon the heads of the blue-coat boys who trust to nature alone for a head-covering. Moreover, the hair of the head is said to be sensibly thicker in some arctic races.* Still we cannot doubt that it is there also for ornament as well as use, and that conjugal selection has had much to do in determining its richness of supply.

The moustache and beard guard the air-passages in the same manner that the eyelashes guard the eyeball. They stand as sentinels at the orifices of the nose and mouth, and challenge the entrance of foreign matter. The moustache especially is of immense service to millers, bakers, masons, and all workmen engaged in dusty trades. Further, the beard acts as an admirable protective covering to the throat. Instances of the benefit resulting from the growth of the beard in individuals with throats sensitive to cold are so well known that I need hardly allude to them.

But why is woman denied these advantages? Some think that she also at a very remote period enjoyed the same benefits, but that she lost them through doubts arising in the mind of

* “The Human Species,” by Quatrefages.

man as to whether a beard and moustache were ornamental appendages in his mate, or perhaps from some unworthy jealousy and a desire to monopolise these badges of lordship for himself. According to Suidas, who lived in the tenth century, the Athenian ladies became very sensitive to their inferiority to man in this respect, and tried hard to cultivate hair on the cheek and chin. In many cases they went so far as to wear false beards.

Every now and again a woman appears with a well-grown beard. There are numerous well authenticated cases of this kind. Allow me to show you the portrait of Julia Pastrana, a well-known Spanish dancer — more distinguished perhaps for the luxuriance of her beard than the excellence of her dancing. Again in London, in 1858, a young woman of twenty had considerable difficulty in persuading a clergyman to perform the marriage ceremony in consequence of her possessing a bushy beard four inches long.

In women who have attained a certain age it is a matter of every day experience to see a tendency to hair growth on the face. This is a circumstance of considerable interest, because we occasionally see changes analogous to this in the lower animals. In the Museum of the University of this city there is a hen-pheasant which has in a measure assumed the plumage of the male bird.*

But a beard is by no means universal amongst men. Thus the Siamese, Malays, Chinese, and Japanese are beardless, and so also are the native Americans. As a rule these races express strong objections to beards. The Japanese ladies consider them "very ugly," and the North American Indians consider them "very vulgar." Upon this principle the latter carefully eradicate with pincers every straggling hair which may from time to time appear on the face. The Indians of Paraguay carry this practice so far that they in addition pluck out both eyebrows and eyelashes. As a reason for doing this they state that they do not wish to look "like horses." Several amusing stories are told of the effect produced by bearded strangers appearing amongst natives entertaining these views. Thus, some officers once landed

* Article by Prof. Turner in Proc. Roy. Phys. Soc., April 1879.

on the Marquesas Islands, and entered into friendly conversation with the people. Suddenly one of their number was violently seized by the chief, and his friends expected every moment to see him murdered. Nothing, however, was further from the mind of the chief. A hair on the face of the officer had offended his ideas of good taste, and he simply wished to perform the friendly act of plucking it out with his shell tweezers.

Let us in the next place consider whether the short hairs scattered over the body fulfil any useful function, and if not, how we can account for their presence. They are so few and short, as a rule, that we cannot regard them as affording the skin an effective covering. Nor can we believe, as some do, that they protect the surface of the body from the effects of friction. Just look at any part of the skin which is especially subjected to friction, as, for instance, the skin of the wrists over which the stiff margins of the cuffs play, and you will observe that instead of the hairs being especially developed they are, in a great measure, rubbed off. Then if they counteract the effects of friction, where should we find them better marked than on the soles of the feet and the palms of the hands, whereas the skin of these regions is characterized not only by the total absence of hair, but also of the power of producing hair. In short, we are driven to the conclusion that the short hairs are rudimentary structures, or, in other words, vestiges of a hairy covering which at one time did fulfil a protective and sheltering function. In this respect they are quite analogous to the rudimentary teeth which appear in the young whale-bone whale. These teeth never cut the gum, and are perfectly useless. The analogy is rendered still more striking by the fact that on certain parts of the body it is no uncommon thing for hair to be formed in the skin which never reaches the surface except to be shed. The skin of the nose is, to all intents and purposes, quite bald, yet minute hairs are being constantly formed in its midst. To prove this you have simply to squeeze out the contents of one of the sebaceous follicles there, and amidst the fat which exudes the microscope will reveal a number of short delicate hairs.

The amount of short hair scattered over our bodies is very variable. In the male it is always more plentiful than in the female, and certain races, such as the Ainos, the Australians, the Todas of the Nilgherries, are distinguished for their hairiness, whilst others, such as the African Negroes and the Mongolians, show scarcely a trace of hair on their body. Amongst the Ainos, indeed, the hair over the shoulders and on the back and limbs is sometimes so thick and long as to deserve the name of fur.

I have referred to curious cases where the beard is developed in women. We meet with equally interesting instances of excessive hair-growth over the entire surface or part of the body. Two years ago Farini exhibited a little girl of seven years old called Krao, whose body was covered with a thick coating of hair. He called her the "human monkey," and claimed that she was the long sought for "missing link." Need I say how ridiculous these assertions were. Krao was merely a human child in whom the short hairs of the body were excessively developed. I shall now show you her photograph projected upon the screen. I may mention another case which occurred in London in 1865, in a girl of twelve years old. From the illustration which I show you you will observe that the excessive hair-growth is limited in this case to the upper part of the body.

General hairiness of the body appears to be a character which is readily transmitted. Krao's father was said to be hairy, and at the Court of Ava there is a family in which this peculiarity has appeared in three generations. This curious case is placed altogether beyond the range of doubt. We have the independent evidence of two thoroughly reliable authorities who saw and figured the three members of this remarkable family at different times, viz., in 1829, when the family consisted of father and daughter; and in 1855, after the daughter had been married and had borne several children, of which one exhibited the peculiarity.*

* John Crawford's "Journal of an Embassy from the Governor-General of India to the Court of Ava." Captain H. Yule's "Narrative of the Mission sent by the Governor-General of India to the Court of Ava."

Structure of the hair.—Up to the present I have said nothing of one of the most important points which we have to consider in this lecture, viz., the structure of the hair and the manner in which it is implanted in the skin.

We generally describe a hair as consisting of a root, a shaft or stem, and a point. The *root* is the short soft and slightly expanded portion which is withdrawn from the skin when a hair is plucked from the body; the *shaft* is the part which projects beyond the surface of the integument; and the *point* is its attenuated free extremity.

The root of the hair is contained within a minute tubular recess in the skin, which is termed the *hair-follicle*. This is the chamber in which the hair is manufactured; it is here also that additions are made to its root, so that it increases in length. In short, the hair-follicle is a little laboratory in which the entire process of hair-production and hair-growth is carried on. It is very essential, therefore, that we should know something of its structure.

The skin, as you are doubtless aware, consists of two layers of totally different constitution, viz., an outer *scarf-skin* or *epidermis*, and an inner *true-skin* or *corium*. The scarf-skin consists of an enormous number of minute microscopic bodies called cells heaped together and joined the one to the other by cement substance. It is essentially the protective layer, and with this end in view, the superficial cells become flat and horny. The hair and nails are appendages or outgrowths of this scarf-skin or epidermis, and amongst the lower animals the claws, hoofs, spines, feathers, scales and so on, all belong to the same category, all are modifications of the epidermal layer.

The *true-skin* or *corium* is not cellular but fibrous in its construction. It is composed of fine fibres running in all directions, and woven together so as to form a tough pliant stratum. The web thus formed is exceedingly dense and close near the surface, but the deeper we go the more open and lax does it become, until it passes insensibly into the subcutaneous fatty tissue—a fatty layer which constitutes the cushion upon which

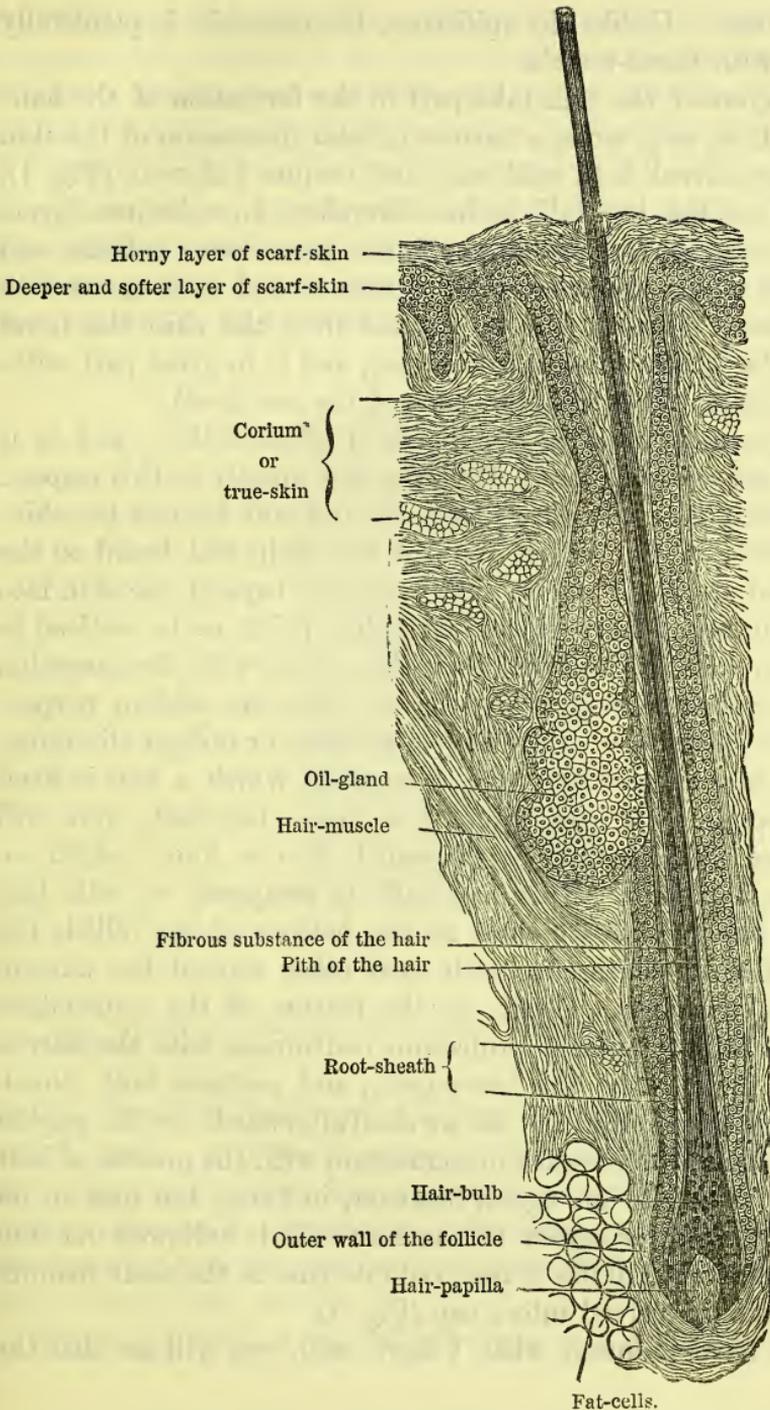


Fig. 1. Hair-follicle with a hair-root contained within it. (From Gegenbaur's Anatomy after Biesiadecki.)

the skin rests. Unlike the epidermis, the true-skin is plentifully supplied with blood-vessels.

Both layers of the skin take part in the formation of the hair-follicle. It is, as it were, a narrow tubular depression of the skin which has carried both epidermis and corium before it (Fig. 1). The wall of the hair-follicle has therefore two distinct layers entering into its formation—the inner layer being cellular and epidermic, whilst the outer layer is fibrous and continuous with the corium. When a hair is plucked from the skin the inner layer of the follicle adheres to the root, and is in great part withdrawn with it. It is therefore termed the *root-sheath*.

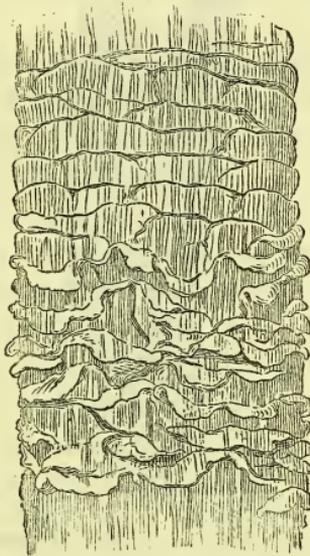
But you ask, what is the depth of a hair-follicle, and is it equally deep in every case? It varies very greatly in this respect. Those which hold the short hairs do not sink beyond the skin. The follicles of the larger hairs of the scalp and beard on the other hand are much longer, and penetrate beyond the skin into the subcutaneous fatty tissue. Another point to be noticed in connection with the hair follicle is this: that, with the exception of those which contain the eyelashes, they are seldom perpendicular to the surface. They have a slanting or oblique direction.

Let us now enquire into the manner in which a hair is fixed in its follicle. If you examine a fresh hair-root, you will notice that its extremity is expanded into a knob which we term the hair-bulb. This hair-bulb is composed of cells like those of the root-sheath, and at the bottom of the follicle the two are directly continuous with each other around the circumference of the bulb. Again, at the bottom of the hair-follicle there is a little fungiform projection continuous with the fibrous corium. It is called the *hair-papilla*, and contains both blood-vessels and nerves (Fig. 1). As we shall afterwards see this papilla is of the utmost importance in connection with the process of hair growth. It is also an agent, however, in fixing the hair in its follicle. The lower aspect of the hair-bulb is hollowed out into a cavity, and the papilla is received into this in the same manner that a head is received into a cap (Fig. 1).

If you have followed what I have said, you will see that the

hair-root is attached to its follicle, (1) by a continuity at the bottom of the follicle of the cells composing the root-sheath and of those forming the hair-bulb, and (2) by the hair-bulb being moulded over the papilla in the same manner that the socket of a ball and socket joint is moulded over the ball. There is yet a third connection, but to understand this we must in the first place study the structure of the hair stem.

When a twig from a young sapling is cut across, we notice that the woody part which forms its chief bulb is coated on the



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Fig. 2. A portion of a hair-shaft to show the external scaly covering. (From Henle's "Anatomie des Menschen.")

outside by a thin bark, and that running along its centre is the cellular pith. A hair has parts exactly analogous. The bark of the twig is represented by a thin external scaly layer termed the *cuticle*; the woody portion has its analogue in the *fibrous substance* of the hair; and the pith has its representative in a cellular core which we call the *medulla*.

The *hair-cuticle* is exceedingly thin. It consists of a single

layer of minute flat scales arranged upon the surface of the hair like the scales on the skin of a fish or a serpent. They are not disposed so regularly however, and they overlap each other like the tiles on the roof of a house, with this exception, that the overlapping takes place in an upward direction from the root to the point of the hair (Fig. 2). The free uncovered margins of the scales, therefore, look upwards, and when a hair is examined by a microscope, they show in the form of wavy lines, and at the



Fig. 3. Hair-root drawn away from the follicle. It shows how the upwardly directed scales on the surface of the hair-root are adapted to the downwardly directed scales which line the hair-follicle. (From Henle's "Anatomie des Menschen.")

1. Fibrous substance of the hair.
2. Scaly covering of the hair.
3. Scales lining the hair-follicle.
- 4 and 5. Wall of the hair-follicle.

same time give the outline of the hair a slightly toothed or serrated appearance.

This arrangement of the cuticular scales gives to hair a property of the very highest commercial importance. I refer to *felting*. Human hair is ill adapted for this purpose, because the scales lie too closely to the body of the hair; but wool, in which the scales stand well out, is peculiarly well suited for felting, in so

far that they allow the hairs to firmly interlock the one with the other.

And now that we know the character of the hair-cuticle, we are in a position to understand the third mode of attachment of the hair-root to the hair-follicle—a connection to which I have already incidentally alluded. The hair-follicle is lined by delicate imbricated scales, but these are directed downwards, and are accurately moulded upon the upwardly directed scales which coat the hair-root (Fig. 3). No wonder, then, that when a healthy hair is plucked from its follicle it carries with it the greater part of the root-sheath.

The *fibrous substance* of the hair constitutes its chief bulk. It consists of flattened fibres applied to each other in the longitudinal direction, and firmly cemented together. These fibres, however, are not the ultimate elements of the fibrous substance. Each fibre can be broken up into minute, flattened, elongated plates or cells; these are glued together by a firm cement.

The fibrous substance is the seat of the strength, elasticity, and in great part of the colour of the hair. But how is this colour produced? It depends upon two factors, viz. :—(1) the presence of pigment, and (2) the presence of air.

The pigment or colouring matter is somewhat irregularly distributed. It is placed partly within the cells which build up the fibres, and partly in the cement substance which binds the cells together. The air is contained in minute chinks or crannies in the fibrous substance. These are very numerous in white hairs, but are almost entirely absent in black hairs.

The *central pith* is not present in every hair, nor indeed is it to be found throughout the entire length of those hairs in which it exists. Thus it is absent in the fine short hairs which are scattered generally over the body, and also in a large proportion of the hairs of the scalp. It constitutes a central core, which extends from the hair-bulb to within a short distance of the point. A small portion, therefore, of the terminal part of the hair is composed merely of fibrous substance, coated with the scaly cuticle. The pith forms a very inconsiderable part of the shaft of a human

hair, rarely contributing more than one quarter of its entire diameter. In structure it consists of two or three longitudinal rows of rectangular cells which appear like so many strings of beads placed side by side. These cells contain a certain amount of air.

Such, then, is the structure of a human hair, chiefly fibrous, coated by a thin layer of irregularly overlapping scales, and in some cases traversed by a central pith. I should have liked very much to have compared it with that of the hair of the lower animals, but time will not permit of this, as we have still a great number of other topics to discuss more nearly connected with my subject. Allow me to say, however, that the structure of human hair is such that it can almost always be distinguished from hair drawn from other sources, and this is a point of more than mere passing interest.* In many cases it has been the means

* Medical jurists, as a rule, hold that human hair can in all cases be distinguished by its structure. Having some misgivings upon this point, I determined to test it by comparing human hair with that of the anthropoid apes, and my friend, Prof. Haddon, of the Royal College of Science in Dublin, very kindly supplied me for this purpose with a few hairs plucked from the back of the orang, chimpanzee, and gorilla.

The hair of the orang is very much coarser than the head-hair of man, and the pith is present in much greater quantity. When compared, however, with the hair of the human beard, a very close resemblance is manifest. Its diameter may be slightly greater than the majority of human beard hairs, but the proportion between the pith and the fibrous substance is almost identical. In both it forms one-third of the diameter of the shaft.

The hairs of the gorilla and chimpanzee are very similar, and they have a diameter which is perhaps slightly greater than that of the average human head-hair. The pith is better marked, and the proportion between it and the fibrous substance of the hair is more uniform. I was very much struck with the resemblance presented by a hair taken from the head of a Peruvian mummy, which is in the museum of the University of Dublin, and the hair of the chimpanzee. I have made drawings of these varieties of hair, and as they are all represented upon the same scale the reader will easily estimate the points of difference and resemblance. I may mention that the beard-hair and the portion of the hair of the gorilla which is

of detecting criminals, or removing suspicion from innocent people, as, for instance, where hair has been found clinging to clothes or instruments which have been used for murderous purposes. Not long ago, portions of a dry parchment-like substance were found nailed to the doors of certain very old churches. On these being removed, minute hairs were observed springing from the surface, which on examination proved to be of human origin. The parchment was thus proved to be human figured were white. In Waldeyer's atlas of the hair, a hair of the chimpanzee is figured alongside a black and a white human head-hair, and in diameter it is the smallest of the three. His figure of the white human

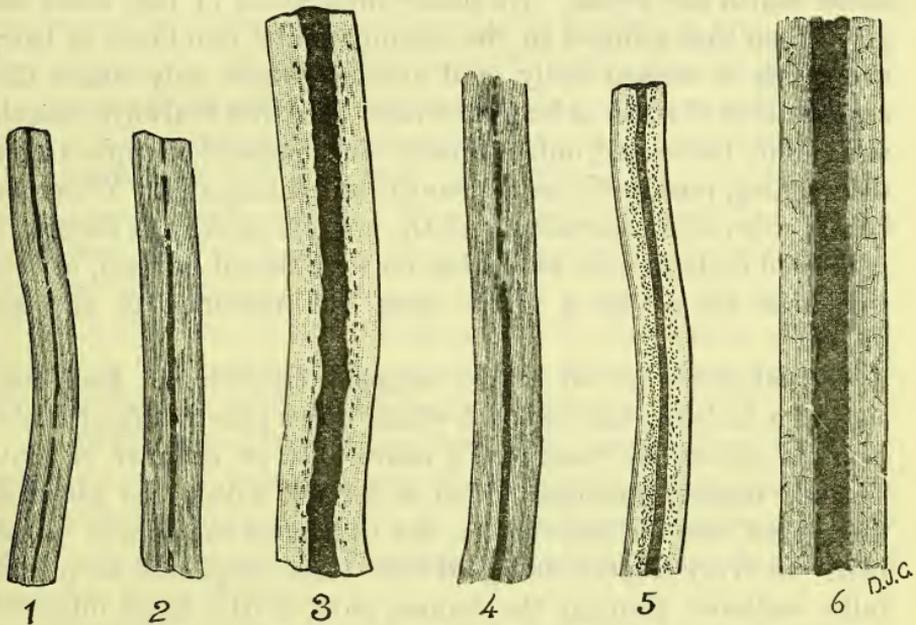


Fig. 4. 1. Human head-hair. 2. Head-hair of a Peruvian Mummy. 3. Human beard-hair. 4. Hair from the back of the Chimpanzee. 5. Hair from the back of the Gorilla. 6. Hair from the back of the Orang-Utan.

head-hair is almost identical with the drawing which I have given of the hair taken from the back of the gorilla.

I have come to the conclusion, therefore, that it would be extremely difficult to distinguish human hair from the hair of the anthropoid apes. Indeed, I believe that in many cases it would be impossible.

skin, and represented the hides of some unfortunate individuals who had been flayed for sacrilege.*

Oil-glands and hair-muscles.—In connection with each hair which springs from our bodies, there is a very remarkable contrivance by means of which it is kept smooth, glossy, and pliant. It is furnished with two or more oil-glands which secrete a greasy fluid. Nature therefore supplies her own pomade, and when the scalp is healthy no other is required. In fact, I may say that artificial oiling in such cases is injurious, because when nature finds her work performed by other means, she is apt to become sluggish. The need of the hair in this respect is the stimulus under which she works. No better illustration of this could be given than that afforded by the examination of two heads of hair, one which is washed daily, and another which only makes the acquaintance of water at long intervals. The first is always smooth and glossy; the second, unless some artificial pomade be applied after the washing, remains for some time dry and intractable. When the hair is worn short therefore, and the scalp is healthy, it should be immersed daily in cold water, but no soap should be used, as this would be too severe a strain upon the resources of the oil-glands.

The oil-glands are of a very simple construction. Each consists of a little sacculated pouch which opens into the hair-follicle, near its orifice, by means of a short duct or channel of exit. The oily matter, therefore, which is formed within the gland is discharged into the hair-follicle, and thus upon the surface of the hair. In every respect analogous with these oil-glands, so plentifully scattered through the human skin, is the large oil-gland which is situated in the bird at the base of the tail. You have all seen a bird pruning its plumage—carrying its beak backwards and forwards from this gland and lubricating its feathers with the secretion.

The glands in the eyelids are very large, and the secretion

* Several years ago the late Dean Stanley informed my father (the Rev. Dr Cunningham of Crieff) that a door in Westminster Abbey had a similar covering.

which they emit greases the margins of the lids and prevents the tears, unless copious, from trickling over the face.* In the ear passage the secretion is commonly called the "wax." It is yellowish in colour and intensely bitter, so that with the hairs in this locality we have a formidable barrier interposed against the intrusion of insects.

Hairs are likewise provided with muscles. These consist of slender bands of contractile tissue which cross the obtuse angle which is formed by the hair-follicle and the surface of the skin. On the one hand this little muscle is attached to the superficial part of the true skin, and on the other to the lower end of the hair-follicle (Fig.1). In passing between these points it partially embraces the oil-gland. And now let us see how it acts. In the first place it is not under the control of the will, but cold and certain emotions, such as horror and fear, at once call it into play. In such cases the hair muscles contract. They straighten the hair-follicles and erect the hairs. The well-known condition of goose-skin is the result. When a thrilling ghost story is told "the flesh creeps," or when a sudden ghastly apparition presents itself our hair shows a tendency to stand on end. All this is due to the contraction of the hair-muscles. In illustration of this I cannot do better than show you the admirable representation, by Sir Charles Bell, of a countenance expressive of fear.

In addition to their action upon the hair-follicles, the hair-muscles exert an influence upon the oil-glands. As we have seen, they partially embrace these. Consequently when they contract, they subject the glands to pressure, and help the flow of the secretion into the follicle.

Hair-growth.—I have spoken of the hair-follicle as the laboratory in which the manufacture and continued growth of the hair is effected. The building material is close at hand. At the bottom of the follicle is the little papilla upon which the bulb of the hair rests, and this papilla, as we have seen, is permeated by minute blood-vessels. In the same manner that our rivers and

* In addition to these large glands the eyelashes have special glands of their own in connection with their follicles.

canals carry bricks, mortar, and wood for the construction of our houses, so these blood-vessels convey to the hair-bulb the material necessary for hair-growth. Additions are therefore being continually made to the base of the hair through the greater part of its life, and as it rises up in the follicle, its upwardly directed scaly covering sweeps before it the scales which line the follicle. The scales which are thus carried to the surface constitute a part of the scurf of the head.

In its first formation the young hair usually passes upwards through the follicle with its point bent upon itself like a loop. This gradually forces itself through the orifice of the hair-follicle, and then the hair straightens itself by means of its own elasticity. Sometimes, however, the mouth of the follicle is closed by a plug of hardened greasy matter from the oil-gland, or, it may be, by a collection of scales from the scarf-skin. In such a case the growing hair may be unable to force a passage, and as it continues to elongate, it coils itself up like a watch spring inside the follicle. In time it produces an itchiness which calls our attention to the predicament in which it is placed, and we proceed to liberate it.

But when we are discussing the phenomena of hair-growth, you may very naturally ask, At what rate does hair grow and what length does it attain? The first part of this question is very difficult to answer, because so many circumstances influence hair-growth. In young people it grows much more rapidly than in people of advanced age, and in the same manner the earlier part of a hair's life is more active than the latter part. The time of the day and the season of the year are also considered by some to have an effect on hair-growth. Thus it is said to grow faster during the day than at night, and during the summer than in winter.

The average growth of the beard has been computed to be $6\frac{1}{2}$ inches each year. A man of eighty years of age, therefore, who has shaved regularly all his life may be said to have sacrificed to the razor about 35 feet of hair.

In the case of the head-hair the greatest discrepancies exist in

the results obtained by different observers. I shall, therefore, limit myself to the statement that in young females who have lost their hair by fevers, it has been observed to grow at the rate of 7 inches each year.

When the growth is good the average length of hair on the female head will be found to vary from 22 inches to 28 inches. Anything beyond this must be regarded as exceptional. Cases, it is true, are recorded in which it has measured from 5 to 6 feet, but these are very rare. When compared, however, with the hair-growth of the North American Indians, even this falls very far short. A chief of the Crows is mentioned by Catlin as possessing hair of the almost incredible length of 10 feet 7 inches. It is only on occasions of ceremony that an American Indian allows his hair to hang exposed. As a rule it is carefully rolled round with a leathern strap, and when thus done up it weighs several pounds.

In our own country custom does not permit man to vie with woman in the growth of the hair of the head. If the contest did arise I fear that man would be left very far behind. Some of you might wickedly insinuate that in the race unfair advantage might be taken by the fair sex: for not to refer to their Delilah propensities, their power of appropriating what does not belong to them in the way of head gear might be called into play. But to be honest, we must admit that the male scalp does not possess such rich gifts as a hair-producing organ as the female scalp. And for what reason? I would tire you were I to go into the various causes ascribed. Most of them are unsatisfactory. Let me give you one or two examples:—(1) that it is due to so much hair-making material being abstracted from the blood in man for the manufacture of the beard;* (2) that it is due to the mental labours of man being of a more severe kind; (3) that hair finds in the female scalp a more congenial soil for its development and growth, owing to a supposed greater amount of fatty tissue under the integument of the head.

* When we remember the beardless American Indian and his enormous power of hair-growth on the head there really does appear to be some grounds for this belief.

To my mind the most reasonable explanation is that of conjugal selection. Bald women have an undoubted difficulty in procuring husbands, and therefore their defect is less frequently transmitted than in the case of bald men, to whom the ladies do not seem to object, and who by a curious coincidence rarely transmit a deficiency in hair-growth to their daughters.

I have told you of cases in which the hair of the head grows to an exceptional length. The beard also occasionally takes on an unwonted activity. The most of my audience have no doubt heard of the sad fate of the worthy burgo-meister of a small town in Holland, who whilst hastily ascending the stairs leading to the Council Chamber, tripped upon his beard and was killed by the fall. I show you also the photograph of an American farmer, whose beard measured over 6 feet.

Life history of a hair.—We must now trace the biography or life history of a hair. The duration of hair life is limited, and sooner or later it is shed. Indeed it is stated that the hairs of an infant are completely shed within a year after birth; those on the body and limbs go first, whilst the hairs of the head and the eyelashes follow. This change may be carried on almost unperceptibly, as the place of the falling hairs is taken by a second crop. The process of loss and renewal is very simple. The old hair is detached from the papilla, and soon another hair makes its appearance at the bottom of the same follicle, and grows towards its orifice. The detached hair is thus gradually thrust out and shed. It is not at all uncommon to see the two hairs—the young and the old—projecting from the mouth of the same follicle. The whole process then is somewhat similar to the replacement of the milk teeth in the child by the permanent teeth.

The second crop of hair which appears is perennial. Each hair has been calculated to remain attached from two to six years. Before it dies, provision is made for its successor, and so this process of shedding and renewal goes on continually.

During its life a hair is only capable of growing a certain determinate length. The circumstance which determines this length is the amount of nutritive material which can be drawn

from the blood-vessels of the papilla. This being the case you will readily understand why a hair which has reached its full length on being cut will again resume its growth until, for a second time, it attains its typical length.

There is thus a continual and normal loss of hair constantly taking place, and it is only when the loss exceeds the powers of renewal that a tendency to baldness results. In the case of the female head, the daily loss may contain a quarter of the hairs shed of a length under six inches without giving rise to any apprehensions; should the number of fallen short hairs exceed this proportion the hair-loss is then abnormal—hairs are being shed which have not attained their full length, and the renewal will not keep pace with the loss.

As I have already hinted, baldness is much more common in men than in women, and I have also alluded to the curious coincidence that a bald-headed father does not as a rule transmit his defect to his daughters. So common indeed is baldness in the male sex, that it is rare to see a man over fifty with a good head of hair, and how frequently do we see comparatively young men with a shining pate. From the earliest times we have records of bald people. We are told in the Bible that forty-two little children were torn to pieces by two bears for mocking the bald head of the prophet Elisha, which seems to indicate that baldness was then rare and a subject of ridicule. Further, there is a tradition to the effect that the great dramatist, Æschyllus, met his fate by an eagle mistaking his smooth crown for a stone, and letting drop a turtle upon it in order to break the shell, but the shell proved harder than the tragedian's skull.

I have stated that I believe the greater luxuriance of hair on the female head to be largely due to the influence of conjugal selection. The converse of this, viz., that the tendency to baldness in man is due to the same cause, could not be entertained for a moment. No one would go so far as to assert that a smooth head is ornamental or a feature which would aid man in his matrimonial projects.

It is indeed difficult to account for this greater predisposition in

man to premature loss of hair. It is in a high degree hereditary. In a few cases it may be due to early dissipation, and in some other instances it may be due to an imprudent life led by some ancestor. Far be it from me even to hint that this is the usual cause. No doubt mental worry and strain have a powerful effect in producing it; and the absurd form of hat which fashion has for so long a time condemned us to wear, must also be highly detrimental to hair-growth. Both silk and felt hats, by their stiff, hard margins, exercise a constricting influence around the head and compress both the blood-vessels and nerves of the scalp. In addition to this, they are seldom provided with proper means for ventilation, and therefore prevent that free evaporation from the scalp which is so essential for the health of the hair and its follicle.

It is the custom of several races to produce artificial baldness by shaving the head. The Chinaman is perhaps the best example of this. He shaves the hair from the forehead and temples, and leaves only a circular patch which he allows to grow into a tail. The Andaman Islanders shave almost the entire surface of the scalp, as thoroughly as the imperfect implements at their command will allow them. Formerly they used chips of broken flint for this purpose, but since the arrival of Europeans upon their islands they can indulge in the luxury of a shave with a piece of broken bottle-glass. Such being the character of the razor you will not be surprised to hear that a wife takes a peculiar pleasure in shaving the head of her husband.* In our own country a shaven crown was formerly the badge of priesthood. "Towards the close of the fifth century it began to be regarded, both in the east and the west, as a necessary mark of the sacerdotal caste; and now the barber's razor was required to co-operate with the bishop's hand to constitute the priest. Two modes of shaving the clerical crown—the circular and the semi-circular—came into use; but who were the inventors of them? History, with blameworthy carelessness, has neglected to record. The Roman clergy gave

* Letter from Lieut. Casey, R.N., at present stationed at Port Blair, Andaman Islands.

a preference to the circular shave, which was and is performed by making bald a small round spot on the very crown of the head, and leaving it encircled by hair. The Scottish monks, on the other hand, adopted the semi-circular mode, and shaved the forepart of their head from ear to ear, in the form of a crescent." *

Greyness of the hair.—When speaking of baldness, we may as well refer to the change of colour which the hair undergoes as age advances. This is a natural and physiological process; but it may be greatly hastened by trouble and severe study. In many cases, the premature blanching of the hair is hereditary, and not to be accounted for by any cause for which the individual himself is responsible. It is an old belief that those who turn grey early, die early. Allow me to contradict this assertion most emphatically. There is no foundation for it whatever.

Under ordinary circumstances the change takes place gradually. It commences, as a rule, on the temples, and travels towards the crown. Ultimately it involves the whole head. Particoloured hairs may be frequently found: of these it is usually the basal portion which is white while the terminal part retains its colour. This is an interesting fact, because it shows that the change may occur during the life of an individual hair. †

But what produces this condition of hair? Two factors would seem to be at work, viz., (1) a loss of the power to produce pigment; (2) an increase of air in the shaft of the hair.

Up to the present I have merely referred to the gradual change of colour with which we are all familiar. Sometimes, however, it occurs suddenly—in the course, perhaps, of a few hours. Many cases of this kind have been recorded by thoroughly reliable witnesses. Fear, overpowering grief, and other strong emotions, are the agents which bring about this remarkable result. We

* "Church History of Scotland," by John Cunningham, D.D.

† Brown-Sequard made some very remarkable observations upon his own beard whilst it was turning grey. He marked certain of the coloured hairs and kept a constant watch upon them. He states that in some instances an entire hair would turn grey in the course of a night.

have all heard how the auburn hair of Marie Antoinette turned grey in a single night, and the same change is said to have occurred in Sir Thomas More the night before he was executed. Perhaps the most striking case is that related by Surgeon Parry. He states that he saw the jet-black hair of a rebel Sepoy, whilst under examination and stupefied by fear, turn grey in the course of half-an-hour. Let me give you one other instance. A gentleman, forty years of age, with dark hair, left home on his bridal trip. On his return he was hardly recognisable. His hair, and even his eyebrows, had in this short space of time become snow-white.

It is difficult to give any reasonable explanation of these sudden cases of hair blanching. No more powerful argument could be used for the vitality of the hair and its permeability by fluids. Still it is hard to conceive how in so short a time the colouring matter in the hair could be destroyed. It has been suggested by one writer that it is effected by the permeation of the hair by an acid fluid. Others again consider that the pigment remains unchanged, but that the whiteness is produced by an increase in the quantity of air in the hair-shaft. That the pigment remains unaltered in the first instance is rendered likely by the sudden blanching of the hair over a localized area, which sometimes accompanies severe attacks of neuralgia. In such cases the hair in a few days regains its natural colour.

Hair as a race-character of the human species.—Before concluding I must say a few words upon the value of the hair as a race-character. It must be clear to every one that the colour cannot be regarded as a character of much moment in this respect. There is no one special colour of hair peculiar to any one race. Indeed, in our own country we may see every hue, from the fairest flaxen to the jettest black. Mr Sorby has shown that the colour of the hair is determined by the presence in the hair of three or four distinct pigments, and that all the varieties of tint are produced by variations in the relative proportions of these pigments. Some anthropologists are inclined to believe that the earliest men who peopled the globe were red-haired, because amongst all human races individuals have been observed whose hair more or less approaches to this tint.

Independently of colour, however, there are characters present in the hair which separate many of the races of man widely from each other. In the Americans, Chinese, Japanese, and natives of High Asia, the hair is long, straight, and harsh like a horse's mane. Amongst the Negroes, Hottentots, and Papuans it is crisp and woolly. Between these extremes we may place the Europeans, in whom the hair is wavy and flowing.

This marked difference in the hair of these races depends in a great measure upon the contour of the hair shaft. The straight, stiff hair of the American or Japanese is cylindrical, and when

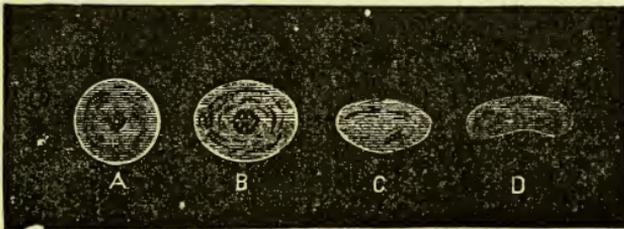


Fig. 5. Transverse sections of hairs of four different races.

- A. North American Indian.
- B. English.
- C. Negro,
- D. Papuan.

They are not drawn to scale, and the English hair therefore appears much too large.

cut across, the section appears circular. The woolly hair of the Negro and Papuan is flattened and tape-like, and shows an oval outline when cut transversely. The hair of the European holds a middle place in this respect, and presents a slightly oval figure when seen in transverse section.

Here then is the reason why in certain individuals the hair is curly, and in others lank and straight. It is simply due to a difference in the contour of the shaft. A circular shaft causes the hair to lie smooth and straight, whilst an oval shaft give rise to waviness or curling, according to the degree of flattening it presents.*

* The close curling of the negro's hair would also seem to depend upon another factor. In the negro scalp the hair-follicles are curved, which doubtless would tend to produce a spiral twist in the hair.

In Brazil there is a tribe called the Cafusos which has sprung into existence by crossing between the long, stiff-haired natives and the imported negro slaves. As might naturally be expected from the admixture of these extremes, this people possess hair of a very extraordinary kind. It rises perpendicularly from the head in close curly masses, and forms a wig of such enormous dimensions that the possessors must stoop low when entering their huts.

I had intended, at the close of this lecture, directing your attention to some of the methods employed in dressing the hair in different countries, and had prepared for this purpose some lantern slides as illustrations. My time, however, is already exhausted. If you will allow me I shall therefore merely show you the slides, and let them speak for themselves. In many countries the care which is taken of the hair and the ingenuity which is displayed in dressing it is very extraordinary. In Canton in 1858 the number of Chinese barbers is said to have exceeded 7000. Most of the Fijian chiefs employ a hair-dresser whose whole duty is centred in the care of his master's hair; in the Latooka tribe it takes seven or eight years to complete the head toilet. As a general rule, in uncivilized countries it is the men who thus adorn themselves. In Marquesas Islands, indeed, the husband sometimes sacrifices his wife's hair towards his own adornment. He shaves her head, and appropriates her hair for his own crown.

In finishing, I may remark that I suspect that your criticism of this lecture will be, that whilst you have heard a good deal about "the hair" you have been told very little about its management, and still less about the diseases to which it is liable. I have refrained from entering this field for two reasons. In the first place, these points were dealt with in a very able lecture delivered to you by Dr Jamieson two years ago; and in the second place, my experience in these matters is very limited, and I did not wish to speak to you on topics outside my range of study. My aim has been to make you acquainted with hair-structure and the phenomena of hair-growth, and I may say in one sentence that all proper management of the hair must be founded upon this knowledge.

MARKETING AND COOKERY.

BY TEACHERS FROM THE EDINBURGH SCHOOL OF COOKERY AND DOMESTIC ECONOMY, Superintended by The Honorary Secretary of the School.

THE Health Society in applying to the School of Cookery for a lecture on this subject, has thereby given practical recognition of cookery as a means of promoting or of marring health. This great department lies almost entirely under the control of women, and it therefore seems a fitting subject for a lecture from women to women. In addressing you to-night we may say that the simple teaching offered is specially addressed to those poorer working women who, with small means at their disposal, and little apparatus to help them, are yet anxious to provide wholesome though inexpensive food for their families.

From these we must ask attention to three very important points, *forethought, economy, and ready-money payments.*

When you receive the weekly money you should plan out what your week's dinners are likely to be, fitting one with the other so as to have less cooking to do on the washing day or cleaning-up days. The articles that keep well should be bought in half pounds or pounds, so as to save the constant loss of time in running for little quantities.

Then there must be economy, which means not only saving but wise spending ; and while, on the one hand every crust and bone should be turned to use, you can also be economical by laying your money out on the kinds of food most likely to keep your family well-fed and healthy.

Then as to paying ready money, this habit not only enables you to look about till you find the best article you can get for your money,—and a good housewife should know when she gets her money's worth,—but it takes away that terrible temptation to get something extra just because it may go down in the bill. With small means, if you wish to keep out of debt be sure to pay ready money, for then you know exactly how far your money will go.

We propose to-night to cook a few dishes to illustrate different classes of food

BUTCHER'S MEAT.

Good meat is known by certain signs. It should be a deep red colour, the flesh firm, and when pressed with the finger no mark should remain. It should have a fresh smell, and should not become moist when kept. The fat should be pure white, and in the finest pieces of beef the fat should be mixed in the lean in delicate threads. You should not buy meat that is pink or dark purple in colour, that has a sickly smell, or that is offered under the usual market price. The cheaper pieces of meat may be made into wholesome dishes by slow cooking, either boiling or stewing, and with certain additions may be made wholesome, economical, and savoury. We shall now show you the

Health Society Stew.—Required 1 lb. of stewing beef, one onion, one small carrot, half a turnip, one tablespoonful of vinegar, three breakfast cupfuls of cold water, one tablespoonful of flour, pepper and salt. Cut the meat into small pieces, put them into an iron saucepan with the onion (skinned and cut in slices), and sprinkle over these the pepper, salt, and vinegar. In a basin add the water gradually to the flour, stirring to prevent it from going into lumps, pour this over the meat. Place the saucepan over the fire, and stir till nearly boiling. Pare the turnip (the coarse fibre on the outside is indigestible), scrape the carrot, and cut both into neat pieces and add them. For those who find onion heavy, it is an improvement to pour boiling water over it when

skinned and let it stand for ten minutes. The addition of a piece of soda the size of a pea draws out even more of the indigestible part of the onion. Put the lid on the pan, and let the stew simmer gently while you make the balls.

If you had a suet dumpling for dinner yesterday, you might lessen to-day's work by making a little more dough than was wanted for the dumpling, and putting it aside for to-day's balls. The dough swells a little, and will go further if prepared one day and used the next.

Balls.—To four tablespoonfuls of flour, allow two tablespoonfuls of finely chopped suet, a pinch of salt, and a little water. Put the flour, suet, and salt into a basin, and when they are well mixed add enough cold water to make a dough, divide this quantity into four, flour your hands, form into small balls free from cracks, and throw them into the stew. Let it cook by the side of the fire with the lid on till tender; this will take about two hours altogether, longer if the meat is tough or gristly. Small pieces of meat are more quickly cooked than large.*

To simmer gently and to cook for a long time are the great secrets of making a tender stew. A little vinegar not only improves the flavour, but helps to soften the fibre of the meat.

FISH.

Fresh fish should be well covered with scales, the gills should be a bright red colour, the body stiff, the eyes bright and prominent. Many people prefer cod and ling after it has lain for a night covered with salt; this makes it firmer. At ordinary prices, a fresh herring is the cheapest and most nutritious of fish for the money, and can be prepared for eating in a great many different ways.

White fish is considered to be the lightest and most digestible. Be sure you save the liquor the fish is boiled in; with this, and

* As this dish will not be sufficiently cooked within the lecture hour, we have already prepared exactly the same ingredients which have been cooking, in order to be ready at the end of the hour.

with the boiling of the bones, skin, head, and fins, you can make various good soups.

We shall now suppose that you have had boiled cod for dinner yesterday, and a little has been left over. This we shall turn into *Fish and Cheese*.—Required 1 lb. cooked fish, $\frac{1}{4}$ lb. macaroni, 2 oz. grated cheese, pepper and salt, half-a-pint of sauce, a small piece of dripping or clarified fat, a few bread crumbs. Cook the macaroni by putting it into hot (not boiling) water, with a little salt, leaving the saucepan uncovered. Allow the macaroni to boil for twenty minutes, till it is quite soft and swollen, drain the water off, and chop the macaroni into small pieces. Grate the cheese. Grease a pie-dish, put in it a layer of fish, then some macaroni, then sauce, and sprinkle some cheese over it, and the same again till all is used. Cover the top with bread crumbs and a few morsels of dripping. Brown it in the oven or before the fire. As everything in this dish is cooked, it only requires to be warmed through and browned. Instead of macaroni you can use cooked rice, potatoes, or bread crumbs.

If this is a busy day, you have probably made a little more sauce yesterday than you required for the boiled cod, and have put it aside for to-day's dish.

The sauce is made thus :—

Sauce.—Required 1 dessertspoonful of flour, a piece of dripping the size of a small egg, a breakfast cup of the liquor the cod was boiled in, a pinch of salt.

Put the dripping into a small saucepan, let it melt but not get hot. Add the flour and mix all with the back of a spoon. Then add the liquor very slowly, a little at a time, stirring continually to prevent the mixture going into lumps. Stir over the fire till the sauce boils, boil well up for about three minutes, when it is ready for use.

This is the way all melted butter sauces are made, from this very cheap substitute up to the richest preparations. The sauce may be made richer by using butter instead of dripping, and milk instead of the fish liquor, and chopped parsley, or various flavourings may be added, but for this sauce, in whatever form you make

it, you must be sure (1st) that the fat and flour are well mixed together ; (2nd) that the cold water is added very gradually and well stirred ; and (3rd) it must be thoroughly boiled.

THE PULSES.

The late Sir Robert Christison, whose name will always be remembered with honour in Scotland, took a warm interest in our School, and gave us much useful advice. One of his written remarks was, "When people can afford little or no animal food, be sure you preach pulses and porridge." So, leaving porridge for later reference, we now in his name "preach pulses." These consist of lentils, peas, and beans, and are too little used in this country as a substitute for animal food. They contain the same kind of nourishment that animal food does, and in Egypt and India are used much by the natives in its place.

Lentil Soup.—Required 1 lb. of lentils, two onions or leeks, a piece of carrot and turnip, a piece of dripping about the size of an egg, about ten breakfast cupfuls of water, pepper and salt.

Wash the lentils well till they are quite clean. Let them soak over night in the water, to which add a piece of soda about the size of a bean. They require less time to cook when thus soaked. About two hours before dinner put the lentils and water into a saucepan, and when it boils, add the onions, turnip, carrot, skinned, pared, and scraped as you saw in the stew recipe. They should be chopped very small, to enable them to cook more quickly. Also add the dripping, and allow the whole to boil for about two hours, skimming very carefully from time to time. Then strain it through a colander, rubbing the lentils and vegetables all smooth, but keeping back any skins or husks. If you have not a colander, pour the thin part of the soup off first, and rub the rest smooth with the back of a wooden spoon. Return it all to the pan to warm ; season with pepper and salt, and serve with toast cut into small square pieces.

Lentil soup is very nourishing, and does not require any meat or bones. You can vary it by adding a little curry or mustard, and serving with plain boiled rice. The great French cook,

Soyer, used to say that all vegetable soups are improved by the addition of a little vinegar and brown sugar.

The cheapest, and in some respects best kind of lentils are the Egyptian. They, however, have a good deal of earth about them, and require much more washing than the split red lentils, which resemble split peas in appearance.

A dish that Sir Robert Christison specially recommended to us is made of well-boiled lentils, surrounded by boiled rice, and covered with melted butter, to which a little chopped parsley has been added.

There are many ways of cooking lentils, peas, and beans. All of these may be made into soups of various kinds, or may be added to broth or other soups. Peas make a capital dish in the shape of peas-pudding, which is taken with pork. Pease-brose and fat pease-brose (the latter being ordinary pease-brose with the addition of some dripping) are admirable and nutritious dishes, with the additional recommendation of being quickly and easily prepared.

Beans, either broad or haricot, may be served as a vegetable when plainly boiled, or with parsley sauce over them, and they should always accompany boiled bacon. Or, after being well-boiled, and the water allowed to drain away, they may be tossed in a frying-pan with fat bacon cut into small pieces.

It is not in our department to give you the arguments for and against vegetarianism, but a few facts which are well established may be of practical use to you.

1st. Pulses are not so easily digested as animal food, and are, therefore, more suited for those who have good digestion than for the weakly.

2nd. Pulses are more digestible when taken with even a small amount of animal food, than when taken alone.

3d. When fat or oil is taken with them, they are also more easily digested than if eaten alone.

VEGETABLES.

“The pulses” are vegetables, but those we shall now speak of are more commonly called garden vegetables.

The potato is our most valuable and commonest vegetable, and one which can be cooked in a great variety of ways. For plain boiling, it is best to cook potatoes in their jackets or skins. This skin consists of something like thin cork, which keeps all the good in the potatoes while they are cooking. There is in most garden vegetables, but especially in the potato, a substance called salts of potash, which is very valuable in strengthening the bones, in keeping the blood pure, and in preventing scurvy and other kinds of suffering. It is said that after the potato was brought to England by Sir Walter Raleigh, the plague disappeared, and scurvy became greatly lessened. This is believed to have been chiefly in consequence of the use of the potato ; so you see how important it is not to lose more of those salts of potash than can be helped. When the potato is pared before cooking, about half of those salts of potash escape into the water and are lost.

Boiled Potatoes.—Choose potatoes of an equal size, in order that they may all be ready in the same time. Wash and brush them well, and pack them closely in an iron saucepan. Cover with cold water, and add a little salt. Put the lid on the pan, place it on the fire, and as soon as it boils, draw a little to one side, and let the potatoes cook gently until nearly soft. If they are boiled too quickly, the outer part will be broken and soft before the middle part is cooked enough. When the potatoes are sufficiently soft to be pierced by a fork, pour off the water, draw to the side of the fire, and cover them with a clean cotton cloth, which will absorb the steam and finish the cooking. In about fifteen minutes they will be ready. The length of time that you boil potatoes depends on the size, age, and quality you use. Large old potatoes take the longest. Those grown in sandy soil are the finest, and keep their colour best when cooked. The potatoes I am cooking will take about twenty minutes.

As an iron pan is in every house, we have shown you the simplest way of cooking potatoes ; but a still better way is to cook them in a steamer. A steamer can be made to fit any pan ; it has holes in the bottom of it, through which the steam from the boiling

water in the pan passes, and cooks the potatoes without their coming in contact with the water. This large steamer cost half-a-crown, and is fitted to the pan. When potatoes become old and not so good, it is advisable to pare them before boiling. When you do this, you must be most careful to pare the skin very thinly, because the best part of the potato is next the skin. An old pointed knife is most convenient for this, and for taking out the eyes.

As a rule, garden vegetables should be as fresh as possible, but potatoes, carrots, and turnips will keep for some time; so will cabbages in frosty weather. If, however, a cabbage is frozen, you must be careful not to plunge it into boiling water, but to put it for some time into cold water to allow it to thaw.

To boil a Cabbage.—Remove the coarse outer leaves, which are indigestible. To get rid of earth and insects, put the cabbage in plenty of cold water for about twenty minutes or half-an-hour, and shake it well; if you have some vinegar you can spare, add a tablespoonful. The old way of adding salt to the water is now found not to be quite satisfactory, because though it does remove the insects, there is a slimy substance left from them on the cabbage. Have a saucepan ready, with thoroughly boiling water in it. Put the cabbage in this, and see that the boiling water covers it. After it has boiled five minutes, pour off this boiling water and pour fresh boiling water over the cabbage. This is a great improvement to all green vegetables if at all old or coarse. Let the water boil very fast, with the lid off, for about half-an-hour to three-quarters of an hour, till the stalk end of the cabbage is soft. Old and large cabbages require longer boiling than young and small ones. When ready, place it in a colander or in a plate, and press with a plate to squeeze out the water.

There is a capital dish you can make with any potatoes and cabbage that may be left over.

Colcannon.—Required equal quantities of cold potatoes and cold cabbage, about 1 oz. of dripping to 1 lb. of vegetables, a piece of dripping to grease the basin, pepper and salt. Crush the potatoes with a fork, chop the cabbage small, mix both

together and put into an iron saucepan or a frying-pan, with the dripping, pepper, and salt. Stir over the fire till the dripping has melted, and mixed well with the vegetables. Grease a basin, put the mixture into it, and place the dish in a hot oven or before the fire for about twenty minutes.

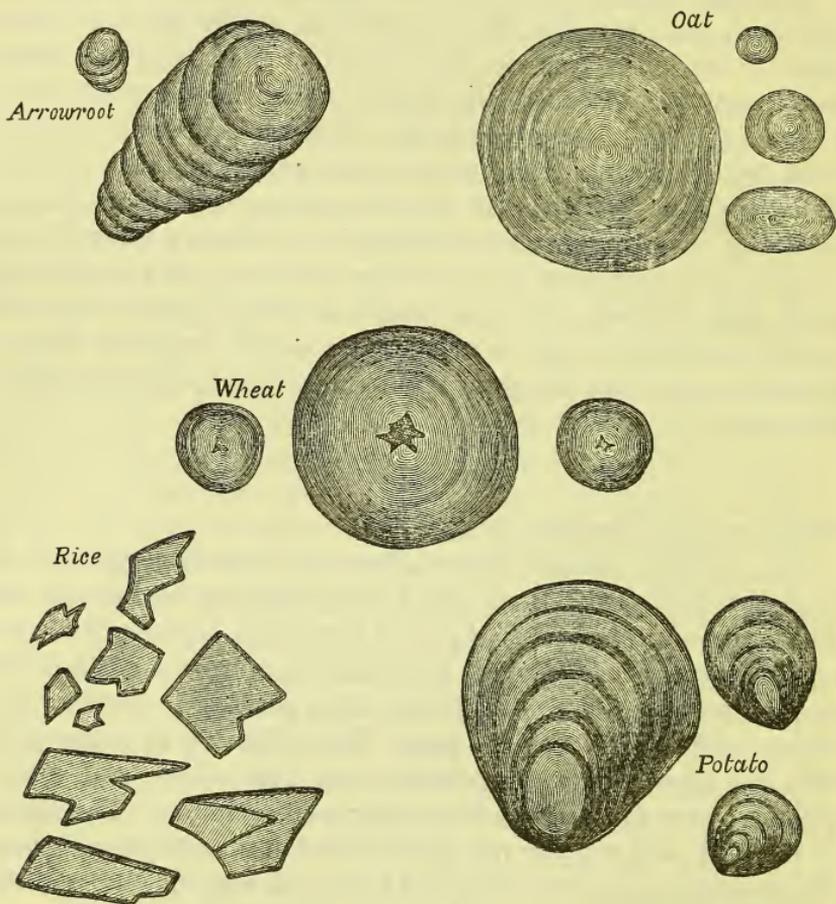
It is very important to have fresh garden vegetables as part of our food, and you should be careful to supply these for your family's use. There is no more excellent way of giving them than in our fine national dish, Scotch broth. Made with barley, a little dripping, fresh vegetables chopped and well cooked, some grated carrot, a little brown sugar, pepper and salt, it is an admirable dish. If you live in the country, you can use young nettle-tops in spring instead of cabbage. Of course a sheep's head or piece of meat will make it stronger, but you get a nourishing good dish without, and one which is only equalled by our equally celebrated, but now, alas! too much neglected dish—porridge. And this brings us to the general group of foods under the name of

GROCERIES,

which we shall illustrate by a

Rice Pudding without Eggs.—Required one tablespoonful of whole or broken rice, 1 oz. shred suet, dripping, or butter, one dessertspoonful of sugar, half pint of skim milk, a pinch of seasoning (nutmeg, ground ginger, cinnamon, or allspice). Wash the rice by pouring water over it, and then pouring it away several times, until the last water is pure. Shred the suet by scraping it into thin slices with a sharp knife; put half of the suet into a pie-dish; over this put the rice, sugar, and seasoning. Then pour in the milk, and put the rest of the shred suet on the top. Place this in a cool part of the oven, and let it cook very slowly for about an hour. If you let this cook at all quickly the milk will dry up, and you will need to add more. It is long, slow cooking that is needed, to allow the rice to swell, and take in the milk. This is an excellent dish for young children, who, after the age when they get milk alone, should have various kinds of milk puddings.

For these it is best to use hominy, semolina, macaroni, barley, rice, and ground rice, as they contain more nourishment than sago, tapioca, corn-flour, or arrowroot. With all of these you must be most careful to cook them long and thoroughly. There is a great deal of starch in them, and unless they are first mixed



with cold liquid, and every little grain of starch is allowed, by slow heat, to swell, soften, and burst, it is indigestible, and likely to cause suffering, especially in young children. This diagram will give you an idea of the difference of size between the uncooked and the cooked grains.

You should not buy flour in very small quantities, as it is all the better of being kept for a short time, to allow it to become drier. Good flour should be soft to the touch, not gritty, and should not have the slightest musty smell.

We shall now "preach porridge." When you are at the grocer's be sure you lay in a supply of oatmeal; in buying it you get, of all our foods, the best return for your money. There is not a dish in the world to compare to porridge and milk for making the body firm and healthy, for giving you strength to work with, and warmth to resist the cold. But you have difficulties, some one may say. When the husband goes out at six o'clock in the morning, it is difficult and expensive in a winter's morning to have the fire on and the porridge cooking for half-an-hour. In answer to this, we may tell you that a London doctor, who is making a special study of food, tells us that porridge is really more wholesome and digestible if made one day before and warmed up. But if you don't like this, and we can't recommend it, you can at least give the "gudeman" a plate of freshly cooked porridge for supper when he comes home, varying it occasionally by pease-brose, some soup, or other warm nourishing dish.

Then the children, you say, get tired of porridge. No doubt in this as in all other foods you need variety, and you must remember that our usual Scotch way of cooking porridge is apt to be heavy for children. Our usual tasty way of cooking porridge is to slowly sprinkle the meal in handfuls into boiling water, add salt to taste, and let it boil about twenty minutes, stirring well; eat it hot before it becomes stiff. It is somewhat more digestible however, though less palatable, if the meal is mixed well with cold water, and then slowly boiled.

On the mornings when the children do not get porridge, do not give them tea, as it is very hurtful to their nerves; give them milk and hot water to drink. Indeed, when we are at the grocer's, it would be a very good thing if sometimes we should forget to buy tea for ourselves. Every woman knows the comfort of a good cup of tea, but doctors tell us that, while all women are apt to indulge rather too freely in "the cup that cheers, but not

inebriates," much of the indigestion, weak nerves, and white faces among our working-women especially is caused by using what is merely a refreshing drink as a *substitute* for food. Remember that we may stop hunger without feeding the body, and we may train ourselves in good habits in food, as in other things.

MILK.

As our time is short, we must make the rice pudding also the text for a few remarks on milk. Many of you will remember Mr Chiene's remarks upon milk and the dairy.* He told you that milk is a sponge, and a dangerous sponge—that it absorbs at once any hurtful matter, and is one of the most fertile sources of epidemics. "No milk shop should have any connection with an inhabited house, there should be no possibility of sewer gas reaching the basins of milk. . . . Keep a sharp look-out on your milk-cart, and see that it is not utilised for carrying pigs' meat." Having done your best to choose a clean dairy answering these requirements, you should, when you have limited accommodation for keeping milk, buy it as fresh as possible. If it must be kept in the kitchen or a sleeping-room, be sure that the basin or jug is closely covered, always remembering that when the air is close or impure, the milk is sure to be affected by it. In hot weather, or when the milk has to be kept over night, it is often advisable to scald it to make it keep. Scalding is bringing the milk almost to the boiling point. If in doing this you find a skin form on the top of the milk, on no account throw it away. It is a very valuable part of the milk, and if you throw it away you deprive your children of something which helps to build up and strengthen their bodies. This kind of skin should be rubbed smooth with the back of a spoon and returned to the milk. You must also be especially careful that the dish milk is kept in is well washed in clean hot water and thoroughly scalded. Indeed in everything connected with food you must attend strictly to thorough cleanliness.

* "Civic Sanitation," by John Chiene, F.R.C.S.E. (*Health Lectures*, 4th Series.)

BREAD.

There seems to be a considerable waste in many houses in the form of crusts, arising in part perhaps from giving the children a "piece" between meals. There are many ways in which these odd scraps may be used up. The simplest is to soak them in boiling water till soft, squeeze as dry as possible, and add some hot milk and a little sugar. This makes a wholesome meal for the children. Another way is to make

Goose Pudding.—Required about $\frac{1}{4}$ lb. of scraps of bread, one large or two small onions (previously well boiled), half a table-spoonful of flour, half a teaspoonful of sage dried and rubbed down, a piece of dripping about the size of an egg, two table spoonfuls of milk, salt and pepper. Soak the bread for an hour in hot water; squeeze as dry as possible; bruise the bread with a fork till it is smooth. Chop the onion finely; mix all the ingredients well together except the dripping. Grease well a baking tin, place the mixture in it, and put the rest of the dripping in small pieces on the top. Bake in the oven for half-an-hour. If you have no oven, put the tin on a hot hob or girdle for twenty minutes, then brown before the fire, turn out of the tin and cut into pieces. Serve hot or cold.

New bread is neither economical nor wholesome; it should always be used either one or two days old. We have all become so accustomed to use white bread, that many think the whiter it is the better it is. This is quite a mistake; bread made with seconds, whole meal bread, rye bread, all give a better return for your money than very white bread. You probably know that much has been done to improve the grinding of wheat, in order to provide this whole meal bread, which we are told by many is wholesomer as well as more nutritious than white bread. If you cannot adopt these darker breads entirely, at least remember that in bread, as in all other departments of food, variety is both tempting and good for the health.

You will find in an appendix to the printed lecture general directions for the different ways of cooking, viz., roasting, broiling, steaming, boiling, stewing, frying, and baking. Of these

roasting and broiling are no doubt the most savoury, but are only suited for the finer pieces of meat. Steaming is a most economical method, and should be much more used than it is. It requires very little fire; there is no waste of any of the materials cooked, and none of the liquid cooked can pass off in steam, as in baking and boiling. Stewing, as we have already mentioned, is the best and most economical method of cooking tough and gristly pieces of meat.

Bones are useful for making soup with. We have heard of one careful woman who boiled twopence worth of bones whole one day for soup; the next day she split them and boiled them again for more soup, and the third day she "just gave them a boil again to make sure that nothing was left in them."

To keep our bodies healthy and strong we must have variety of food. Dr Russell, in his lecture on "Food and Drink,"* explained to you fully what the different classes of food are, and the work each class has to do. It is therefore not necessary here to enter into those particulars again; it is enough for our present purpose to press upon you the great importance to health of variety in food, and of variety in the methods of cooking it. Good food is not necessarily expensive food. A great authority on food and diet—Dr Parkes †—writes: "A labouring man by ringing the changes on oatmeal, maize, peas and beans, rice and macaroni (which is made from corn), to which may be added cheese and bacon occasionally, may bring up his children as well nourished as those of the richest people, and at a small cost. Oatmeal, the most nutritious of the cereal grains, and formerly the staple food of our finest men . . . Indian corn . . . peas and beans, and rice are far less used by our poorer classes than should be the case."

One word in conclusion: the woman who does her marketing and cooking ignorantly and badly, as surely promotes indigestion, ill-temper, and dram-drinking, as the thoughtful and efficient cook undoubtedly promotes good health, good temper, and sobriety.

C. E. G. W.

* "Food and Drink," by Dr J. A. Russell.—"Health Lectures," 1st Series.

† "The Personal Care of Health," by E. A. Parkes, M.D., F.R.S. Published by the Society for promoting Christian Knowledge, price 1s.

APPENDIX.

GENERAL DIRECTIONS FOR COOKING.

From "The School Cookery Book" (Macmillan & Co., price 1s.), from which most of the preceding recipes are also taken.

ROASTING.

Meat for roasting should be kept hanging till the fibre becomes tender. The length of time required depends on the state of the weather and the season, ranging from a few days, or, in summer even a few hours, to three or four weeks in a dry cold winter. In frosty weather the meat must be brought into the kitchen for a few hours, before using it, to soften it. To ascertain the length of time required for roasting, weigh the meat and allow in roasting one quarter of an hour to each pound and one quarter of an hour over. If, however, the piece of meat is very thick, allow half an hour over. Young and white meat (veal, lamb, pork) require twenty minutes to each pound and twenty minutes over. They are unwholesome when underdone.

Sweep up the hearth, and make up a large fire in a well-polished fireplace an hour before it is wanted, so as to have it bright and glowing. Do not let the fire go down while the meat is roasting: add small pieces of coal or large cinders occasionally, so as to keep it up. Hang the meat by the small end to the hook of the jack. When there is no jack, the meat may be hooked to a skein of twisted worsted suspended from a hook projected from the mantel-shelf. Wind up the jack, or twist the worsted, so as to make it spin slowly. Place the dripping pan under the joint. If you have a meat screen see that it is bright (so as to throw back the heat upon the joint), and place it before the fire. Meat should be placed for the first ten minutes as near the fire

as can be done without scorching, as the great heat hardens the outside, and keeps in the juices. Baste it as soon as the fat melts. Basting prevents the meat becoming dry and scorched. Then withdraw the meat 15 or 18 inches from the fire, and baste it frequently whilst cooking with the dripping produced by the melting of the fat.

A lean piece of meat should be basted with hot dripping melted for the purpose. The meat may be dredged with flour a quarter of an hour before it is quite ready, to make it browner and to thicken the gravy a little. When it is placed on a dish (called in Scotland an *asheet*), sprinkle it with a little salt. Before making sauce of the brown gravy, pour away the dripping from the dripping pan (keep this dripping for other purposes), add a little boiling water to the browned gravy left in the pan, mix well, add a little salt, and pour round the roast.

Roasting in the Oven.—This is usually called *baking* meat. Place the meat in a baking tin in a very hot part of the oven for five minutes to harden the outside and keep in the juice. Baste it as soon as the fat melts; then remove it to a cooler part; place beside it a cup or basin of *hot* water to keep the air of the oven moist without cooling it. Baste the meat frequently. For the length of time required, see preceding directions. All ovens in which meat is cooked should be properly ventilated in order to allow the escape of an injurious vapour produced by meat when cooked in a close oven. Meat roasted in the oven is not considered so digestible as when roasted before the fire.

Roasting in the Pan.—Melt and heat one ounce of dripping in an iron pan.* Brown all sides of the meat in this, so as to harden the outside and keep in the juices. Then draw the pan aside, and let the meat cook slowly with the lid on, basting it constantly. For the length of time required, see preceding directions. This way of roasting is especially suitable for small pieces of meat, and is economical because of the small quantity of fuel required.

* Tinning is apt to melt with the great heat and small amount of moisture.

BROILING.

Broiling is cooking over a hot clear fire on a gridiron. Place a thoroughly clean gridiron over the fire ; let it become quite hot, as the hot metal will help to harden the outside of the meat, and so keep in the juices ; rub the gridiron with suet to prevent the meat sticking to it. Place the meat on the hot gridiron, turn it continually, so as to let the inside of the meat cook slowly and so remain tender. Be careful to put the fork into the fat or skin. If you pierce the lean, you will allow the juices to escape. If tongs are used, do not squeeze the meat. The length of time required depends chiefly on the thickness of the meat to be cooked. A separate gridiron should, if possible, be kept for fish. When the top of the fire cannot be used (as in close ranges), suspend a hanging gridiron in front of the fire with the meat between the two halves of the gridiron, which must be turned with the meat.

STEAMING.

In steaming, the food to be cooked is placed in a tin or earthenware vessel, covered with a tight cover or greased paper.* The vessel is placed in a pan of boiling water, which comes half way up its side. If the water boils away, more *boiling* water must be added. Puddings, &c., when steamed, do not require to have so much liquid in them as when baked. The dry air of the oven dries them ; steaming keeps them moist.

BOILING.

Meat covered with water and cooked in it is said to be boiled, but it must not be supposed that the water should be kept at boiling point. Plunge the meat into boiling water (212° Fahr.), enough to cover it. This hardens the outside, and keeps in the juices. After the water (cooled by the meat) again comes to the boil, let it remain boiling for about five minutes, then skim carefully, and add cold water, or move the pot to a less hot place, till

* No printed paper should be used in cooking.

the water simmers instead of boils (about 170° Fahr.). Draw the pot aside, keep it at this heat till the meat is cooked, allowing a quarter of an hour to each pound, counting from the time the water begins to boil, and one quarter of an hour over. If it is a large piece of meat, allow half an hour over. Add a little salt when the meat is nearly ready.

For salt meat or pork allow twenty minutes to each pound. Salt meat is put on with cold water. For fish allow ten minutes to the pound, and, when thick, ten minutes over.

Green vegetables should be boiled briskly and without a lid on the pan : this helps to preserve the colour.

STEWING.

In stewing juicy meats the outside should be hardened by browning in order to keep in the juices. The meat is then placed in a stewpan and a small quantity of hot water or stock poured round it. This is slowly warmed and then allowed to simmer slowly, and must on no account be allowed to boil. Stewing chiefly differs from boiling in the quantity of water used, and in the length of time of cooking. The juice that is drawn out of the meat is served in the gravy.

Coarse pieces of meat may be made tender by careful and long stewing, but they should not be browned. If very tough, they may be dipped in vinegar to soften the fibre. Gristly pieces should be put on with cold water and simmered till tender, but not allowed to boil fast.

Another and a good way of stewing is to put the stew in a stone jar with a closely fitting lid, or cover of greased paper. The jar is placed on the hob, or in a slow oven, or in a sauce pan with water kept boiling round it.

FRYING.

Frying is cooking in hot fat. The ordinary but wrong way of frying is to use a shallow frying-pan and a small quantity of fat. This is extravagant and unwholesome. Put into a stew-

pan enough fat to cover the article to be cooked. Make the fat hot. It is at the proper heat when it is quite still and a slight vapour rises from it; do not wait till it smokes, for then it will burn. The fat may also be tested by putting into it a small piece of crumb of bread; if it becomes quickly a golden colour, the fat is at the right heat. Prepare the pieces to be cooked by covering them with a coating of egg and bread crumbs, or flour and milk, or flour and water. This covering hardens with heat, and makes a case to hold in the juices and also prevents the fat getting in and making the meat greasy. Do not have the pieces thicker than about an inch, unless the materials have been previously cooked. Put them into the hot fat, but not many at a time, as the fat would be too much cooled. When they become a golden colour remove them; place them for a few seconds on kitchen paper near the fire to absorb the fat, and then serve.

Oil, butter, lard, and dripping, or clarified fat, are used for frying. Oil and butter are very expensive, and should only be used in high class cookery; lard is apt to make what is fried in it greasy; dripping or clarified fat is the most suitable for use in an ordinary kitchen.

Dry Frying.—In dry frying a very small quantity of fat is used, and it is usually done in a frying-pan; the meat or vegetables should be frequently turned to prevent hardening. Bacon does not require fat at all, as its own melting fat is sufficient. Chopped vegetables, such as cabbages and potatoes mixed (the bubble without the squeak), are excellent food with a little dripping, and may be done in the frying-pan. Cold pudding may be cut in slices and fried in this way.

BAKING.

Baking is cooking by means of heated air in a confined space called an oven. Bread, cakes, and pastry are usually cooked in this way. As a general rule, anything containing starchy materials, as flour, arrowroot, &c., should, if not previously boiled, be first placed in a hot part of the oven to burst the starchy grains and

enable them to mix thoroughly with the surrounding liquid; they should then be removed to a cooler part, to cook slowly without scorching. If pastry is put at first into a cool part of the oven, the fat melts; but as the starch grains of the flour are not burst, they cannot absorb the fat, which runs out and makes the paste greasy and heavy.

The proper management of an oven must be the result of experience, as it is impossible to give exact rules. A large brick oven gives the most steady heat. Iron ovens become easily overheated, and small iron ones are apt to scorch what is cooked in them unless carefully regulated. Therefore, bread should be divided into smaller loaves when baked in a small oven, to prevent the outside being browned while the inside is still uncooked.

To test an oven, put into it a piece of stale crumb of bread; if in five minutes it is a golden colour, the oven is hot enough for cooking pastry or bread; if, on the contrary, the bread becomes dry and only slightly coloured, the oven is of a moderate heat, and suitable for browning puddings, &c. Another test is to put a piece of kitchen or writing paper into the oven; if it curls up in about a minute, the oven is hot enough for baking.

Where there is no oven, puddings may be browned before the fire. Meat, puddings, and even pastry, may be cooked in a Dutch oven before the fire. Scones, oat-cakes, &c., may be cooked on a girdle (much used in Scotland) instead of in an oven.

ADULTERATION OF FOOD.

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THE subject of food adulteration, although it is one of a somewhat different nature from those which have already been treated of in this course of lectures, and although it is one perhaps to most people not very attractive, is seen when properly looked into to be one of very great importance indeed, and interesting not only to people in general, but specially interesting to and deserving the close attention of the financier, the sanitarian, and the moralist.

Notwithstanding, however, this my opinion, I freely admit that when first applied to by the Committee of the Health Society to deliver this lecture to you I had very serious misgivings as to the probable success of a popular lecture on such an unpopular subject as Food Adulteration. For it must be conceded that however valuable certain kinds of information may be, it is not at all times pleasant to hear of them, and I think this applies with a good deal of truth to the lecture of to-night, dealing as it does with the various forms of sophistication to which the food and drink we are daily partaking of is subjected.

Still on reflection I arrived at the conclusion that this may be a good instance of fore-warning being fore-arming, and that if dangers are to be encountered in this way, it can at least do us no harm to be told of their existence, their nature, and possibly of the means by which they may be avoided.

The practice of adulterating food seems to be a very old one.

In Athens in its palmy days, the adulteration of wine seemed to be carried to such an extent as to necessitate the appointment of a special inspector, and the duties of this early City Analyst seem to have been much the same as those pertaining to his modern counterpart. In Rome also we read that the wine, according to the records of Pliny, was adulterated to such an extent that even the rich could not get certain varieties in a state of purity.

Coming to a later date and nearer home we learn on good authority that in England, in the 11th century, the brewers, bakers, vintners, and pepperers, as dealers in drugs or spices were then called, were the chief sinners in the matter of adulteration.

Indeed about this time, so much did the trade of baker stand in need of regulation, that what was called an assize of bread was instituted. This was followed by the statute of assize, and although at first the main object of this statute was not the suppression of adulteration, as time went on the malpractices of bakers became so flagrant that clauses were introduced stating punishment for certain offences. Thus we read in the assize of 1582:—"If there be any that by false meanes useth to sell meale; for the first tyme he shall be grievously punished, the second tyme he shall lose his meale, the third tyme he shall forswere the town, and so likewise the bakers that offend."

These were certainly rather smart punishments, and yet they were not by any means too severe for the abominable crime of wilful food adulteration. They are no doubt a little different to those which we mete out to similar offenders in our own time, and they serve to show in what righteous abhorrence this offence was held by the law makers of these early days.

As in our own day, the mode in which adulteration was effected by those pioneers in the art varied considerably. Sometimes, as with us, alum was added to flour or bread, but unless this was done very clumsily its detection, so backward was the then state of science, was by no means a matter of certainty.

Occasionally bread by a cunning device was made to look well outside when it was really bad within. And in an old record

we read the following account of a pretty severe punishment for this offence. A baker was sentenced to the pillory, having been convicted of making bread of what was good dough without but bad within, because such falsity redounds much to the deception of people who buy such bread.

Bakers, however, were not the only sinners. Besides them I mentioned brewers as tradesmen who were apparently justly suspected of evil practices in connection with the wares they dealt in. So strong, indeed, was the suspicion entertained by our forefathers that their ale was not altogether what it should be, that a set of men called ale tasters were appointed, whose special duty was to examine the ale sold, in order to determine its quality.

The mode of testing ale in vogue 300 years ago, we may well imagine was hardly so refined a process as that which we employ at present. It had, however, the undoubted merit of simplicity, and consisted first, as indeed the name of the body indicates, in tasting the ale. That process having been found to yield satisfactory results, the liquor was then tested to ascertain whether it had been adulterated by the addition of sugar. This test was carried out by the inspector first spilling a quantity of the liquor on a bench, and then with his leather breeches on, sitting down on it. If sugar had been added, the inspector after a time became so attached to the seat that to quit it was a matter of difficulty. If, however, the ale was pure and free from sugar, he after the lapse of the prescribed time rose from his seat with the usual facility.

The vintners also were suspected, and not without reason, if we are to believe Addison, of supplying the public with liquor, which, according to the phraseology of our present Food Adulteration Act, was "not of the substance, nature, and quality of the article demanded." In a half-humorous strain the genial writer of the "Spectator" thus refers to the attempts of these subtle philosophers, as he calls them, to manufacture wine without having recourse to grape juice. He says, "They are daily employed in the transmutation of liquors, and by the

power of magical drugs and incantations raise under the streets of London the choicest products of the hills and valleys of France. They squeeze Bordeaux out of a sloe and draw champagne from an apple."

The Bordeaux from the sloe is perhaps not now so well known, but many of us have made the acquaintance, either wittingly or in ignorance, of champagne drawn if not from an apple at least from a stalk of rhubarb.

In the matter of the punishment with which the crime of food adulteration was visited, our ancestors acted much more severely, and in that respect I think more wisely than we do in these days. On the continent especially was this the case. Thus we read that a baker who was condemned for selling what was styled "false bread," was adjudged to be taken to several public places in the city dressed only in his shirt, there, having small loaves hung round his neck, and candles in each hand, he had to ask pardon and mercy of God, the king, and justice for his fault.

Another baker guilty of a similar offence was heavily fined, his oven was destroyed, and his shop was closed for six months with a placard on it setting forth the nature of the offence and punishment.

An adulterator of wine was on one occasion punished even more severely. He was forced to drink some of his own wine. The punishment probably was greater than was intended, for, we are told, he died from the effects of his forced potation.

Apart from punishment, however, we have in some respects fallen off sadly in the matter of regulations for selling pure food. For example, in an early Act we find a penalty of £100 directed to be inflicted on any one found keeping or manufacturing any vegetable substance, being an imitation of or intended to serve as a substitute for coffee. But most unfortunately we learn that later on grocers were not only allowed to keep chicory on their premises, but were allowed to sell it mixed with coffee—a step which no doubt paved the way for much of the adulteration that undoubtedly took place some years ago.

I am in possession of a copy of a verbatim report of the pro-

ceedings of a meeting of those interested in the coffee trade, held about thirty years ago in London, and in this report it is recorded that the chairman of the meeting distinctly stated that though now more of what is called coffee is consumed, yet there is less consumpt of genuine coffee. And one individual produced at this meeting a sample of stuff composed of burnt peas, dog biscuit, prepared earth, and another substance which he would not describe, and which mixture, he said, was employed either to adulterate or even as a substitute for that material so largely mixed with coffee—viz., chicory.

Indeed, so far did the refinement of adulteration go that a patent was actually taken out to protect a process which an ingenious inventor had elaborated for the manufacture of a certain mixture of chicory and coffee. This mixture was pressed into the shape of coffee berries, so that retailers of coffee might be fully prepared for those troublesome and fastidious patrons who in order to make certain that they were being really supplied with pure coffee insisted on witnessing themselves the operation of grinding.

But adulteration was practised without much attempt at refinement. It is on record that so unblushing became the process of bread adulteration by means of alum that the alum was sometimes found in a loaf in pieces as big as a large pea. And it was stated in the most open fashion by a witness before a select committee that his firm, in order to give preserved foods, such as vegetables, a taking appearance, boiled them in copper vessels until they assumed a deep enough green tint—in other words, until they had absorbed a sufficient amount of a dangerous poison to make them look better than those sold by other and more conscientious manufacturers. Such an abominable practice as this—and which is, I may remark, carried on in the present day—is altogether and utterly inexcusable, and I think almost justifies the very forcible language of that brave old enemy of adulteration, Accum, when he writes, “that the eager and insatiable thirst for gain which seems to be a leading characteristic of the times calls into action every human faculty, and gives an

irresistible impulse to the power of invention ; and when lucre becomes the reigning principle, the possible sacrifice of a fellow-creature's life is a secondary consideration."

Those, then, are a few facts relative to the history of adulteration of food ; let me now lay before you one or two statements indicative of the prevalence of this crime.

One very well-known analyst, writing on this part of the subject, states that during six years he examined over 3000 articles of food, and the result was that there were few of these which admitted of adulteration or the adulteration of which was profitable which were not extensively subjected to sophistication. Such an assertion as this is almost incredible, and would, I dare say, have been very generally disbelieved had it not been corroborated by many competent witnesses,—such, for example, as those examined before the Parliamentary Committee on adulteration in 1855. Indeed, such was the nature of the evidence adduced on that occasion that the Committee stated in their report "that they cannot avoid the conclusion that adulteration widely prevails. Not only is the public health thus exposed to danger, and pecuniary fraud committed on the whole community, but the public morality is tainted and the high commercial character of the country seriously lowered both at home and in the eyes of foreign countries."

These are certainly very grave statements, coming from a very high authority. It is satisfactory, however, to remember that they refer to a period of nearly thirty years ago, also that by recent legislation and the consequent appointment of a number of properly trained chemical analysts, matters have in late years in this respect been very much improved. Still, as I shall have occasion to show directly, we are very far even yet from being altogether free of the demon of food adulteration. The practice still exists in our midst, and will continue, I very much fear, until much more stringent measures than at present obtain are enforced for its suppression.

I am not aware of the reason of what I am about to state, but

it always seems to me that offenders against the adulteration laws are very often indeed treated in the most absurdly lenient fashion. I have to appear occasionally in certain courts in different towns in Scotland to give evidence in cases where persons are charged with adulterating human food, and the presiding judge on these occasions invariably appears to assume a half apologetic air in addressing the accused. He orders a chair to be placed for his accommodation, and altogether seems to say: I am really extremely sorry that you should be put to the great inconvenience of coming here, but I hope you clearly understand that it is not in consequence of any action on my part. The case is proceeded with, the charge is found proven, and some of the panel's ill-gotten gains go to pay the small fine which is imposed. The next case which is called is that of some poor half-starved tramp who has taken a fish from the river to make a breakfast for himself and his miserable dependents. There is no apology or chair for him; he is tried and found guilty without loss of time, mercifully fined in a sum greater than he ever at any time could call his own, which not being able to pay, he is straightway bundled off to prison without more ado.

Now I look upon the first of these two offenders as by far the worst. Why, a man who wilfully adulterates human food is worse even than the famous highwaymen of old. These gentlemen of the road mercifully offered one an alternative. Your money *or* your life was their demand—our modern food adulterators not only demand, but most surely take both our money and our lives.

Excuses for Food Adulteration.—As in almost every other case of evil doing we have for the crime of food adulteration numerous excuses. The principal and favourite excuse, albeit a most extraordinary one, is that food is sophisticated in obedience to the tastes and wishes of the public—a curious public certainly, that prefers to be poisoned and robbed rather than be supplied with their money's worth of pure and wholesome food. Then, if this assertion is too much even for the long-suffering credulous British public, we are told that certain forms of admixture are really improvements.

The public, it seems, must have its pickles, bottled fruits, and vegetables, of a bright green; its confectionery must have coats of many colours; its sauces, potted meats, &c., must be red; its cheese and butter must be yellow; and its bread white. Now, while it is true, no doubt, that in some instances the public may like substances which they are going to use as food coloured in this fashion, they certainly would, in the great majority of cases, prefer to have them without the colour, if they were told, as they should be, by what means the colours are produced.

Not very long ago the Public Analyst of Glasgow found that a most beautifully coloured cake, which was exposed for sale in a shop window, owed part at least of its taking appearance to the deadly poison Scheele's green, one of the principal constituents of which is Arsenic. I myself some time ago found a wholesale confectioner in Edinburgh turning out large quantities of beautiful yellow lozenges, which were also coloured by means of a deleterious metallic compound; and pickles and preserved vegetables are sent to me constantly containing compounds of copper or other poisonous substance.

It is, I admit, quite possible that a person in ignorance may prefer bright green peas to those having a sickly greenish yellow hue, but if such an individual be informed that the inviting colour of the otherwise wholesome vegetable is obtained by the admixture of verdigris, or some similar poisonous compound, it is to be presumed that he, not being an inmate of Bedlam, would prefer that which, though not presenting such a bright appearance, might be partaken of in safety. So much then for this alleged insatiable desire of the public to be supplied with adulterated food.

But we are told further that, the wishes of the public entirely apart, some kinds of food are really improved by adulteration, or, as it is more euphoniously put, by admixture. Startling statement certainly, and yet it is made again and again, and not casually or irresponsibly, but authoritatively and of set purpose.

In our Court in Edinburgh, not very long ago, in a case of food adulteration which was tried there, not only did the sellers of the

adulterated stuff maintain that it was better than the pure article, but they had several highly paid witnesses in attendance ready to say the same thing.

Well, I can easily understand that there should exist in the lay mind some little anxiety to know something of these articles which are improved by—let us say admixture.

But first in this connection, let me draw your attention to the curious and suggestive fact that these things which are added by way of “improvement” are always very much cheaper than the article which has been subjected to the improving process. Take, for example, the very common admixture of coffee with chicory. We are told distinctly that the chicory is added for the purpose of improving the coffee, but when we remember that coffee costs somewhere about 2s. per pound and chicory about 4d., we are led, even the most charitable among us, to have some faint suspicion that this very questionable improvement and this solicitous regard for the wishes and tastes of the public resolves itself into a question of gain to the manufacturer or trader. Especially when we remember that this improving process is frequently carried to such an extent that but little of the original substance is discernible in the “improved” compound.

The same may be said of the addition of flour and the yellow dye-stuff known as turmeric to mustard. We are gravely assured, and indeed I have heard it stated on oath by those interested in the sale of this material, that it is altogether a mistake to use it pure. In such a condition we are told that it won't keep, that its taste is not pleasant, and so on. A sufficient answer to all of this nonsense is that certain manufacturers make and sell really pure mustard, and that even if this could not be done, and that if mustard did require a little flour or some similar material to make it keep, it does not require for this purpose anything like the very large amount which is frequently put in. In such cases of necessary admixture, if such cases there be, we should follow the example of a celebrated wit, when he astonished his milkman by appearing himself one morning on his door step, provided with two jugs, and politely re-

quested to be furnished with the milk and water separately, as he intended henceforth to mix them himself.

I remember once of hearing a mustard manufacturer giving evidence on oath as to the mode of manufacturing the mustard he sold. Being asked what was the use or object of putting in the flour which he said his mustard contained, he answered very readily, "To make it keep." Next, the gentleman of the long robe, wishing to know what was the greatest proportion of flour he used for this purpose, was told, evidently frankly enough, as well as I remember, about 20 or 30 per cent. The next question was how much flour is it necessary to add for the effectual preservation of the mustard? About 10 per cent was the ready, but unguarded, reply. Then came the knotty question, For what, then, is the extra 10 or 20 per cent. added? The answer was not very satisfactory, but I think we may all get an answer for ourselves by calling to mind that while the delightful condiment when pure costs 2s. a pound, the useless flour—at least useless here—costs about 1d.

So far indeed was adulteration practised on this plea that it was necessary for the preservation of certain articles that the legislature was actually brought, in the case of one commonly-used article, to sanction an addition of a very questionable nature. I refer to the admixture of oil of vitriol with vinegar.

That such a repulsive blend is altogether unnecessary is proved by the fact that now most, if not all of the vinegar made by the larger and better manufacturers does not contain a drop of sulphuric acid.

When, therefore, you hear of any wholesome article of food which you are in the habit of using being mixed with something else in deference to the taste of the public, or even for the purpose of making it keep, I would advise you to look strictly into the matter for yourselves, and in most of such cases I think you will find that the admixture is made not for these purposes alone.

Another plea sometimes urged in extenuation of adulteration is that it is impossible to supply genuine articles at the price which the public are willing to pay for them. Now no doubt

there is a little in this deserving of attention, but very little. Competition, we know, has the effect of lowering prices and minimising profits, and people, as a rule, like to obtain what they purchase at as cheap a rate as possible. It is, however, the duty of the trader and not the public to fix the prices at which the various commodities can be sold; and if a trader were careful to inform his patrons that while he could not guarantee the genuineness of the very cheap articles he sold, he could do so with all confidence in regard to those which cost a little more—he would not, I think, have cause long to complain of his inability to sell the pure though apparently more expensive articles.

Another excuse, if so it may be called, in defence of adulteration is, that in some forms it does no harm—by which is meant that only innocuous substances, such as water, are used for the purpose of admixture. Thus the addition of water to milk or whisky I have heard characterised as a comparatively venial offence, seeing that it does no harm. But with quite as much reason might it be said that a seller who uses light weights or deficient measures does no harm. Neither offence is the means of us being poisoned, but both assuredly make us pay for that which we have not received.

Different articles used for the purpose of adulteration.—The majority of substances so used are for one of three purposes:—1st, to increase the bulk or weight of the dearer article; 2nd, to brighten or alter its colour; 3rd, to increase its pungency, or, as it is said, to improve its flavour.

The first mode of employing adulterants is the most common. As examples we may mention addition of water to milk, flour to mustard, chicory to coffee, grease of different kinds to butter. As illustrations of the second mode we may take the addition of compounds of copper to preserved vegetables, barley-meal to oat-meal, alum to bread. As examples of the third we may take the addition of pepper to ginger, chemical essences to confectionery, artificial flavourings to wine.

Means of checking adulteration.—These we may say really consist—first of discovery, and second of punishment. As the

second cannot be inflicted until the first has taken place, and as, moreover, the first very often constitutes a very important part of the second in its most salutary form—the first, that is the discovery, becomes of the greatest importance.

The detection of adulteration of food is effected by means of two agencies—chemical analyses and microscopical examination. Alum in bread, copper in vegetables, and water in milk, are all detected by means of analysis, while flour in mustard, barley in oatmeal, starch in pepper, are all discovered by the aid of the microscope.

These examinations, chemical and microscopical, are carried out, as most people are aware, by a body of men known as Public Analysts. These officials have not as yet been very long in existence, and yet, notwithstanding great and manifold forms of opposition, have already, as shown by the table I have suspended on the wall, lessened adulteration to a very great extent.

This table, though, besides showing what Public Analysts have done, shows also what an enormous amount of work they have yet to do. For in looking at this table, it must be remembered that many of the samples of food therein referred to were procured by official inspectors, who are unfortunately too well known to the dealers, and who, therefore,—their errand being known,—are supplied frequently with goods very superior to what are given to the public under the same name.

One of the inspectors in a county in the South of Scotland pointed out to me that so well known was he that one shop-keeper had a stock of bags evidently for his special use. So that whether he bought sugar, tea, or oatmeal, it was always put into a bag, bearing on its face, “Notice—This is sold as a mixture of chicory and coffee.”

From this table, to which I have just referred, it will be seen that of all the samples of food sold in the way I have mentioned, no less than 21 per cent. were adulterated, and I have not the slightest doubt that had these samples all been bought by ordinary people in the usual way, the percentage of adulterated samples would have been very much higher.

And I will go a step further and say that had it not been for the apathy of the public, and, indeed, actual opposition shown to public analysts in the discharge of their duties, and in their attempts to provide a purer and more wholesome food supply, the falling off in the number of adulterated articles sold, great as it is, would have been considerably greater.

But, unfortunately, and to me most inexplicably, every one from our administrators of justice downwards seems to wish to deal most leniently, or rather, I should say, manifests a strong desire not to deal at all with this most iniquitous and quite inexcusable practice of food adulteration.

All sorts of pleas are tendered by those accused of this crime, and what to ordinary minds seems the most absurd statements are listened to. A confectioner was convicted of having sold some sweets which he had coloured with the beautiful but poisonous substance chromate of lead. He professed not to be able to account for the presence of this poison in his lozenges, unless, he warily added, a little of the material with which he had recently been painting his yellow cart had got accidentally mixed with the sugar.

A dairyman charged with the usual failing of his fraternity gave as his excuse that his cows had lately been fed on hay, and the next comer accused of like unprofessional conduct, and seeing how successful his fellow sinner's explanation had been, and determined not to be outdone, announced triumphantly that his cows had been fed on straw. The pleading was effectual and both men got off.

Another explained that his milk was rather weak but not from adulteration, but simply because the machine which he used for cooling the milk by means of cold water was leaky.

Another asserted that he did not put any water into the milk, but that unfortunately the pails being exposed on a very wet morning while the cows were being milked in the field, he opined that the rain was answerable for the attenuation which had undoubtedly taken place.

Another excuse, and so far a successful one, for selling watered milk, was that the seller was a widow, and, adds the reporter, it

is astonishing how many enterprising widows undertook to sell milk on the strength of that decision.

But this strange desire to shield the adulterator of food from punishment is not confined to those officially concerned. Ordinary people come to me exhibiting the same spirit. They bring samples of food which they wish analysed, not, they explain, with any view of prosecuting the poor man who has sold the material, but simply to see whether that be bad or good. One is inclined to ask what is the use of having an analysis made unless some action is to follow.

But further still, even after a public analyst is appointed, the authorities in many cases exhibit the strangest desire to keep him unemployed. In the year 1880 the analysts of forty-one places reported that they had not analysed a single sample. The results of such a mode of procedure may be well imagined in this money-getting age.

At present I act as public analyst for many different places in Scotland, but I must say that in all of them, except perhaps two, the authorities not only permit but in some instances actually encourage the working of the Food Adulteration Act. In the place where the Act is worked most energetically, namely, in the county of Roxburgh, it is now a very rare thing indeed to get an adulterated sample of food, whereas in Leith, where the authorities do not seem to deem it their duty to enforce the Act at all, a very different state of matters prevail. Not long ago I sent to Leith and had some articles of food bought, and these on being analysed were, every one, found to be adulterated.

But I now pass on to tell you, and it must be very briefly, of the usual adulterants of the more common articles of food. At the head of the list I place milk, not only because it is the most important form of food, but also because it is most unfortunately, in Edinburgh at least, the one most subject to adulteration. Pure milk!—alas, how few of us know what it is—is the principal and natural food of the young, and this being so it is not too much to say that upon the quality of the milk supply

depends to a very great extent indeed the health and well-being of children; and we all know what an important factor that is in determining the future condition of the race.

Of all forms of food, not even excepting bread, milk is the most extensively used. In London alone, according to a recent calculation, the sum paid for milk every year amounts to no less than £1,400,000. This gives us some idea of the enormous amount of milk which is used, and of the amount of money, to say nothing of health, of which we are robbed by the scandalous but very common practice of milk adulteration. Just reflect for a moment that adulteration with water to the extent of only 10 per cent. on the London milk supply infers a loss of about £140,000 a year. We don't consider 10 per cent. of water in a sample of milk very extensive adulteration in Edinburgh; but still it would appear from a report issued by the Local Government Board that even London milk, all over, I mean, is not adulterated to that extent. In that report it is stated that only £70,000 to £80,000 is paid annually in London for water sold as milk.

The only way in which milk is adulterated, at all events in the present day, is by the addition of water, or by the abstraction of cream. All the sensational stories of sheep's brains and chalk being used for this purpose are totally without foundation.

But this form of adulteration, though seemingly simple and comparatively harmless, is yet a very serious matter when we come to consider the extent to which milk is employed as food. The infant mortality, especially among the poorer classes in towns, as everyone having any knowledge of the subject is well aware, is lamentably high; and is this most regrettable fact not to be accounted for to a very great extent by the knowledge which we possess of the nature of the miserable innutritious food with which the poor creatures are supplied in the form of skimmed and watered milk? For it is the poor who are not able to protect themselves who suffer principally by this, and indeed by most other forms of food adulteration.

But all of us, whether rich or poor, are liable to suffer from milk adulteration in another way besides that of being deprived

of food. The water, we know, which is found in the wells of farms and dairies is often, for very obvious reasons, extremely impure, and to the practice of adulterating milk to ever so slight an extent with such impure water, is to be ascribed, no doubt, many of these mysterious outbreaks of disease which we hear of every now and again as taking place in our midst. And you must have noticed that these unwelcome visitors are found in Edinburgh's Belgravia as well as in her slums.

I have analysed hundreds of samples of water from different parts of the world during my twenty years' experience—many of them very bad indeed. But one of the worst waters I ever examined was from the well of a milk establishment supplying milk to Edinburgh. It is some comfort, however, to remember that water, such as that I refer to, could hardly now be used in Edinburgh in any way in connection with milk, as all our dairies, &c., are under the inspection of our vigilant officer of health, Dr Littlejohn, who, if he found any such water in any milk establishment, would immediately take such steps as would prevent it being used in the dairy.

The question is often put to me, is there no simple test or form of analysis which could be used by people in general for the purpose of ascertaining whether milk they are about to use is pure? I am sorry always to be compelled to answer this enquiry in the negative. There is, unfortunately, no such test of any value in existence.

Numerous forms of so-called milk testers have been proposed for this purpose, but the indications of all of them are very fallacious. The two best known milk testers are the so-called creamometer and the lactometer. The first is simply a graduated tube divided into one hundred divisions. Into this the milk to be tested is poured until it reaches the top, or zero mark. It is here allowed to repose for twelve hours, or until the cream is supposed to have risen to the surface. The number of divisions occupied by the cream is then read off, and this is supposed to indicate the richness of the milk. Rich and genuine milk will throw up from 10 to 14 divisions of cream, while poor or adulter-

ated milk will show only 8 or 6, or even less, the percentage varying with the extent to which the milk has been diluted or skimmed.

As, however, the rising of cream is dependent upon other things than the richness of the milk, this test is not to be relied on. I had occasion to investigate this matter some years ago, when results obtained by the use of this instrument were made use of to disprove analysis made by me in one of the milk cases then in court. And I found that, by a little manipulation, watered milk could be made to show as good, or even better, results in this creamometer than pure milk.

The other instrument or lactometer is almost equally valueless. It is nothing more than an ordinary hydrometer, which is an instrument made use of to ascertain the relative weights of equal volumes of different liquids.

Milk is heavier than water, and so heavy milk is supposed to be good, but as cream is lighter than milk, a milk which had been skimmed would show better on this instrument than would a genuine milk. And yet these lactometers are used and implicitly believed in as milk-testers by many otherwise well informed people, and it is said, and I suppose truly enough, that at one time certain French officials, whose duty included that of examining milk, were all armed with these lactometers. Thus equipped they perambulated the streets, and whenever they thought proper, they demanded a sample of milk from any dealer. Into this they plunged their lactometer, and if the milk did not come up to the mark, it was forthwith poured into the gutter. In this way, no doubt, many a gallon of good milk was lost.

But the lactometer has been in use nearer home. The governors of one of the London poorhouses inserted in their contract specification the stipulation that the milk supplied to the institution should come up to a certain mark on the lactometer, and for a time they got pretty good milk, until, indeed, in an unfortunate moment one ingenious contractor discovered how the milk was tested, and he soon succeeded—though he supplied only very poor milk—in satisfying the requirements of the lactometer,

and at the same time in making a very good profit. He first of all partially skimmed the milk—that made it too heavy; the lactometer stood too high, so as an inexpensive and effectual corrective, he added a little water, which, of course, made the milk lighter, and so he continued the addition until he brought the lactometer to the right point exactly, thus fulfilling to a nicety and in the most scientific manner the requirements of the governors. The only way as yet known to test milk accurately is by means of a properly conducted chemical analysis, and a description of that process would, I am afraid, be somewhat out of place in this lecture.

The next article of food I wish to speak of is bread, and of this most important substance I am happy to say I have a very different tale to tell from that which I have just told of milk. The bread which is sold in Edinburgh, and indeed in Scotland generally, as far as my experience goes, is very pure. Never yet have I found in Edinburgh bread anything of the nature of adulteration.

As most of you are aware, bread is in some parts of this country adulterated with alum, which is used, so it is said, for the purpose of making the bread white, and for giving bread made from inferior flour the appearance of that made from flour of a better quality. It is asserted also that bread is occasionally adulterated with common salt for the purpose of making it hold more water. Sulphate of copper is another substance said to be put into bread for the purpose of improving its appearance. I have the same story to tell of all these forms of adulteration. I have never found any of them in bread, and I do not think that they are ever employed by the bakers in Edinburgh.

Passing on I come to another important article of food, viz., coffee, and here again we get to another extreme. If there is little or no adulterated bread to be had in Edinburgh, there is hardly such a thing as pure coffee.

Again and again have I instructed the food inspectors to bring me some pure coffee, or to procure what, at all events, is sold as such. The result is almost always the same. Either I am

handed some inferior mixture, or in cases where the inspectors are known, and the object of their visit suspected, they are told by the dealer that he has no pure coffee. This seems to me a most extraordinary and no less unfortunate state of matters.

Coffee in a state of purity is one of the most delightful things we can drink, while the stuff which is sold at the present day in Edinburgh as coffee is only tolerable after our taste has become thoroughly depraved.

The materials used for mixing with coffee are chicory, roasted wheat, beans, date stones, and burnt sugar, all of which yield infusions as different in all respects from coffee, except perhaps as regards colour, as it is possible to conceive.

The extent to which coffee is now adulterated is almost beyond belief. One analyst reported that a sample of so-called coffee which had been sent to him for analysis consisted of chicory flavoured with coffee, and I had a sample not very long ago which might not inaptly have been characterised as burnt sugar flavoured with coffee. One coffee dealer, evidently in haste to be rich, advertised his wares as being "fine French coffee—a blend of the finest East India and other coffees, carefully prepared by a new French process, whereby the aroma and properties of the coffee are fully developed." This enterprising advertiser was, however, somewhat severely fined because his developing process was found to consist solely in the admixture of the enormous proportion of 90 per cent. of chicory. Well, that is rather an exceptional amount, but to find 40 or 50 per cent. of this cheap uninviting root in coffee is not by any means unusual.

We detect chicory in coffee by means of the microscope, and I show you on the table hung on the wall a diagram from which you get an idea of the structure of the coffee berry and the chicory root.

I cannot leave this subject of coffee without putting before you one or two figures showing to what an enormous extent the consumption of this most excellent beverage has fallen off in consequence of the great adulteration to which it has of late years been subjected. This country has, we all know, increased in wealth and in

population very rapidly during the last thirty or forty years, and as a consequence of this the consumption of what we may call the luxuries has increased also very rapidly. Thus in 1843 we consumed of whisky and spirits generally 0·87 gallon per head, and this at the present time has risen to 1·03. In 1843 we consumed of wine 0·22 gallon, and at the present time we consume 0·40 gallon. Of tobacco the consumption in 1843 was 0·84 lb. per head, it is now 1·37. Of tea the quantity used in 1843 was 1·47 lbs. per head, the quantity now used is 4·62 lbs. per head. Of cocoa we used in 1843 0·09 of 1 lb. we now use 0·34 of 1 lb.

And now we come to coffee. The consumption of coffee in 1843 was 1·1 lb. per head, and it increased to 1848 when it was 1·37 lbs. It has since steadily fallen off, and it is now only 0·89. To what are we to look for the explanation of this very remarkable fact, that while the consumption of spirits, wine, tobacco, tea, and cocoa has all increased, the consumption of coffee has very materially decreased. There can be no doubt, I think, that the decrease in the use of coffee is owing to the adulteration to which it is subjected. People are losing their taste for coffee, and no wonder, when instead of getting what must be regarded when pure as one of the most refreshing and delightful of beverages, we get when we ask for coffee an infusion made, in great part, of a root having a sickly, sweet, mawkish taste, and being entirely destitute of all these valuable, refreshing, and stimulating properties for which coffee is so justly famed.

The next article of which I have to speak is butter, and this also I am forced to admit is still very often adulterated, and often to an enormous extent. Occasionally, indeed, do I receive samples of butter so called, which contain no butter at all, being composed entirely of some kind of foreign grease. This was the case with three samples which I received lately. One of these was bought in a shop in Edinburgh, one was from Leith, and another was from a country town in Dumfriesshire.

The trade in spurious butter is now very large. According to a recent report by the local Government Board no less than six million lbs. of a stuff called Oleo Margarine—whatever that

may mean—are exported annually from New York alone to Rotterdam, Hamburgh, etc. Arrived there this material is mixed with colouring matter and washed or mixed with milk, and then in whole or great part exported to this country.

From another source I have the information that two Dutch butter-making firms use for manufacturing adulterated or spurious butter no less than twenty thousand kilos of Margarine daily. Besides it is well known that this prepared grease is made now to a very large extent in this country.

It is a common observation that this material when clean is really fairly wholesome, and that it is better at all events than rancid butter, which is at present largely consumed by the poorer classes of the community. Be that as it may, there is no doubt whatever that selling this fat as butter is in the highest degree reprehensible. According to some authorities, indeed, selling it for food under any name is wrong, as it is said that frequently the heat employed in its preparation is not sufficient to kill the embryo parasites often found existing in the fat from which it is made, and that in this way this so-called butterine may become an active carrier of disease. On this latter point, however, I have no personal experience.

Butter is also occasionally adulterated with water, and also in some rare instances by the addition of an excessive amount of salt. These, however, are trifling compared to the common and favourite mode of sophistication—the addition of foreign fat.

The detection of the adulteration of butter is a somewhat complicated operation, and can only be done satisfactorily by means of a properly conducted chemical analysis.

The next article I notice is sugar, and this safe and wholesome food is, I am happy to say, almost invariably sold in a state of purity. The only foreign matter which, so far as I can recollect, I ever detected in sugar was ground rice and a small quantity of potash salt. The former had come from the mill in which the sugar had been ground, and the latter had arisen, no doubt, from careless refining. It is, I think, extremely satisfactory to be able to say that in Edinburgh two of the principal materials used as food are supplied to the public in a state of great purity.

Coming to what is, or at all events should be, one of the most important articles of food, viz., oatmeal, I am sorry that I can hardly give it so favourable a character as I gave the bread. As a rule, however, oatmeal is sold in a state of great purity. Occasionally barley meal is found in samples sent for analysis, and this addition is made, so it is said, to give meal made from poor and inferior oats a whiter look and an appearance of meal made from better oats.

Barley meal is, no doubt, occasionally added for this purpose ; but the small quantities of this substance which I have detected seem to me to have been introduced rather by accident than design. A few weeks ago I had a sample of oatmeal submitted to me for analysis, in which I detected a notable amount of ground lentils or some similar seed.

The next article, tea, is one which is very largely used at present in this country. In my opinion it is consumed, especially by the working classes, far too liberally. One dose of tea in the twenty-four hours is quite sufficient, and many people, I am quite convinced, who are at present troubled with headaches and many of the so-called nervous diseases, would be far better if they never drank tea at all. Especially I would advise all who hear me now to avoid that very great mistake known as a tea dinner. Tea and butcher meat should never be taken together, at least as forming the principal meal. The tannin, an important constituent of the tea, prevents the digestion of the meat.

The adulterations of tea are few in number. The principal, and I am almost inclined to say in the present time the only adulteration, is the addition to the tea of used tea leaves. The leaves, after having been exhausted in the teapot in the ordinary way, are collected in large quantities, dried, and, if necessary, rerolled and then mixed with fresh leaves.

Sand, impregnated with iron, has also been detected in tea. Green tea is sometimes "faced," as it is called—that is, it is powdered on the surface with different ingredients for the purpose of communicating to the leaves the admired green appearance. Prussian blue, indigo, plaster of Paris, slacked

lime, graphite, and French chalk, have all been employed for this purpose.

As a rule, if we except this green tea, the tea sold in Edinburgh is very pure. The stories of tea being adulterated with the leaves of the sloe, hawthorn, &c., however true they may have been at one time seem altogether destitute of foundation in the present day. In an old Act of Parliament, however, passed in Geo. III. time, we read that "great quantities of sloe leaves and ash and elder and other trees and shrubs were being manufactured and sold as tea, to the injury and destruction of great quantities of timber woods and underwoods."

Passing now from the more substantial articles of food to those which are used only occasionally, and more as adjuncts to the others, I first of all notice that old and justly favourite sweetmeat, honey.

Through all ages this substance has been an important and well-known luxury, and it is not pleasant to relate that in these, our own days, degenerate and money-making as we have become, a large proportion of the stuff sold under the name of the classical dainty is little more than flavoured starch syrup.

My experience of honey has been very bad, every sample which I have examined, so far as my memory serves, having consisted largely of this syrup. And this is pretty nearly the experience of another analyst who examined some samples from America and Switzerland, and found all of them, except two, to be adulterated.

The process of manufacture seems to be very simple. The syrup is first made from starch and oil of vitriol, it is then mixed with a little genuine honey, in order that it may possess the true flavour. This compound is then packed into very neat little jars, furnished with a bright taking label, and sent into the market as honey.

Unfortunately, analysts in their attempts to stop the sale of such a vile concoction as this are not much assisted by the public, who are either careless, or it may be are ignorant of the flavour of true honey—or they are quite content to eat and pay for the product of potatoes and vitriol as honey, so long as it is con-

tained in a package of taking appearance and possessed of a high sounding name. The two things, however, are as different as they well can be.

The honey which I have examined has always been what is known as "strained honey," but I am informed that the potato starch article is to be had in the comb. I have not to my knowledge seen this latest product of adulterating ingenuity, but it is said that the comb is very beautifully made out of white paraffin wax, and looks almost quite as well as the real article.

Unfortunately there is no simple test by which spurious honey can be distinguished from real, except by the taste. Analysts distinguish between the two substances by ascertaining the effect produced upon polarised light by a watery solution of the suspected material. Genuine honey turns a ray of polarised light slightly to the left, while the artificial imitation turns it strongly to the right.

Of preserves, such as jams and jellies, I have very little to say. The only adulteration I can remember of detecting in jam consisted in the substitution of dried and apparently foreign fruit for genuine black currants in the jam of that name.

We have all heard of marmalade being made from turnips, &c. This story I am inclined to believe is founded upon a popular delusion. No doubt jam purporting to be made from more expensive fruits has been shown to consist largely of some cheaper fruit, but with the exception of such admixtures, we may almost say that preserves of this kind are not adulterated.

With regard to preserved fruits and vegetables, many kinds of which seem to be consumed very largely in Edinburgh, these are occasionally impure, and the impurity arises from two causes. First, direct and wilful adulteration; and second, accidental impregnation with a portion of the metal of which the vessel containing the fruit is made.

As an example of the first we may take these beautiful green peas which one sees so often in the shop windows. As far as I can recollect, every sample of these vegetables which I have examined have been adulterated with a poison-

ous compound in the shape of a salt of copper. This adulteration is practised, I need hardly say, for the purpose of communicating the admired bright green colour which these peas possess in so eminent a degree. We have all also heard of pickles being adulterated in the same way. Such an admixture of a poisonous substance with any article of food is of course in the highest degree reprehensible, but to deal so with pickles is perhaps hardly so bad as with peas, seeing that many of us do not eat pickles at all, and that most of us at all events do not eat pickles so freely as we do peas.

As to the accidental admixture of poisonous substances with preserved fruits we may take such things as tinned peaches, pears, &c., as good examples.

In such things I have frequently found a quantity of metallic impurity, arising no doubt from the juice of the fruit having dissolved some of the solder or even of the tin of the vessel in which the fruit was contained. This can hardly perhaps be called adulteration, and yet as the effects of eating such impure food might be very serious, it behoves the sellers of these articles either to assure themselves that their wares are free from poisonous matters or to withdraw them at once from sale. My experience though of this, is that dealers trouble themselves very little in the matter.

Then as to these luxuries of life—confections. These favourites of our early years, I am happy to say, are not now nearly so impure as they used to be. It is positively alarming to read in some of the older books treating of this subject of the substances which were formerly in use for the manufacture of confectionery. In this respect matters have very much improved, and yet not long ago I found a large confectioner in Edinburgh colouring his lozenges, &c., with a yellow metallic compound, and a few months later I had sent to me some lozenges, by eating a few of which one person, at least, was very nearly fatally injured. My analysis revealed the presence of a very considerable amount of metallic poison.

These, however, are exceptional cases, and I believe that now

the confections made, at all events by the larger manufacturers, are very pure, that is, they are free from dangerous impurities.

Perhaps in this connection I should say a word as to the quality of the various forms of aerated water now made in such immense quantities. The best known of these is soda water. This title, to start with, is a misnomer. Soda water, as a rule, contains no soda at all; it is simply water holding in solution a large quantity of carbonic acid, and this escaping when the cork is removed from the bottle gives rise to the admired effervescence.

Lemonade, ginger beer, &c., are simply this so-called soda water sweetened with sugar and flavoured with different essential oils.

These things, so far as I know, are never wilfully rendered impure. In consequence, however, of the use in their manufacture of machinery partly constructed of lead, copper, or other metal liable to be attacked by the materials used in the process, it is no uncommon thing to find these popular beverages contaminated with metallic impurity to an undesirable extent. The presence of such a metal as lead is shown by adding to the water after the effervescence has ceased first a small quantity of hydrochloric acid, and then a liberal dose of hydrosulphuric acid, when a black or brown precipitate will be produced if the soda water is impure.

I have now just to say a few words relative to our three favourite condiments, and I have done. These three substances are vinegar, pepper, and mustard.

The first one, the Vinegar, although not always by any means so pure as it should be, is very seldom wilfully adulterated. The adulterations which we do find at rare intervals are sulphuric acid and water. Generally speaking, vinegar as now sold is of good quality, it possesses a fair degree of strength, and the old idea that the addition of a certain proportion of sulphuric acid was necessary for the preservation of the vinegar seems no longer to prevail. This then is one more item to be added to the unfortunately very short list of these articles of food which can readily be procured in a state of purity.

The second condiment I have enumerated, viz., pepper, is not nearly so free from admixture as vinegar. The substances used for adulterating pepper are said to be somewhat numerous. Among others are enumerated: ground rice, linseed meal, and sand. I cannot say that I ever detected either rice or linseed meal in pepper, but I have on more than one occasion detected the presence of sand.

The last substance on the list, viz., mustard, is adulterated to a very great extent. In fact I very much doubt whether there is any pure mustard sold in Edinburgh at all. If there is, I am convinced it bears a very small proportion to the total amount sold. This, I concede, is very bad, and at first sight it does not seem to say much for the efficiency of the public analyst. It is not the fault, however, of that long-suffering functionary. We have had several cases of mustard adulteration before the courts in different parts of Scotland, and in almost every one the authorities have been non-suited. How this result is arrived at is, I must admit, a little beyond my comprehension; but it seems that, according to the very peculiar Act of Parliament under which we work, that a man may sell mustard mixed with other and cheaper things, in response to a request for mustard, without let or hindrance.

The materials principally used to adulterate mustard are flour and a yellow dye called turmeric. The adulterations, therefore, of mustard, at least the common ones, are not numerous, but they are very prevalent. Pure mustard is, I believe, made and sold; but in consequence, I imagine, of the profit made by selling it being comparatively small, it is sold to a very limited extent only.

One can easily understand that there are very strong inducements, indeed, to sell adulterated mustard. Mustard is mixed, frequently I believe, to the extent of nearly one-fourth of its weight of flour. Flour costs somewhere about 1d. per pound, and mustard costs about 2s., so that if a dealer succeeds, say in disposing of 20 lbs. of mustard adulterated to this extent, he sells 5 lbs. of that which costs about 1d. per lb. at the rate of 2s. In other words, he sells for £1 that which costs less than 1s.

When a maker sells tons in a day instead of pounds, we can easily understand that he will make a very handsome income.

The adulteration of mustard is easily detected by means of the microscope, as you can see for yourselves from the diagram on the wall.

And now I have finished, but just before I close I would like to say a single word about the many abominations that are at present sold under the collective name of patent medicines.

The adulteration of drugs is a very important subject, but I must delay its consideration until another occasion. In the meantime, though I advise you all most strongly to eschew at once and for ever the use of all these medicines, with the wonderful names which, together with the lists of the marvellous cures they have effected, are so widely advertised. I have analysed some of these preparations, and a more complete system of robbery than is inferred by their sale it would be difficult to conceive. I think it is a pity that the composition of these so-called medicines is not so well known as their names and the powers and virtues claimed for them. If that were the case, gullable as we are, especially in the matter of medicines, these worthless concoctions would soon be things of the past.

In the matter of drugs as in the case of food, the efforts of public analysts must, to be successful, be seconded by the action of the public themselves, in whose hands the solution of the problem really lies. If people remain as they are at present, profoundly apathetic apparently as to the purity of the food they consume, all the public analysts that ever were will be insufficient to stamp out the evil; but if these officials be assisted in the discharge of their duties as they ought to be by the public generally, so that transgressors may be detected and punished in such a way that adulteration shall cease to be profitable, then these worst of rogues shall disappear, honest men will come in their place, and we will soon have what every one must admit is of the very greatest importance, so far as health and happiness is concerned, an abundant supply of really pure food.

THE DIGESTION OF FOOD IN RELATION TO HEALTH.

BY DR ANDREW WILSON, F.R.S.E., F.L.S.

MR CHAIRMAN, LADIES, AND GENTLEMEN,—The question, “Why do we eat our dinner?” is one which appears of very plain, matter of fact character, but it is also one, the answer to which, involves a very considerable part of the philosophy of human life, and of animal life at large. If we can properly answer the question, “Why do we eat our dinner?”—which, after all, is only another way of asking why we have any necessity for food-taking and food-getting at all—we shall be able to solve nearly three-fourths, not merely of important questions relating to human physiology, but likewise questions relating to political economy as well. For it cannot be denied that the task of getting food is one which lies heavily on the shoulders of thousands, nay, millions of our fellow-beings. If somehow or other, we had been constructed on a type or plan different from that which obtains in our case, so that there would be no necessity for food-taking and food-getting, human life would no doubt have been relieved of a very considerable amount of strain, and of a considerable amount of evil in addition. But we have nothing to do in this lecture with these somewhat transcendental enquiries. It is our business to-night to take the human frame as we find it, and to endeavour to answer as fairly and plainly as may be the questions, “Why do we eat our dinner—what is the necessity for taking food?” These matters involve inquiry into the reasons why

food is taken, how food is digested, and the rules which should regulate healthy digestion in all its phases. If, therefore, we can gain some broad, even elementary, idea of these points, we may claim to have laid the foundation of a study in physiology of a most interesting kind.

One of the most interesting subjects the physiologist can bring before a popular audience in answering the question I have just proposed, is that phase of human life which consists in the fact that a human being, or indeed any animal (and we might include any plant as well), is in a state of continual change, resulting from the work which, as a living body, it performs. For, at no period of our lives are we exempt from wear and tear. All the actions of life, from the pulsation of the heart to the winking of an eyelid; from the taking of a step, to the lifting of a finger—nay, more, even those subtle changes which pass through the grey matter of our brain, and which are evolved ultimately in the form of muscular action, and in the still more subtle essence of thought—involve wear and tear to the being which is subject to them. This question, “Why do we eat our dinner?” may be shortly answered by saying that the dinner represents matter drawn from the outer world, and calculated to repair the loss to which, in the act of living and being, we are continually subjected. It is very evident if the human being is a machine which is constantly working, it must be subjected to continual repair. Take even the case of a sleeping man—the rise and fall of the chest, the quiver of an eyelid, the faint movement, it may be, of a hand, show you it is not death, but “death’s twin brother, sleep,” you are contemplating. Although the man is resting from his labours, and though he is enjoying the repose of sleep, it may be said in another sense, that his body is the seat of constant activity. For you cannot still that wonderful pumping mechanism, the heart, which is engaged long before we are born and up till we die, in circulating the vital fluid through our system. Even the dreams which haunt us in our sleep, evince that you have a certain amount of brain-activity in repose; so whilst we repair the body in sleep we are still wasting its sub-

stance in this continual work of living. At no period of life, indeed, are we free from the attack of continual change.

In one of the weird stories for which Balzac was so famous in his day, he describes a man who made a compact with the evil one, and received as a gift from that Satanic source a certain magic skin—the *peau de chagrin* of the novelist. The possession of this skin gave to the man the power of fulfilling any wish, but proportionately to the number of wishes which were executed through the possession of this treasure, the skin itself grew smaller and smaller, and at last shrank away; so that with the accomplishment of the last wish, skin and possessor alike disappeared. Life is like the “skin of chagrin” such as Balzac depicted. Our greatest treasure is one which even in the act of our possessing it, tends to grow smaller by shrinking away in the act of using, but differs also from the magic skin, in having, for a certain period, possibility of repair.

We see clearly, then, that the philosophy of food-taking really involves a large part of the philosophy of life, and it is my duty to attempt to illustrate to you the main features which are represented in this act of food-taking and food-digesting. After we view in an elementary manner the chief stages in this process, it will be necessary to sum up those plain health-laws and health-axioms which may be said to flow from such a study.

In the table which is now placed on the screen before you, you will observe the expenditure of a healthy adult body per day amounts to about 58,650 grains of matter given off from lungs, skin, kidneys, and intestines respectively, and consisting of water, carbonic acid gas, urea, minerals, and organic matters. The amount of wear and tear represented by this waste, it is quite evident must necessitate corresponding repair; and thus to put the matter popularly we discover that a healthy adult receives into his body, per day, about the same amount of matter in the shape of solid food, water, and oxygen gas. In other words, about $8\frac{1}{2}$ lbs. of matter are received by, and given off from, the adult body per day. This is a statement which appears in the light of physiological book-keeping by single entry; but as regards its commercial aspect, it

is quite evident that in a satisfactory balance of the bodily books, we should have not merely to account for income and expenditure but likewise for profit. In this case the profit, not shown certainly in the balance sheet, is represented by the *energy*, or *power of doing work* we receive from our food. When it is considered that the heart of a man in twenty-four hours performs an amount of work which, if concentrated into one huge lift, would raise 120 tons one foot high, it can readily be understood that this literally enormous power of work can only be derived from the food we eat. And when the work of a human body in its entirety for a single day is summed up, we discover the curious and astonishing, but at the same time fully proved fact, that a power of about 3400 foot tons (that is a power which would lift 3400 tons one foot high) is represented in our daily actions and life.

Now it is with the proper preparation of the food or fuel of the body, that we are to-night especially concerned. This constitutes the work of digestion, and considering that its bearing is plain and manifest on the maintenance of health, I think you will agree with me that the subject is one which underlies all other questions of bodily comfort and happiness. Digestion may be defined not as an act of converting food into blood according to the popular view, but rather as that process whereby the food is changed into a fluid capable of being added to the blood, and of thus renewing and repairing it. In this respect, digestion is not merely a chemical process, but likewise involves many intricate physical ones. The chemical processes include the transformation of the various food substances into others, and the splitting up of certain compounds to form other bodies adapted to repair and renew the tissues. The physical processes are equally important, and are represented by those which secure the passage of fluids and other matters through the various membranes involved in the work of digestion, so that the products of the work shall reach the blood in the state best fitted for the repair of that fluid.

Again, it is necessary at this stage to acquire a plain and

popular idea of the nature of a digestive system. This may be described essentially as a tube running through the body of an animal, and into which food is received. In certain animals, such as the worms, this tubular condition of the digestive system is exactly represented. In other animals (notably the sea anemones) the tube is cut short within the body, and the digestive system thus comes to open into the body-cavity; but in all animals above the rank of these latter, the digestive system, where it exists at all, is a tube completely shut off from the interior of the body to which it belongs.

If, now, to this conception of a tube we add another thought, namely, that attached to the sides of the tube certain organs called *digestive glands* are found, we shall have completed a broad but comprehensive idea of the digestive apparatus. These glands are represented by the *salivary glands* of the mouth, by the *liver*, by the *sweetbread*, and by other structures embedded in the walls of the digestive tube; but they one and all have this feature in common, namely, that they pour upon the food in its passage through the tube, the fluids they make or secrete. These fluids, it is needless to say, have the aim and object of acting upon the food so as to digest and elaborate it.

The digestive system of man is thus seen to correspond to the tube-idea in its nature. You observe, in the view now thrown on the screen, the mouth as the anterior opening of the tube, the gullet or œsophagus, the stomach (which is a mere expansion of the tube), and finally, the intestine divided into the small and large intestine—a tube measuring in man some 26 feet.

Such being the digestive apparatus, we have now to consider the stages through which the food passes in its transit through this tube. Digestion may be divided into three stages—firstly, digestion in the mouth; secondly, digestion in the stomach; and thirdly, digestion in the intestine; and we shall find it necessary to pay some little attention to each of these three divisions of the process. From the popular point of view digestion is commonly supposed to be a process which begins and ends in the stomach. On the contrary, I cannot too strongly insist upon you

recognising the fact, that digestion not merely begins in the mouth, but is continued onwards far past the stomach itself. In the mouth, three processes take place. The food is firstly divided by the teeth, this constituting the process of *mastication*. It is secondly mixed with the saliva or "water" of the mouth, this constituting *insalivation*. It is thirdly swallowed, this constituting the process of *deglutition*.

We shall consider, then, these three actions in their order. The teeth number thirty-two in the second or permanent set. In the first set they number only twenty. If we were asked to make a catalogue of our bodily belongings, the probability is we should be inclined to consider the teeth as parts of the bony system, but so far from having any relation to bones, teeth are really structures which belong to the skin, and are therefore "first cousins," if I may so put it, of hairs and nails. We can readily understand this by glancing for a moment at the development of a tooth. The teeth begin in the form of small *papillæ* or projections on the gum or mucous membrane of the mouth. A groove is first formed, and from the floor of this groove the papillæ in question arise. Each tooth has, in fact, such a projection, as a kind of tooth-mould. In due time the edges of the groove grow together and enclose the projections in sacs. Finally, blood-vessels bringing the minerals which are to form the hard parts of the teeth, coat the papillæ or projection with the tooth substance, and thus in due time the tooth emerging from the sac in which it is enclosed, cuts the gum.

Throughout this process, bone has really had nothing whatever to do with the formation of the tooth, and as the gum which is responsible for the tooth's growth is really modified skin, we can understand how the nail and the hair should thus become related to the tooth in their origin. The second set of teeth is produced in the same manner as the first set; and even before the first set has been completed, the germs of the second set are to be seen in process of growth. Cases in which a third tooth has replaced the loss of a second in man are rare, but in many lower animals a continuous succession of teeth may take place throughout life.

In its structure, a tooth consists of three substances. The bulk of it is composed of *dentine* or ivory, consisting of numerous fine tubes. The crown is covered with a layer of hard substance called *enamel*, and the roots are coated with a third substance called *cement*. Internally, the tooth is hollow and contains a pulp. This pulp, rich in blood-vessels and nerves, really represents the papilla on which the tooth was formed. It is when this pulp is exposed, through the tooth decaying, that the pangs of toothache are induced. Sixteen teeth exist in each jaw of man, the arrangement in each jaw being similar. There are thus four incisors, or front teeth ; two canines, or "eye" teeth ; two bicuspid, or pre-molars ; and six molars in each jaw. The last or hindmost molar is called the "wisdom tooth," from the fact that it appears somewhat late in life ; but I possess the acquaintance of several individuals who, having attained mature years, and still lacking the last molar, are by no means believers in the theory that any connection exists between the development of their dental apparatus and intellectual wisdom.

One of the primary rules for health in relation to digestion concerns itself with the *care of the teeth*. It is astonishing to note how few people comparatively attend thoroughly to the health of the teeth. Yet when we consider the important part played by the teeth in digestion, the duty of carefully considering the health of the teeth rises high in importance in the list of physiological details. Primarily, it might well be argued that the possession of thirty-two hard particles within our mouths indicated an important use for these structures ; but, judging from the frequency with which the food is "bolted" both by old and young, it is clear the proper use of the teeth requires to be strongly insisted on by all health-lecturers. There is only one nation, I believe, worse off than ourselves in the matter of teeth—I mean our American cousins. It is lamentable to reflect upon the amount of pain and misery which is incurred by the neglect of simple precautions in the matter of the teeth. Thus, if the teeth are allowed, as they too often are, through sheer

neglect, to become decayed, mastication is a painful process, the food is bolted in masses too large for easy digestion by the stomach, and the first stage of indigestion may thus be produced. Hence the care of the teeth becomes a moral duty in reference to health, and if the teeth are unsuited for their work it equally becomes a moral duty in this respect to seek the aid of the dentist.

The proper care of the teeth is after all a simple enough duty. No mere fluid washes will benefit the teeth. We must use first of all a brush moderately hard, and a dentrifice, such as camphorated chalk or magnesia, will be found amply qualified to satisfy all the requirements of the teeth. Again, the teeth should be brushed morning and night—not across, but up and down—and the night-brushing I esteem the more important of the two, seeing that through its agency we get rid of the particles of food which may have collected in the mouth from the work of the teeth through the day. Left to themselves, the teeth decay through the simple process of the generation of acids, induced by the growth and multiplication, within the mouth, of those minute forms of plant life whose germs everywhere beset us. Should the gums be tender, or a mouth wash of a healthy character be required in addition to the brushing of the teeth, I should recommend you to add a few drops of “Calvert’s Dento-Phenolene” to half a tumbler of water, and to use this as a simple lavement for mouth and gums.

The second action which occurs to the food in the mouth is that of insalivation. There is scarcely any fluid of which we are more careless than the water or saliva of the mouth, yet this fluid is of extreme importance in digestion. It is furnished by three pairs of salivary glands—the *parotid glands*—situated in front of the ear, and which become enlarged in the affection known as “mumps;” while the *sub-maxillary* and *sub-lingual glands* lie practically in the floor of the mouth. Each gland opens into the mouth by a tube or duct of its own, and thus pours its fluid into the mouth cavity. It seems to be an ascertained fact that the saliva manufactured by these glands varies in its composition according

to its special source, but the functions of saliva are in themselves clearly made out. Thus it is necessary for proper articulation or speech. It dissolves many substances, and thus aids the sense of taste; it is necessary for the act of swallowing in moistening the food; and lastly, it possesses in man, although not in all animals, a special chemical action on the food. In the table I show you on the screen, saliva is shown to consist of a very large proportion of water—in this respect resembling all other fluids of the body—of minerals, of matters derived from the mouth itself, and of a substance special to the saliva called *ptyalin*. The chemical function of the saliva may be described as acting specially on starchy foods. A piece of stale bread taken into the mouth has its starch acted upon by the saliva, and assumes a sweetish taste. Chemically explained, we find this result due to the fact that the ptyalin acts on the starch and converts it into grape-sugar. A preliminary process of digestion is thus seen to begin in the mouth. Nature, in other words, intends that the starch which forms such an important element of our food, shall be chemically changed in the mouth in the fashion just described by the action of the saliva. The habit of bolting the food, therefore, becomes injurious on other grounds than those already mentioned, inasmuch as starchy foods escape the conversion which it is intended they should undergo.

An interesting point in connection with the work of saliva is that which reminds us that the saliva of infants under eight or nine months old is not fully elaborated, and is therefore incapable of effecting this change on starch. Hence no child under the age mentioned, should be supplied with any starch at all. Milk is the only food which the infant should receive, and I think I am perfectly within bounds in saying that the immense mortality which attends children under one year of life, is largely due to the carelessness and the ignorance which together prompt mothers to feed their children on starchy and other foods for the digestion of which the infant frame is utterly unsuited.

The action of swallowing closes the food-operations with which the mouth is concerned. This is, of course, a highly complex

process, in which the tongue and intricate muscular arrangements of the mouth and throat are called into requisition. Popularly described, we may say that the food is moulded into a bolus, which when about to be swallowed is placed on the back of the tongue, which becomes somewhat hollowed to receive it. The tip of the tongue is then applied to the roof of the mouth, and the bolus is tilted backwards. Next the hinder parts of the mouth are drawn up so as to close the openings of the nose into the mouth. The upper part of the organ of voice, the opening of which is protected by a little lid (or *epiglottis*) seen on the illustration on the screen, is also drawn up towards the root of the tongue. As the morsel passes backwards, this epiglottis closes over the opening of the windpipe, securely protecting the tube in ordinary circumstances against the invasion of food, while the mass of food passes into the upper part of the gullet, and is thereupon seized by the muscular walls of that tube and propelled downwards to the stomach. Swallowing is thus largely involuntary in its nature. Occasionally we meet human beings with the power of returning at will the food to the mouth after it has been swallowed, a process which takes place in the ruminant animals, or those that "chew the cud." In the illustration of the ruminant stomach now shown you, we see the four divisions of that organ. The food when first swallowed passes into the first stomach, thence into the second, and thence is propelled upwards to the mouth. After being remasticated it is returned to the third stomach and then passes to the fourth stomach or *rennet*, which is the true digestive cavity.

The food having arrived in the stomach, we must now glance specially at that organ, and thus enter upon the consideration of the second stage of digestion. The stomach of man is a pear-shaped bag, having its large end lying towards the left side, the small, or intestine, end, lying to the right. The liver occupies a position on the right side of the stomach, the spleen to the left, and the pancreas or sweetbread somewhat below the stomach.

The cubic capacity of the human stomach is about five pints. Lined as it is by a mucous membrane, which is continuous with that

of the throat and mouth, it is seen to exhibit rugæ or folds in the empty condition of the organ, its lining membrane being likewise of a pale pink colour. When food enters the stomach these folds disappear, thus giving increased capacity, while the lining membrane becomes of a deep red colour, through the increased flow of blood which takes place to it. The stomach, in fact, thus practically blushes when food enters it, the increased flow of blood being necessary, to afford the raw material for the secretion or manufacture of the gastric juice. This fluid is the characteristic secretion of the stomach, and is formed in certain glands, which may generally be denominated *gastric glands*, and which are situated in the substance of the stomach's walls. Each gland is essentially a minute bag lined by living cells, and having a dense network of blood-vessels (shown you on the screen) surrounding it. The blood borne by these vessels supplies to the cells the raw material; the gastric juice being the manufactured product. This juice is poured out on the food in drops from the little orifices of the glands. Chemically analysed, it is seen to contain a large amount of water along with certain other substances, of which the most characteristic is *pepsin*.

It is a curious fact that the stomach appears to have little or no power of digesting fats, starches, or sugars. The foods over which it does possess a digestive influence are those nitrogenous foods to which reference has already been made in other lectures. Mixed with the gastric juice, these foods appear to be converted into substances called *peptones*, and hydrochloric acid is also found in the gastric juice assisting this conversion. The meaning of this change in the stomach seems to be clear when we consider that, as swallowed, nitrogenous foods are incapable of being absorbed into the blood, whereas, when converted into these *peptones*, they are readily absorbable. Thus the minute vessels of the stomach seem to receive, at this early stage of digestion, a supply of important food, which is directly made use of as an addition to the blood. Part of the structure of the stomach, and likewise of the intestine which succeeds it, consists of muscular tissue, and by this means

the food is made to circulate in the stomach so as to become thoroughly mixed with the gastric juice.

At the close of digestion in the stomach the food is converted into a pulpy mass called *chyme*. Fats, starches, and sugars have undergone little change other than that already described as occurring in the mouth, while the nitrogenous parts of the food have passed into the blood to be conveyed to the liver, and probably to be also utilised in part directly, in the work of repairing the tissues. At the close of digestion in the stomach, the *pylorus*, or intestine-opening of the organ, uncloses, and the food is propelled by the stomach's next contractions into the intestine. The intestine, as I have already said, is divided into the small and large intestine, and it is undoubtedly in the small part of this tube, which extends to the length of about twenty feet, that the chief part of digestion is accomplished. On leaving the stomach, the food or *chyme*, as we may now call it, is mixed with the secretion of the liver, namely *bile*, and with that of the sweetbread or pancreas, namely pancreatic juice.

The liver essentially consists of a collection of minute cells, called *hepatic cells*. Large as the organ is, it is therefore a colony of little living manufacturers of bile, although in addition to this bile-making function, the liver would appear to possess certain other important duties, more or less connected with digestion. In the view now thrown on the screen you observe the distribution of blood-vessels intimately associated with the liver. You may observe that a certain large vein, called the *portal vein*, returning blood from the stomach, intestine, and other organs, enters the liver. We see therefore that the liver may be regarded as an organ placed in the direct track of the impure or venous blood returned from the stomach, intestine, and other organs, and there can be little doubt that into the liver along with this blood there are carried by the portal vein substances absorbed from the digestive system, and which appear to be further elaborated in the liver itself. Meanwhile, along with the bile that is poured on the food after it leaves the stomach, we find the *pancreatic juice* from the sweetbread. This pancreatic juice is of high importance in digestion, for it is known to be the chief digester of

the fats contained in the food, while it likewise has an action on the starches and sugars, and in this respect may be said to supplement in an important degree the work of the saliva of the mouth. The liver used to be regarded as the more important of the two organs in relation to digestion; but the sweetbread from recent researches seems to assume the chief place in this respect, since it appears that chiefly through its action those foods which are not affected by the stomach are chemically broken down and converted into *chyle*—the fluid which I have already spoken of as being adapted when added to the blood to renew and repair that fluid.

What, then, are the special uses of the bile which the liver makes? It is probably correct to assume that the bile in one sense represents rather a waste product than an actual secretion; that it represents the results of more important work done by the liver than the true aim and end of the liver's action. For one thing we know, that when bile is thrown upon the food, and thus passes into the intestine, the movements of that tube are remarkably stimulated. Again, the bile probably exerts an antiseptic or preservative action on the food, thus preventing too rapid or even injurious chemical change. As a digestive fluid, however, its value appears to be of much less importance than in former years was supposed.

The liver, then, is somewhat of a complex, and as yet imperfectly understood organ. It is, for one thing, the production of a large amount of heat, produced by the chemical changes which are perpetually going on within it. Then, when an animal is fed on starches or sugars, it is found that the liver stores up quantities of a substance called glycogen, which is closely related to starch in its chemical composition. Moreover, this glycogen is readily convertible into sugar. If, therefore, starches and sugars are contained in the food, these do not pass from the digestive system into the blood, but appear to be captured by the liver, and stored up as glycogen.

What, in the last place, may be said to be the meaning of this glycogen storage? The probability is, no satisfactory answer can be returned to this question. It was believed by Claude Bernard that the glycogen was given out by the liver in the

transformed shape of sugar, and that this sugar, conveyed to the heart and lungs, underwent chemical combustion in the blood, and was thus a source of bodily heat. Now, this result certainly occurs in the diseased condition called diabetes; but in health there is no passage of sugar into the blood, and the problem which at present awaits physiological solution resolves itself into the enquiry regarding the destination and fate of the glycogen. That it passes away from the liver in some form or other is a supposition fairly warrantable, and I may rest content by laying before you the assumption that its destination is probably the muscles to which it stands in the relation of a food-supply, giving to these organs the matter which is constantly being "burned off" in them, in the ordinary movements of the body.

Returning now to the small intestine, we discover that its inner membrane is thrown into very conspicuous folds called *valvulae conniventes*, which serve to increase the digestive surface over which the food has to pass, and thus the milk-like fluid, called chyle, passing along the intestine, is now ready to be carried into the blood. For this purpose special vessels called *absorbents* are provided, and the chyle seems, in the first instance, to strain through the walls of the intestine into the absorbent vessels, the beginnings of which exist within certain minute projections of the intestine, called *villi*. Absorbed by these vessels, the chyle is carried to a tube lying along the right side of the spine, and called the *thoracic duct*, and this duct in turn opens into a large vein at the root of the neck on the left side. It is at this part of the body, therefore, that the junction between the food and the blood takes place, and it is here that those supplies of fresh material required for the continuance of the body's work are added to the great stream which is perpetually flowing through the blood-vessels.

In the diagram of the absorptive system shown you on the screen, you may see how the absorbing vessels also appear to branch all through the body, their duty being that of gathering from all parts of the body the *lymph* or fluid part of the blood which has been used in the act of nutrition; this lymph being gathered up once again into the blood circulation, and used in the repair of the blood.

Lastly, if we for a moment look at the blood itself, and its composition as shown you in the diagram, you note that it is in its way a fluid epitome of the body itself. It contains those corpuscles which begin to appear in the chyle, and in this light we may note in passing, that the *spleen* itself is simply to be viewed as one of the blood glands attached to the absorbent system, and apparently concerned with the work of elaborating and forming the blood-corpuscles. It is the duty of the red corpuscles of the blood more especially to convey the oxygen gas we inhale in breathing to all parts of the body and tissues. Thus from the right side of the heart the venous or impure blood received from the body is perpetually being sent to the lungs; while from the lungs, after purification, the blood is returned to the left side of the heart, for circulation through the body.

The aims and objects of this lecture would be imperfectly discharged did I neglect to summarise, in a closing sentence or two, the chief points which appear to me to contain the gist of scientific experience in relation to the health-aspects of digestion.

Firstly, I should say that those who wish to avoid indigestion, and the train of physical horrors which accompany indigestion, that hydra-headed ailment, should make a special note that perfect mastication and division of the food by the teeth is an essential condition for health. If the stomach receives masses of food too large for easy digestion, its functions become impaired, and the habit of bolting the food is therefore one of those pernicious practices which sooner or later lay the foundation of a train of evils in connection with the imperfect assimilation of food.

In the second instance, where mastication is not perfectly performed, and where the food is not thoroughly broken down in the mouth, the action of the saliva upon the starches of the food is imperfectly carried out; and thus, food which should be chemically altered in the mouth is passed on to the stomach in a state in which nature never intended it should be acted upon in the further course of digestion.

Thirdly, I should strongly insist upon the recognition of the fact that rest after meals is one of the most important points our

attention in this matter of healthy digestion. The work of digesting food really involves a large expenditure of nervous and muscular power, as well as a considerable expenditure of other powers not so readily demonstrated. Viewed in this light it can well be understood that no violent exertion should be indulged in immediately after a meal. The old proverb, "After dinner rest awhile," has thus a physiological justification, and I am fully persuaded that many who suffer from digestive troubles may rid themselves of such troubles by attention to this latter rule.

In the fourth place, I regard the individual culture of health as being the only sure basis on which we can authoritatively speak, each with regard to his own wants and experience in the matter of foods, drinks, and digestion. Those philosophers who talk so glibly about the abuse of alcoholic liquors, ought to be reminded that their remarks might equally well be made to apply to the abuse of tea, coffee, and indeed to other foods and drinks. You cannot lay down laws for the million in this respect. Life can never be regulated by some mathematical rule of three, as some ardent persons amongst us seem to think. It is not the experience of the mass, but that of the individual, wisely formed and appreciated through a knowledge of health laws, which alone can serve as a guide in the choice of the foods and drinks which are most suitable for him.

Lastly, I should not omit to mention that cheerful company at meals is by no means an unimportant addition to healthy digestion. It is, on the contrary, one which is too frequently overlooked, to the detriment, I am persuaded, of our health. It is true this may be a condition not always or readily attainable; but if "a merry heart lives long," as the poet has expressed it, I for one can readily see a justification of the aphorism, in the fact that the happiness thus induced, must both act and react upon the healthy digestion of food.

These, it appears to me, are the chief points to which our attention should be directed in connection with the nourishment of our frames; and to the intelligent enjoyment and personal cultivation of such views, I am persuaded, we shall owe the possession and practice of a healthy and, because a healthy, happy life.

ANNUAL MEETING.

PROFESSOR ANNANDALE, Chairman of the Committee, presided at the Annual Meeting of the Society, at which the appended Report was read. About 400 members were present. He intimated that letters of apology had been received from the following gentlemen :—Professor Douglas Maclagan, Bailie Clark, Councillor Dr Russell, and Dr Byrom Bramwell, who all regretted their inability to be present.

In moving the adoption of the Report, the Chairman said :— I am quite sure that you will all agree with me in thanking very sincerely those gentlemen who have given the lectures this session. (Applause.) I feel certain that these lectures have been of great service to those who have heard them, and will be so also to those who may read them in future ; and I hope that all who so know of them will tell others of them, so that the benefit of these lectures will be extended as widely as possible. (Applause.) I cannot help thinking, Ladies and Gentlemen, that in addition to the information that is provided by these lectures there is another good thing in connection with them, and it is this, that they tend to bring together in our audiences all classes of society. (Applause.) I have no sympathy with those who endeavour to set class against class—(applause)—because I think it the duty of every true citizen to bring the different classes together, so that they may know each other better. I am sure they will find they have many sympathies in common ; and although there may be differences of opinion in regard to many things, yet if we men and women only feel and consider these sympathies, it cannot but result in good to us all. (Applause.)

Passing now to the particular lectures which have been given during this session I shall make a remark in regard to the first lecture—that given by Dr Batty Tuke. One of the most important practical points in connection with Dr Tuke's lecture was that in which he referred to what is called "over-pressure" in schools. Well, it is quite possible, I think, that occasionally there may be this "over-pressure;" but I think he touched upon the real point, and that was the question of not only feeding the brain but of feeding the body. (Applause.) We all know that unless the body is kept in a healthy condition by proper food and treatment, it is perfectly impossible the brain can be vigorous and healthy, or in the case of young people that it can be properly developed. Therefore I take this opportunity of asking you to support all those institutions in town—and there are several of them—which have for their object the feeding and clothing of the destitute poor children. (Applause.) It has sometimes occurred to me, Ladies and Gentlemen,—and perhaps I am touching, especially in this hall, on a delicate point, still, as it is my opinion, I give it you for what it is worth,—that if some of the money, energy, and enthusiasm which is expended on what are called foreign missions, were expended in connection with our poor at home, it would be better for our country. (Applause.) I do hope no one here will think that in making this remark, I object in any way to foreign missions; but looking, as I have done, to the results which are obtained in connection with many of them at a great expenditure of labour and money, I cannot help thinking that more important results in every way would have been obtained if that money and energy had been expended in our own country. (Applause.)

Then we come to the second lecture—that of Dr Byrom Bramwell—on "The Causes and Prevention of Disease." Now in my own special profession it is a great matter for us, when we are called upon to treat a disease, to ascertain its cause; because if we can do that, we have of course the best chance of treating it successfully. You all know that "prevention is better than cure," and whenever you can prevent any disease by putting

away its cause, you not only save many lives and much distress, but you will also save much money. (Applause.) If you look at it from a practical point of view—and I am a practical man, because my part of the profession makes me a practical man—(applause)—it comes to this: suppose your house-drains are out of order, and you do not put yourself to the trouble to get them put right, you may be sure that sickness and all its attendant troubles will almost certainly be the result. Fever will break out in the family, perhaps several members are attacked, and you have to call in the doctor,—and the doctor's bills come to something. Then medicines come to something additional, and perhaps paid nurses are also required. Finally, there may be death and all the lamentable expenses of a funeral. Consider then—and this is *practical*, remember—how much actual expense as well as trouble might have been saved if the small amount required to put your drain right had been expended at first. And if, as probably the majority of you are, only tenants of your houses, remember that your landlord is bound by law to keep your house in a sanitary condition, and that if he seems unwilling to do what is necessary to keep it fairly healthy, you should at once bring your case before the Burgh Engineer, or our excellent Town Medical Officer, Dr Littlejohn. Therefore, I say, this lecture of Dr Bramwell's is especially valuable in teaching you some of the causes which produce disease, and how to prevent them.

Then, in regard to Dr Ritchie's lecture on the Bath, it seems to me there has been no lecture more appropriate, because, remembering the saying that "Cleanliness is next to Godliness," we have on a Saturday night the lecture on cleanliness and on the Sunday we are supposed to have a lecture on theology. I need hardly say the lecture was especially valuable, the more so because it has given rise to a very important and practical *leaflet*, which will be largely distributed. I believe this leaflet alone will have great effect in promoting cleanliness among our poor population, because Dr Ritchie has shown in it, by an interesting sketch, that there is no excuse even in the poorest house for the absence of

the bath. All you have to do is to put up a sheet or blanket in a corner, have a tub of water, and there you are. (Laughter.)

Then Professor Cunningham's lecture was also very interesting, especially to our female friends, because they learned from it how many yards of hair they might have if they only took proper care of it. (Laughter.)

In regard to the lecture on Marketing and Cooking, there can be no doubt that, as the report says, it was one of the most important of the series. (Applause.) Now there is nothing more important in connection with true temperance,—and I am very sure of this,—than that the women of our working classes should know how to market economically and cook food which is digestible, and to a certain extent tasteful. Many a man who comes home and finds a dirty or untidy house, and food either not cooked or improperly cooked, and perhaps the money he has left for housekeeping all spent in an uneconomical way, I am sure in many instances takes up his hat, and goes straight off to the public-house; whereas if he had found a tidy house, a clean and *well-cooked* dinner, and however poor it may be, it may always be *that*, he would have gone and washed his hands and face, taken his bath behind a sheet perhaps—(laughter),—and sat down with his wife and children, and enjoyed their simple meal. Then possibly he will say to his wife, if it be a Saturday night, "We have had a comfortable dinner, and not spent much money." We will go to the Health Lecture, and put sixpence in the plate. (Laughter.) Or, if he preferred, he might go to hear the Christy Minstrels, or to see the pantomime, or to have any other rational amusement.

Then we come to the lecture on "The Adulteration of Food," a very important matter. My own personal opinion in regard to it is this, that the inspection of adulterations is not at all satisfactory. I wish that this matter were upon a much more satisfactory footing, and in saying this I mean it should be more satisfactory not only as regards the buyer, but also as regards the seller. Take, for instance, milk. Milk is one of the most important diets, as you all know, not only for adults, but especially

for children. Now many prosecutions in connection with the adulteration of milk have failed, and properly so, for this reason—the authorities have not taken into consideration the condition of the cow which furnishes the milk. My idea is there should not only be careful inspection of the milk itself, but also of the cow which gave the milk, and its surroundings. (Applause.) There are many family men and women here, and all know well that a woman cannot at times nurse her child because she is in a delicate state of health—her milk is not properly nourishing. There are also many temporary conditions—a woman has a shock, or a family row which affects her nervous system, and the result is, the baby who has imbibed her milk has a pain in its stomach next morning. Cows have nerves as well as women, and are sometimes in delicate health as well as women; and the fact really is, that we are often getting milk from delicate cows, or from cows which are temporarily out of health. Now, if in inspecting the milk the condition of the cows is also taken into consideration, then perhaps we should get at some reliable ground on which to prosecute. I should have no sympathy with any who adulterates milk or other human food knowingly; in fact, I should put him in solitary confinement, and feed him upon what he has adulterated. (Laughter.) I think, however, that in some instances the *retail seller* of food, whether milk or otherwise, has been rather hardly dealt with; because he may sometimes get the food with perfect faith from a wholesale dealer who may have adulterated it, and the retail dealer may suffer. Therefore, we want something more thorough in our investigations. We must not only investigate the material itself, but investigate the source. (Applause.) If this were done more thoroughly we should be doing justice not only to the consumer, but to the seller. (Applause.)

Our last lecture was that on the “Digestion of Food,” a very important matter. There is one point in connection with it which many scientific people quite ignore altogether, and it is this, that, as the old saying has it, “What is one man’s food is another’s poison.” Although we know many things in regard to ordinary

digestion, many people have individual peculiarities. Every individual, as Dr Andrew Wilson said, should judge for himself and find out what agrees with him and what does not agree with him, and stick to the former. In connection with this it is a well-known fact that some of even the most simple foods are in some instances almost poison to particular people. Mutton, for instance, sometimes, in exceptional cases, acts as poison; although I hope all of us here to-night can enjoy a leg of mutton without fear of harm. It is for this reason I may impress upon you the necessity not only of attending to the general and ordinary principles of digestion, but also of endeavouring to avoid those things which do not agree with you. (Applause.)

I would now like to say a few words in regard to these little leaflets which have been placed in your hands to-night.* The Health Society Committee were anxious that the public should know exactly what our authorities can do for them in Sanitary matters, and we therefore communicated with the authorities, and they very kindly have, under the direction of Dr Littlejohn, furnished us with this leaflet. We found many people were not aware of what the town would do for them in regard, for instance, to infectious diseases, and in regard to disinfecting houses and clothes; and we hope that by distributing this leaflet, knowledge as to these matters will be widely known and taken advantage of. We are much indebted to the authorities, because they have not only provided this leaflet but have printed it at their own expense. (Applause.)

There is another matter, and a somewhat delicate one, which has not been referred to in the report, but as it is connected with health I would like to refer to it. It is Temperance. I have already referred to this question when speaking of the importance of good cooking and simple food in regard to it. I know there are differences of opinion as to how it may be best promoted, but I hope there is a unanimous feeling among us that Temperance should exist—(applause);—and I think we should all endeavour so far as we can to put a stop to the intemperance which is

* This leaflet is printed on page 186.

undoubtedly one of the saddest things which exist in our country. (Applause.) Now, I cannot but think that this Health Society of ours is doing great work in this direction. We hold that one of the most important things in connection with real temperance, *the* most important in my opinion, is the PRACTICAL EDUCATION OF THE PEOPLE—teaching them what is good for them and what is not good for them, teaching them to have HEALTHY HOMES, CLEANLY BODIES, SIMPLE FOOD AND DRINK, and also PROPER AMUSEMENTS. We have also pointed out the importance of getting hold of the very poor children when they are quite young, and not only teaching them but feeding them and clothing them properly. I think if the Health Society continues its labours in this great educational work, they will certainly be assisting to an appreciable extent this great cause of true Temperance, and not only temperance in drink, but *temperance in all things*.

I would ask you now to look at the Financial Statement at the end of the Report. I am sorry to say this is not satisfactory. Practically speaking, we are not living upon our income. This year we have had to encroach on our capital to the extent of nearly £20. Now, Ladies and Gentlemen, this is not as it should be. If you, as members of this Society, think it is doing good, that it is benefitting all classes, then I think that we are justified in expecting that you should do a little more in the way of adding to our funds. (Applause.) We do not ask for much ;—we do not expend a great deal, as, you know, all our lecturers give their services free, and therefore I think it is scarcely creditable to the citizens of Edinburgh that its Health Society, which is generally acknowledged to be doing good work, and which provides such excellent lectures by distinguished men, should not be able, at least, to pay its way each year. We shall be very happy, therefore, to receive to-night, or at any other time, subscriptions, which will, if possible, take this discredit from us. (Applause.)

I will now conclude by moving the adoption of the Report. (Applause.)

MR M'CANDLISH, F.R.S.E., said—I rise with great pleasure to second the motion the Chairman has just made. It scarcely needs anything to be said in commendation of that motion. The very fact of so large a company being assembled here on such a stormy night is a sufficient indication that here at any rate a proper value is placed upon the work of this Society. (Applause.) But I should like, having been asked to take part in this meeting, to express the very great gratitude which I think the community owes to this Society, and to its Council and Office-bearers, for organising the course of lectures about which you, sir, have been giving us so graphic an account. One of the first things perhaps most of us require to learn is to know how very ignorant we are about the commonest affairs of life. I was thinking only to-day about a number of things which everybody supposes that since they were children they could do without any teaching or effort. I daresay few here imagine it is not the easiest thing on earth to walk, but those of us who have gone through the experience of being volunteers know that to walk straight to any given point, and so as not to tread on the heels of the man before you, or allow the man behind to tread on your heels, so as not to stumble on the man on your right hand, or on the man on your left, is a thing that requires a great deal of training and practice. (Applause.) Two friends of mine, within the last few weeks, have begun to receive instruction, one in singing and the other in elocutionary reading. The first thing both of these persons were taught was *how to breathe*. I fancy we all of us imagine we can at least breathe. (Laughter.) But to the great surprise of one of my friends, she was told that for many years she had breathed altogether wrongly. (Laughter.) So she has begun to learn now how to do it. I recollect a friend of mine telling me a number of years ago—a very distinguished and eminent man he was—that it was only when well on in life he happened to take up a friend's eye-glass and apply it to his eye, that he discovered he had not properly *seen* up to that time. A new world was opened up to him, for it turned out that for all these years, although he thought

he saw, he had not really been seeing things properly at all. In the same way I suppose we all imagine we know how to live and keep our health, but those who have listened to the lectures, or read them, or even heard what you, sir, have been saying to us to-night, must have found out that they want a great deal of instruction on these points, and that most of us, during the greater part of our lives, have been going wrong in some particular or other with regard to our health. We are therefore greatly indebted to this Society for the educational process which it has set in operation, and I do not know that there is almost anything more important to men and women than the end which this Society aims at, namely, the securing of good health amongst the community. (Applause.) I fancy that there are—in fact, there is no doubt that there are—endless distinctions between the miserable condition of mortal disease and the happy condition of robust and perfect health, and I should not be at all surprised that many of us were living in utter ignorance of whether we were in good health or not. People are in low spirits, are cross and ill-natured at times, they want energy and force, and these and other such unpleasant things they ascribe to all sorts of causes, while they are *really* the result of not being in good health. And so one great gain such persons would have by attending the course of instruction this Society gives, would be to find out how much more healthy they might be if they chose to take the trouble and give the time and attention required for this most important purpose. There is an interchangeableness of things in this matter as there is in other matters of science. Everybody knows that a certain quantity of heat can be turned into a certain quantity of power or motion, and that a certain quantity of motion can be converted into a certain quantity of heat. In the same way we can convert a certain amount of time and attention into health, and that health again into money. We can, on the other hand, neglect health, and save some present time and attention, but we shall very soon find out our mistake and loss in doing so; whereas if we took things a little more wisely, and saved our health, we should

find that health again is the fruitful source of profitable time, of fresh force, and more money. (Applause.) Then another very important thing brought out by the lectures of this Society is the great value not only of being in health ourselves, but of our neighbours being in health too. We may be at the greatest possible pains to keep ourselves healthy, and have healthy food and houses, but if our next door neighbours neglect these things,—if for instance *they* have bad drains though we have good ones, and fever becomes epidemic in the neighbourhood,—then all our efforts may be frustrated because our neighbours are not so well informed or so careful as ourselves. It becomes, therefore, of the utmost importance that we should do everything in our power to promote the health of the whole community. (Applause.) Then, sir, I would just venture to say that although, like all great discoveries, this great question of sanitary science, which is a comparatively modern discovery, may not make its way in the world with very great rapidity, yet it *will* make its way; and it will certainly do so all the faster through the work of this Society. Because not only does each man and woman who hears or reads these lectures get a great deal of information for themselves, but they become sources of information for others. The facts brought under our notice come home so forcibly to each of us that it is scarcely possible for us to hear or read them without talking about them to other people, and so gradually widening the circle informed as to and interested in these important matters. I will conclude by saying that while health alone is not the only important thing to promote in the community, yet everybody must be convinced that the great mass of misery and sin and suffering which meets us on all sides requires to be combatted by every possible means. I do not believe that moral means alone will prevail without some physical means too, or that physical means alone will prevail without moral means. The two improving forces must go hand in hand. We have to do battle with sin and misery all along the line, and *every* direction in which instruction can be given and influences brought to bear so as to make men more moral, more

happy, and *more healthy*, ought to receive encouragement from all who have the best interests of their fellowmen at heart. (Loud applause.)

The Report was then unanimously adopted.

COUNCILLOR M'INTOSH, in moving a cordial vote of thanks to the Committee and Office-Bearers of the Society, stated that he—as a member of the Public Health Committee of the Town Council—knew that the authorities were grateful for any assistance and suggestions they might obtain through such a Society as this in carrying out the important public sanitary duties entrusted to them. He would ask the public, however, to have a little patience, and grant them time to carry out all the desirable reforms. In one direction particularly, he said it was necessary to proceed with the greatest caution—viz., in the condemning houses as unfit for human habitation. This could never be done in a wholesale way, but must be done slowly and cautiously, as otherwise the evils of overcrowding, &c., would only be intensified.

The Honorary Secretary, Mr WALTER A. SMITH, in reply, said,—Ladies and Gentlemen, I have to thank you for the cordial manner in which you have responded to this motion. What I wish, however, particularly to say is this, that the very best thanks you can give to us is that you should all get as many of your friends as you can to join the Society. It is mentioned in the Report that one member of the Society secured through his own exertions 100 members. (Applause.) Now that is a very striking example to keep before you, and one you should all endeavour to follow to the best of your abilities. Roughly speaking, about 600 members joined the Society this year. That is far too small a number, but if each of you did what this friend of ours has done,—I will not ask you to get 100, but if you each only get ten,—then next year we will start with 6000 members, and that will not be too many. Work in that direction as much as you can, and you will so thank us best.

Dr JAMES RITCHIE then moved a vote of thanks to the Chairman, and the proceedings terminated.

SANITARY DUTIES & REQUIREMENTS

as provided for in the Public Health and Police Acts.

Advice can be obtained personally or by letter on application to the Health Office, High Street.

The following are the SANITARY OFFICERS:—

THE INSPECTOR OF CLEANING; THE BURGH ENGINEER OR SURVEYOR;
And THE MEDICAL OFFICER OF HEALTH.

Address—POLICE CHAMBERS, HIGH STREET.

Should a Complaint addressed to any of these Officials not receive prompt attention, and should a reminder remain unnoticed, the Town Clerk should be communicated with, whom failing, the Councillor for the district should at once be appealed to. In all cases, however, the Proprietor or Factor should be applied to in the first instance.

HOUSE.—Landlords are bound to provide that the Dwelling-House is—1st, Dry; 2nd, In Good Repair; 3rd, Free from (a) Obnoxious Smells, (b) Smoke, (c) Vermin.

COMMON STAIR.—Should be kept—1st, Clean; 2nd, Ventilated; and 3rd, Lighted.

COURT OR BACK GREEN.—Should be kept—1st, Free from Rubbish; and 2nd, be Drained.

[* POULTRY should on no account be kept within the City.]

BACK LANES OR PUBLIC PASSAGES.—Should be kept—1st, In Good Repair; and 2nd, Free from Rubbish.

ILLNESS IN THE FAMILY.—I. ORDINARY.—Advice is available to the poor (and in emergencies to all classes) at the Royal Infirmary, Chalmers' Hospital, Sick Children's Hospital, and the various Dispensaries, viz. :—The *Royal*, in Richmond Street; The *New Town*, in Thistle Street; The *Cowgate*, in Cowgate; The *Fountainbridge*, in Fountainbridge; The *Northern*, in Stockbridge. For the Eye and Ear specially, at Cockburn Street, Cambridge Street, and Thistle Street.—

II. INFECTIOUS.—1st. Hospital accommodation is provided in the Infirmary and City Fever Hospitals, and in the Sick Children's Hospital. 2nd. A patient's clothing and bedding are disinfected; and also patients are removed to Hospital by the Sanitary Officials *free of expense*. Special penalties are attached to the offences of patients exposing themselves in public places and conveyances, or of any one exposing or selling infected articles of clothing, bedding, or furniture. 3rd. Medical Practitioners are bound by the Police Act to report to the Local Authority cases of Infectious Disease in their practice. Dairymen and Milk Sellers are by the Police Act also bound to give information of infectious disease in their families.

VACCINATION is practised gratuitously at all the large Dispensaries.

WATER SUPPLY.—This should be provided either inside dwellings or in close proximity. It is essential that CISTERNS should be covered, and cleaned out at least twice a year. Where there is W.C. accommodation, two cisterns should be supplied—one of which should be for domestic use.

SMOKE NUISANCE.—As this interferes with the ventilation of houses, and destroys the amenity of the city, all are requested to assist the Public Health Committee of the Town Council with evidence as to cases.

This Leaflet is issued by THE EDINBURGH HEALTH SOCIETY with the sanction of THE PUBLIC HEALTH COMMITTEE.

January 1885.

FOURTH ANNUAL REPORT

OF THE

EDINBURGH HEALTH SOCIETY,

SUBMITTED TO THE MEETING OF MEMBERS ON SATURDAY,
THE 31ST JANUARY 1885.

THE Committee have pleasure in submitting their Fourth Annual Report of the work done by the Society. As in previous years that work has consisted chiefly in arranging for the delivery of the course of Lectures, which has now just been successfully completed. The Committee believe that the delivery of such Lectures is a considerable factor in arousing public interest in, and educating public opinion regarding, the all-important matters of public sanitation and private domestic health, which lie at the very roots of the Well-being of the nation. The close and intimate connection between the physical and moral condition of the people is daily becoming more and more recognised, and the Committee earnestly trust that in endeavouring to improve the first, they are at the same time having a direct good influence upon the second.

The Lectures during the past Session have covered a wide range of important questions of practical utility, and have been delivered by persons of eminence and authority in their respective subjects. In the first Lecture, on "Certain Social Aspects of Insanity," delivered on the 22d November last, Dr Batty Luke pointed out that the recent outcry regarding "Over-pressure in Board Schools" might, with much more justice, have been directed against the "under-feeding" of many of the poor children attending these schools, thus indicating the

advisability of making arrangements in connection with the Board Schools in some poor districts for feeding the Destitute Children, who are forced to attend and expected to compete in class work with their better fed companions.

The second Lecture was that given on "The Causes and Prevention of Disease," by Dr Byrom Bramwell, and was full of useful information and excellent advice. Third on the list was that most practical exposition of the important place of "The Bath" in our daily life, by Dr James Ritchie; and this was followed by a Lecture on "The Hair," by Professor D. J. Cunningham of Dublin, which was illustrated by Lime Light views. Among the most successful evenings during the Session was that on which "The Marketing and Cookery Demonstration" was given by Teachers from the Edinburgh School of Cookery, under the superintendence of Miss Guthrie Wright. This was most admirably arranged in every way, and must have suggested to many of the large audience of working men and women, various useful improvements and at the same time economies in their housekeeping arrangements. The next two Lectures, viz., that on "The Adulteration of Food," by our talented City Analyst, Mr Falconer King, F.C.S., and that on "The Digestion of Food in relation to Health," by Dr Andrew Wilson, which was profusely illustrated by beautiful Lime Light views, formed a natural sequence, and brought the Session to a close.

It is with great pleasure that the Committee express their thanks to the Lecturers for their generous and voluntary efforts on behalf of the Society. It must have been gratifying to them as well as to the Committee that the audiences were so large,—the hall having been crowded nearly every night. The Lectures are now being published, and the Committee trust that the Members will assist in their distribution by buying them, and advising their friends to do so also. From some of the Lectures short "Leaflets" have been prepared, giving the practical "Health Lessons" therefrom in plain and simple language, and these are being distributed among the very poor in Edinburgh

through the City Missions and other agencies. They can be had on application to the Honorary Secretary at the price of 2s. 6d. a hundred. The Committee would also direct the particular attention of the Members and the Public to a Leaflet they have arranged to issue with the special sanction of the Public Health Committee of the City, specifying Sanitary Duties and Requirements as provided for in the Public Health and Police Acts. It is hoped that these Leaflets will be placed in the hands of Members at the Annual Meeting along with this Report, and the Committee recommend that they be carefully read and kept for reference. The Committee desire to thank the Town Authorities for printing this Leaflet and giving the use of it to the Society.

The Committee have had during the past year various matters of public interest under discussion, and amongst those regarding which they have taken action is the insanitary condition of the Water of Leith. They also issued a circular to all the large shops in Edinburgh, respectfully requesting the proprietors to provide seats in their establishments for the women and girls in their employment. The Committee are glad to understand that the City Authorities have decided in establishing Public Baths and Washing-Houses in the Old Town; and they beg to express their hearty thanks to the Town Council for having secured for the citizens that splendid new Health Resort, —Blackford Hill.

The Members will be pleased to learn that in October last the Committee received a Special Certificate of Thanks from the Jury Commission of the International Health Exhibition held in London last year, for the work done by the Society.

During the year 593 Members have been enrolled to the Society. The number during the previous year was 603.

The Committee would again urge all Members to endeavour to get as many of their friends as possible to join the Society next year. As an instance of what may be done by individual effort in this direction, it may be stated that nearly 100 Members were this year obtained through the exertions of *one* Member of the Society. The Committee are anxious to carry out their wish,

referred to in previous reports, to establish a Gymnasium or Recreation Hall; but they cannot do so without a very large number of Members providing the necessary subscriptions. From the Treasurer's Report appended hereto, it will be seen that the ordinary Income of the Society was only £68, 6s. 5d., falling short of the ordinary Expenditure to the extent of £19, 10s. 7d. The Committee cannot help feeling somewhat disappointed with this result, and trust that the Public will afford them more generous support in future years.

The Rev. C. J. Ridgeway retired from the Committee some months ago owing to his leaving Edinburgh. The Committee were sorry to lose him as a colleague, but the Rev. P. M'Adam Muir of Morningside kindly consented to take his place. The Committee recommend that Mr Muir's election be now confirmed. The following five Members of Committee now fall to retire in accordance with the rules, viz.:—Bailie Clark, Dr Affleck, Dr Foulis, Mr Yorston, and Mrs Fraser. They all offer themselves for re-election, with the exception of Dr Affleck; and in room of that gentleman the Committee recommend that Dr Alexander James be elected to the Committee.

Reported on behalf of the Committee by

THOS ANNANDALE, *Chairman.*

WALTER A. SMITH, *Hon. Secretary.*

EDINBURGH, 31st January 1885.

* * * *All Communications should be addressed to the
Honorary Secretary, Falcon Lodge, Murrayfield.*

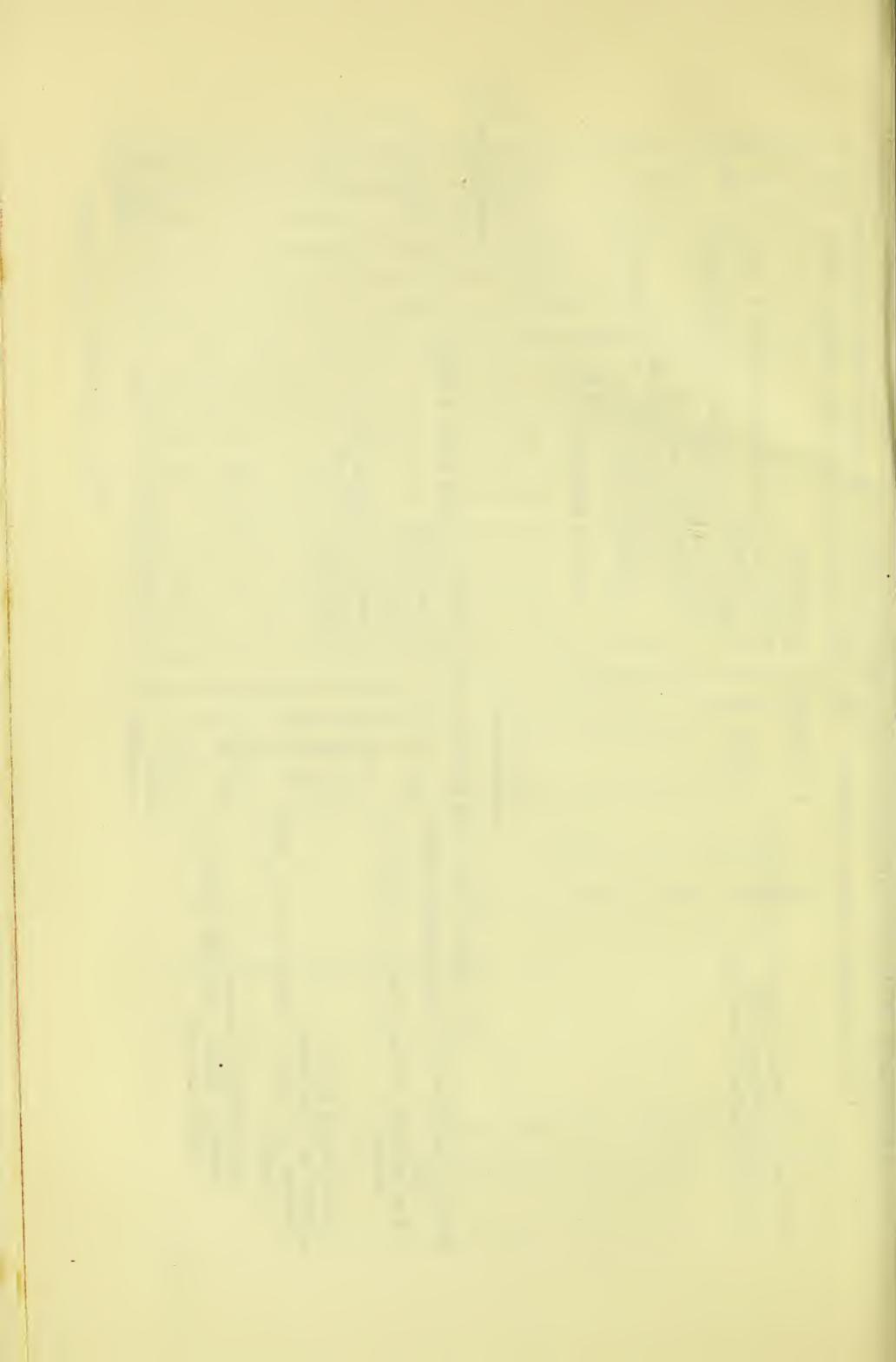
I.—CAPITAL ACCOUNT.

To Balance of Funds in favour of the Society as at 29th February 1884, - - -	£133 12 8	By Balance <i>against</i> Ordinary Revenue Account, brought up, - - -	£19 10 7
„ 17 Life Members' Subscriptions, - - -	17 17 0	„ Balance of Funds in favour of the Society at 31st January 1885—	
		On Deposit Receipt with Commercial Bank of Australia, at 5 per cent. Interest, -	£100 0 0
		In National Bank, on c/a, £32 11 4	
		<i>Less</i> due Treasurer, 0 12 3	
			31 19 1
	<u>£151 9 8</u>		<u>£151 9 8</u>

II.—ORDINARY REVENUE AND EXPENDITURE FOR YEAR.

To 574 Annual Members' Subscriptions (average 1/5), - - -	£40 7 6	By Advertising, - - -	£27 8 10
„ <i>Less</i> reserved to meet Cost of Copies of Lectures, - - -	2 10 0	„ Rent of Hall, - - -	18 18 0
		„ Printing, - - -	21 0 6
„ Collections at Doors, - - -	£37 17 6	„ Postages, Portage, &c., - - -	1 7 0
„ Royalties on Lectures, - - -	15 9 0	„ Expenses at Lectures, - - -	14 14 8
„ Interest on Deposit Receipt and on Bank Account, - - -	10 0 0	„ Stationery, - - -	4 8 0
	4 19 11		
Total Ordinary Income for year, - - -	£68 6 5		
Balance <i>against</i> Revenue, carried to Capital Account, - - -	19 10 7		
	<u>£87 17 0</u>	Total Expenditure for year, - - -	<u>£87 17 0</u>

COLIN M'CUAIG, *Hon. Treasurer.*



Edinburgh Health Society.

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PREFATORY NOTE.

THE attention of the readers of this Series of Lectures is directed to the Fifth Annual Report by the Committee of The Edinburgh Health Society, presented to the Meeting of Members on 13th February, which is appended to this volume.

EDINBURGH, *March* 1886.

SCOTTISH PROVIDENT INSTITUTION,

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THIS SOCIETY differs in its principles from other Offices.

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A Policy for £1200 to £1250 may thus at most ages be had for the Premium usually charged for (with profits) £1000 only; while, by *reserving* the surplus, large additions have been given—and may be expected in the future—on the Policies of those who participate.

At last division of Profits, Policies for £1000 sharing a first time were increased to sums varying from £1180 to £1300 or more, and others to £1400, £1700, and upwards.

Examples of Premiums for £100 at death—with Profits.

Age.	Payable during life	Limited to 21 payments	Age	Payable during life	Limited to 21 Payments	Age	Payable during life	Limited to 21 payments
25	£1 18 0	£2 12 6	35	£2 6 10	£3 0 2	45	£3 5 9	£3 17 6
30	2 1 6*	2 15 4	40	2 14 9	3 7 5†	50	4 1 7	4 12 1

* Thus a person of 30 may secure £1,000 at death by a yearly payment *during life* of £20, 15s. This Premium would generally elsewhere secure £800 only, instead of £1,000. Or he may secure the same sum of £1,000 by *twenty-one* yearly payments of £27, 13s. 4d.—*being thus free of payment after age 50.*

† At age 40 the Premium *ceasing at age 60* is, for £1,000, £33, 14s. 2d., being about the same as most Offices require to be paid during the whole term of life. Before that period the Policy will have shared in at least one division of profits.

The FUNDS now exceed £5,300,000.

Only Two Offices in the Kingdom (both older) have as large a Fund.

The CONDITIONS of ASSURANCE are UNUSUALLY LIBERAL.

POLICIES are generally now free from restriction on residence **after Five Years**, and **unchallengeable** on any ground but fraud; while under the Society's **Non-Forfeiture Regulations** there is no risk of a valuable Policy being forfeited through an accidental omission to pay the Premium.

Claims payable on proper title **One Month** after proof of Death.

REPORTS with STATEMENT of PRINCIPLES *may be had on application,*

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THE EXCITING CAUSES OF DISEASE.

BY

BYROM BRAMWELL, M.D., F.R.C.P. EDIN.

MY LORD PROVOST, LADIES, AND GENTLEMEN,—In the lecture which I had the pleasure of delivering to the members of this Society a year ago, I directed attention more particularly to the derangements of nutrition and to those disorders which result from infringement of, what may be termed, the elementary laws of health. And before proceeding to the subjects which I wish to bring under your notice this evening, allow me very briefly to recapitulate one or two of the more important points.

We saw that for the nutrition of the body as a whole, and indeed of each one of its individual organs and parts, the following requirements are necessary :—

1. *A sufficient supply of nutrient material—the blood plasma.*—This implies (*a*) the introduction into the body of a sufficient supply of suitable food and drink ; (*b*) the proper preparation or manufacture of that raw material, in other words, a healthy condition of the digestive system and of those organs, such as the spleen and lymphatic glands, which prepare and elaborate the blood ; and (*c*) the proper distribution of the nutrient fluid, in other words, a healthy condition of the heart and blood vascular system.

2. *A sufficient supply of oxygen.*—This implies a healthy condition of the respiratory organs and of the red-blood corpuscles, which are the oxygen carriers.

3. *The satisfactory removal of the waste products.*—This implies a healthy condition of (a) the organs of circulation (the heart, blood-vessels, and lymphatics); and (b) of those organs which depurate or purify the blood, of which the kidneys, skin, lungs, and the liver are the chief.

4. *A healthy condition of the nervous system.*—Under this head I emphasised the fact that in the young a large amount of nerve force of a nourishing or trophic kind, as we technically term it, is required by the actively growing and developing tissues; and that this fact demands paramount consideration in any and every system of education; that anything like over-pressure, which exhausts the nervous power or monopolises, so to speak, the nervous energies, and withholds from the tissues the nutritive nerve force which they require, must necessarily interfere with the due development of the body, of the brain itself, and therefore of the mind, and is in a medical, and, indeed, in every other sense, fundamentally and radically wrong.

5. *A sufficient amount of rest and sleep.*—We saw that while the regular exercise of its functions is conducive to the healthy condition of every tissue, that every tissue and organ requires a sufficient amount of rest and sleep. I had intended to have dilated somewhat on this point to which I had only time to allude in my last lecture, but as I see by our programme that we are to be privileged by a lecture from my friend, Dr Sibbald, on *Work and Rest of Body and Mind*, it is unnecessary for me to do more than mention its importance.

Further, we saw that it is impossible to draw a sharp and distinct line of demarcation between the condition which we term health and that which we know as disease; that the two states run insensibly one into the other; that little irritations which in the healthy organism only produce mere passing derangements of function, may, if sufficiently long continued, and if sufficiently frequently repeated, ultimately lead to permanent, organic disease.

Lastly, I pointed out that many of the derangements of nutrition, and of the disorders which arise from infringement of

the elementary laws of health, are due either to *want of knowledge or to want of self-control.*

Now it is the object of this Society to supply to the inhabitants of Edinburgh in the first instance, and then (by means of our published lectures) to the community at large, a knowledge of health matters. I regret that we are unable to supply to those who need it the power of self-control. We must look to the parents (more especially to the mothers) of our children, and to the teachers in our schools, for the training and development of the will and the power of self-control. There are undoubtedly great natural differences in the force of will and the power of self-control in different individuals, just as there are great natural differences in the power of acquiring information, of reasoning, and of all the faculties of the mind; but what I want particularly to insist upon is this, that the power of self-control is to a large extent a matter of training and of habit, and that the education of this power of self-control, the power of inhibition as we technically term it—the power which the highest nervous centres have of restraining, controlling, or inhibiting the action of other and lower centres—the highest faculty of the nervous system, should begin in early infancy, and should be steadily cultivated and perfected all through life. What, I would ask, is the use of teaching a child the theoretical distinction between right and wrong, if you do not at the same time endeavour to strengthen its will and its power of self-control; if you do not encourage it by example as well as by precept, *in the habit of doing what is right*, and *in the habit of not doing*, or in other words, in the habit of inhibiting or restraining the desire to do *what is wrong*? I would like to repeat more emphatically and more fully than I did in my last lecture, that the main object of education—I am, of course, speaking of so-called secular education (I may, perhaps, be allowed to remark in passing that I do not like the word secular as applied to education, for I cannot conceive of any system of education which does not include as its first fundamental the inculcating of the higher moral and religious truths)—I say that the main object of education is not, as some people seem to

suppose, to cram the child with the greatest amount of fact knowledge, but to teach it how to work ; to cultivate its power of application and of mental concentration ; to teach it habits of cleanliness, order, regularity, and diligence ; to call forth, stimulate, and strengthen its powers of observation and reasoning ; to give it opportunities of experiencing the feeling of mental satisfaction and enjoyment, with the resulting invigorating effect both on body and mind, which attends the successful accomplishment of any piece of work, however small, which is well done ; to set before it a high ideal of life and conduct ; above all, to strengthen its will, to give it force of character, and to teach it the power and habit of self-control.

Now, these, which are, in my opinion, by far the most important objects of education, are difficult or impossible to measure by any system of payment by results. There is a possibility, therefore, of their being to some extent undervalued or lost sight of, both by the managers of schools in the selection and appointment of teachers, and by the teachers themselves.

THE EXCITING CAUSES OF DISEASE.

This evening I wish to direct attention to some other causes of disease, and to give you some practical information as to their prevention. I must premise my remarks by saying that the causes of disease may be divided into two great groups or divisions, viz. :—

1. *The direct or exciting causes ;*
2. *The indirect or predisposing causes ;*

and that for the production of many diseases, both a predisposing and an exciting cause are required.

Many of the diseases to which I am going to refer are due to the nature of our surroundings, and to the somewhat artificial conditions in which we are compelled by the circumstances of our advanced civilisation to live ; to the imperfect sanitary arrangements of our houses and towns ; to the fact that the air we breathe, the water we drink, the food we eat, are all liable to be loaded

with noxious impurities, and that the very persons with whom we come in contact are at times eminently hurtful and injurious to us.

It is important to remember, as Mr M'Candlish so forcibly pointed out at the last annual meeting of this society, that many of the diseases to which I am about to refer cannot be prevented by the individual efforts of the person who becomes affected by them; and that it is the duty of each member of the community not only to avoid doing anything which may interfere with the comfort, injure the health, or endanger the lives of his fellow-citizens, but also to submit cheerfully and readily to any regulations which the authorities who watch over the public health may see fit to impose, and heartily to co-operate with them, so far as he is able, in their laudable endeavours to diminish sickness and to protect health.

Let us now look at some of the more important of the direct or exciting causes of disease.

1. ACCIDENTS AND INJURIES

Are such common and obvious causes that they need not detain us. Nor can I pretend to advise you how they are to be guarded against and prevented any better than you can advise yourselves.

2. CATCHING COLD.

Exposure to cold, especially to damp cold, and to sudden variations in temperature, is a fertile source of disease, more particularly of rheumatic, bronchial, and pulmonary affections. The number of deaths which result from this cause annually is great. It may not perhaps be altogether inopportune if I say a few words with regard to the proper clothing of the body. One of the most striking characteristics of good health is the power which the human body has of maintaining its temperature at a fixed point, notwithstanding the external alterations in temperature to which it may be exposed. Two things only (in addition to health) are required—*firstly*, it must be supplied with a suffi-

cient quantity of suitable food or fuel, and *secondly*, it must be suitably clothed.

Had time permitted, it might perhaps have been interesting to have described the exact manner in which this fixed temperature is maintained under varying conditions. Suffice it, however, to say that the heat-production is due to the chemical changes which are constantly taking place in all the tissues, more especially in the muscles, and great glandular organs such as the liver. That the heat-loss is in great part due to radiation and conduction from the surface of the skin, and to the evaporation of the surface moisture or sweat; and that the balance between the heat-production and heat-loss is regulated by a beautiful, self-adjusting or automatic nervous mechanism. When, for instance, the body is placed in a cold atmosphere (*a*) the vessels in the skin contract; less blood passes through the superficial or surface circulation; less heat is consequently carried to the surface, for the blood is the great means or channel through which the heat, which is produced in the deeper tissues, is distributed through the body; (*b*) the condition of the skin is so altered that its power of transmitting or conducting heat is diminished; (*c*) the secretion, and therefore the evaporation of sweat is greatly lessened. For all these reasons the heat-loss is very much diminished, and the body does not cool down and reach the temperature level of the surrounding atmosphere, as an inanimate object or even a cold blooded animal would do. But further, the temporary application of cold to the surface not only lessens the heat-loss, but it so acts upon the central nervous system that the heat-production is actually increased. In this way chiefly by the diminution of heat-loss, but partly by the increase of heat-production, the cooling of the body is prevented. Now in very cold climates nature requires to be assisted in her efforts at maintaining a fixed temperature. The Laplanders, for instance, eat large quantities of blubber and fat which are eminently heat-producing foods, and clothe themselves with furs in order to form an additional non-conducting heat barrier between the severe external cold and their own warm bodies.

The requirements which clothing should possess.—In this changeable and somewhat cold climate of ours, the *first requirement* which clothing ought to possess is that it should be *sufficiently warm*.

There is a great deal of carelessness, more especially amongst young men, with regard to this matter. Glorifying in the enjoyment of splendid health, they are apt to think that they can go out in any weather without a great-coat; that they may even get wet through and sit in damp clothes with impunity. Now, I am not going to advocate any system of coddling; it would be, I think, a bad day for our country if we gave up our football because a few boys get broken legs, if we stopped our hunting because a few men are killed every year, or if we were to keep indoors on wet days because some of us get cold; all I want to advocate is reasonable carefulness without coddle. I would like every one to realise that a cold is not always a trivial matter. Very grave disease may indeed result from it afterwards. Consumption, as I shall afterwards, if time permits, more fully point out often has its starting point in a simple cold. In many cases disease of the valves of the heart results from catching cold, and the resulting rheumatism. Most people are aware that the great risk in rheumatic fever is inflammation of the valves of the heart; but few people know that inflammation of the heart may arise when the rheumatic symptoms are slight and trivial. This is more especially the case in children and young persons, in whom a stiff neck, a painful joint, or any other indication of rheumatism, should always be most carefully attended to. Knowing the serious consequences which sometimes result in cases of this description, I would most earnestly impress you with the importance of carefulness in this matter.

The *second requirement* which clothing should possess, is that it should be *sufficiently porous to allow of the diffusion of gases and of the absorption of any excess of surface moisture*. Underclothing made of flannel or of some woollen material, such as merino, answers these requirements (warmth and porosity) the best; silk is also good, though not so good, and its first cost is so much greater that it does not come within the reach of most people.

The *third requirement* is that the clothing should be *light*; and here I would point out that the common idea that weighty clothing is necessarily warm is often fallacious. Woollen materials, which are the warmest, may be lighter than others. It must also be remembered that a heavy dress or cloak, such, for example, as the long cloaks trimmed with heavy furs which so many ladies are wearing at the present time, have this disadvantage, that they necessarily interfere with brisk walking, which, as we all know, is one of the best ways of keeping ourselves warm in cold, frosty weather.

The *fourth requirement* is that the *articles of clothing should fit well and not hang heavily, nor drag nor press unduly upon any part, in short should not interfere in any way with the free movements of the body.*

I need not say that this requirement is not always fulfilled. High heels, which throw the centre of gravity out of the proper line and place an unnatural strain on the ligaments, bones, and joints, interfering with all free movement, and transforming the beautiful elastic step of nature into a miserable and ugly hobble; pointed toes, tight skirts, "wasp" waists, and other monstrosities which could be mentioned, are not altogether unknown.

The practice of tight lacing is specially injurious, for by compressing the ribs and thorax it interferes with the free movement both of the heart and lungs, it squeezes, distorts, indents, and sometimes even dislocates the liver, and interferes more or less with the free play of all the abdominal viscera.

The *fifth requirement* is that the clothing should be *suitable to the occupation and in accordance with the means of the wearer.*

The *sixth*, that it should be *nice looking and becoming.* There will, I fancy, be considerable difference of opinion as to the relative importance of this last requirement. Although I think it the least important, and have therefore placed it last, I by no means wish to undervalue it. I not only like to see people nicely dressed, but I even go so far as to say that it is, in my opinion, the duty of every one to look her best (I put it, you will observe, in the female gender), I say I think it is the duty of every woman

to look her best, and to see not only that she is clean and tidy in her person, but that her dress is neat, tasteful, and becoming. Do not please misunderstand me and suppose that I am advocating expensive or fashionable dressing. Quite the contrary; I strongly deprecate the wasteful expenditure in dress which is only too common in all ranks of society at the present day. It is necessary to remember, on the one hand, that persons of modest means who dress expensively are not suitably and becomingly clothed; and on the other, that with a little taste in the selection of materials, and with a little skill in the cutting and fitting, the most homely and least costly materials may be made both elegant and becoming.

Influence of fashion.—You will hardly expect me to say anything with regard to fashion, that mysterious custom whose imperious dictates such a large number of our lady friends seem to think it would be almost a sacrilege to disobey. The best I can say of fashion is, that it is good for trade, that it puts money into the pockets of the milliners, and that the changes which it necessitates are, as a rule, harmless from a health point of view. There are, however, exceptions to every general rule, and some of the customs which fashion favours are distinctly injurious. I will only mention one, the custom of puffing and painting, which is so common further south, but happily comparatively rarely seen here. Let me read you what Dr Malcolm Morris, one of our greatest authorities on the diseases of the skin, says about this matter. I quote from a lecture on the "*Ethics of the Skin*," delivered before the International Health Exhibition of London last year—a lecture which I would strongly advise all of you to read for yourselves, for it is as full of practical advice and sound common sense as it is racy and entertaining in style. He says (page 14): "But when in addition to all these devices, a decree goes forth that powder is to be applied to the cheeks from morning to night, to the utter destruction of the complexion, it is time to speak out. And that it does so destroy it, is attested at this moment by thousands of skins puckered and pitted, that, but for using powder, would have remained to this day soft as silk. The con-

stant use of powder has precisely the same effect on the glands of perspiration, as the overstraining of the voice has upon the throat of a clergyman or public speaker. With the continuous exertion to secrete moisture to lubricate the throat, the glands become exhausted, and give out so small a supply, that if speaking be persevered in, an obstinate complaint termed clergyman's sore throat is the result. So with the glands of perspiration in the face, as the powder dries up the moisture, more and more is secreted, till the glands become at last unable to fulfil the unavailing task, and shrinking, produce the little chasms that give the orange rind appearance that is but too familiar to all observant people. . . . The immediate action of powder when applied to the skin is to fill up all uneven surfaces, to conceal greasiness, and to hide blemishes of all kinds; the result—a rough, bloodless, deathly pallor. Nor would rouge, however carefully applied, make matters much better. The warm tints produced by myriads of bright red points of blood in the papillae, and partly visible through the translucent epidermis, are inimitable, and defy simulation. Note the difference between the stippling in a steel engraving and ink laid on with a brush.”

3. THE INTRODUCTION INTO THE BODY OF NOXIOUS MATERIALS.

The diseases due to this cause are very numerous, and many of them of great importance. The noxious material may come in contact with the surface of the body and produce disease of the skin, or it may be inhaled with the breath, or carried into the stomach and alimentary canal with the food and drink.

DISEASES DUE TO MECHANICAL IRRITANTS.

In some cases the noxious material, or poison as we might perhaps term it, is simply a *mechanical irritant*. As an illustration of this group I may mention the bronchial and pulmonary diseases which are due to the inhalation of dust particles. Stone masons, knife grinders, potters, and the workers in many other

trades, for instance, very frequently suffer, and often die, from severe forms of lung disease produced in this way. In coal miners, the lung sometimes becomes impregnated with minute (microscopical) particles of coal dust and smoke, though, in consequence of the better ventilation of the pits, this disease—coal-miner's phthisis, as it is technically termed,—is by no means so frequent as it was a few years ago.

All measures which prevent the escape of dust particles into the atmosphere, free ventilation, and the use of respirators, are the means by which the diseases due to the inhalation of fine dust particles are to be prevented.

DISEASES DUE TO CHEMICAL POISONS.

In other cases, the noxious material is a *chemical poison*. Obscure cases of illness, for instance, every now and again result from arsenic having been used in the manufacture of wall papers and paints. Bright emerald greens, which owed their colour to arseniate of copper (Scheele's green), were at one time largely used in house decoration; but it is not only greens which are injurious, white grounded papers sometimes contain large quantities of arsenic. So recently as six years ago, my own children suffered from very anomalous symptoms which I could not explain, until I detected arsenic in the wall paper of the nursery—a white grounded paper with a blue pattern. Dr Stevenson Macadam, who was kind enough to confirm the analysis, found that the quantity of arsenic in this paper was very great. For the first few months after a paper which contains arsenic is put up, there may be no injurious effects; it is only after the surface of the paper gets rubbed and its gloss taken off, that the poisonous particles are thrown into the atmosphere, and are absorbed into the system chiefly through the air passages. I understand that the best manufacturers are now fully alive to the danger; but it is as well in choosing a paper, more especially a cheap paper which contains bright green colours, to have a guarantee from the paper-hanger that it is free from arsenic.

I might mention several chemical substances which prove injurious to the workers in particular trades. Lucifer match-makers, for example, used not unfrequently to suffer from decay (necrosis) of the jaw-bone, the result of phosphorus poisoning. Painters, plumbers, and all persons who come in contact with white lead, are liable to suffer from chronic lead poisoning. The manufacturers of white lead not unfrequently die from lead poisoning. Severe cases of this description are fortunately not met with in this neighbourhood, for there are no white lead factories near Edinburgh, but in Newcastle, where I formerly practised, I used frequently to have amongst my hospital patients the most serious cases of this kind.

I might, perhaps, here mention the fact that I have known symptoms of chronic lead poisoning produced by the use of hair-dyes containing lead. A few years ago a medical friend told me of a case in which death had actually resulted from lead poisoning produced in this manner.

DISEASES DUE TO LIVING ORGANISMS.

In other cases, the noxious material is a *living organism*. In this group an immense number of diseases are included, many of them highly contagious and infectious.

In *some*, as in ring-worm and scabies or itch, the disease is local, and confined to the surface of the body: in the former (ring-worm), the poison is a minute vegetable organism; in the latter, an insect (the *Sarcoptes scabiei*). Both diseases are readily communicated by contact from person to person. To prevent their spread you must destroy by local means the parasite which is their cause.

In *others*, the disease is local and internal. That most common and fatal disease, pulmonary consumption, has been proved by the celebrated German pathologist Professor Koch, to be due to a minute living organism (the *tubercle bacillus*).

In *others* again the disease is general. That dreadful disease pyæmia, which used to be so common in our hospitals, and was so

frequently the cause of death after surgical operations—even after trivial operations—is due to the entrance of germs or septic particles—into a wound, and to the poisoning of the system by the putrefactive products which result therefrom. Owing to the free use of antiseptic measures, decomposition in wounds and the resulting pyæmia are now happily rare. As you are probably all aware, we are chiefly indebted for this immense advance in the treatment of surgical cases, and for the enormous saving of life and suffering which it has effected, to the great surgeon, Professor Lister, whose name will without doubt be honoured by posterity as one of the greatest medical celebrities and benefactors of this or any other age.

The great group of specific infectious diseases, such as scarlet fever and small-pox, are probably all due to the introduction into the body of a particulate organic poison, though in every case the poison has not as yet been absolutely demonstrated.

THE PREVENTION OF THE SPECIFIC INFECTIOUS AND CONTAGIOUS DISEASES.

The prevention of these diseases is of such immense importance that although several previous lecturers have spoken to you on the subject, I make no apology for again bringing the matter before your notice.

It is astonishing how much ignorance, I fear I must go further and say how much culpable negligence, there is in regard to the precautions which should be taken to prevent the spread of these diseases, and that even amongst the more intelligent and more highly educated classes. Take, for instance, the spread of infectious diseases in schools. Cases are again and again met with, in which a child is sent to school from a house in which there are cases of scarlet fever, or still worse, in which a child, who has just recovered from an attack of whooping cough or scarlet fever is sent back to school while still infectious. I fancy that most of those who have conducted for any length of time our high-class day schools in Edinburgh have met with some

cases of this description. Certainly more than one has come to my own knowledge. I need not say that if cases of this sort occur in the upper ranks of society, they are still more liable to occur amongst the labouring and working classes. I can hardly conceive that the magnitude of the consequences which may result from carelessness in this matter is fully realised. A child who is sent to school from a house in which there is a case of scarlet fever, *may* carry (observe I do not say *will* carry) the fever poison with it; some of its fellow pupils *may* contract the disease; some of them *may* die; the schoolmaster or schoolmistress will certainly be caused grave mental anxiety; the school may have to be shut up, the house repapered and repainted, serious pecuniary loss may in consequence be inflicted on those who are perhaps little able to bear it, for I need not say that schoolmasters and schoolmistresses are not, as a rule, wealthy people. These consequences are serious; they are surely sufficiently serious to necessitate the most scrupulous care on the part of all concerned; but I would be giving you a very inadequate and imperfect idea of the magnitude of the evils which may, and which sometimes do actually result, if I were to stop here. I may perhaps enable you to realise more vividly what these results may be, if I make use of a comparison. During the past few years we have from time to time been startled by the accounts of one of those dreadful dynamite explosions, which, thanks to a kind providence, have happily, I think I am right in saying, been miraculously unattended with any loss of human life. Now, suppose that a parent, either through ignorance, or carelessness, or culpable negligence, were to send a child to school with its pockets filled with dynamite; suppose that dynamite were to explode, to wreck the building, and to kill both teachers and scholars, would not a thrill of horror reverberate from one end to the other of the civilised world? And supposing that such a catastrophe were to occur again and again, would not the nation rise as one man and demand that the most stringent measures be immediately taken to prevent the possibility of the recurrence? Now I speak without any exaggeration when I say that the evil which *may*

result from introducing scarlet fever into a school may be even more disastrous. True, the immediate effects are not so startling and sudden, and the full results may never perhaps come before the public eye; but the total loss of life and suffering may be infinitely greater. There is this essential difference between dynamite and the scarlet fever poison, that in the case of dynamite the maximum effect is at once reached; although the immediate result may be terrible, yet the evil is at an end with the occurrence of the explosion; and it is possible, immediately after the accident, to sum up the damage and exactly measure the result. But the scarlet fever poison is a living material, which so long as it meets with a suitable nidus or soil, continues to grow and multiply, and which may be propagated from person to person almost indefinitely. A single case may thus give rise to an epidemic, which may spread itself over the length and breadth of the land, and may produce a huge mortality. It may, of course, be said that scarlet fever is always epidemic somewhere, and that, do what you will, you cannot stamp it out; that children must therefore run their chance. Such an argument is, I hold, altogether fallacious; if it were once admitted it would prevent us taking any steps whatever to check the spread of diseases of this kind. I want every individual here present to realise that much more can be done, and ought to be done, in the way of arresting and stamping out these infectious diseases than we are doing; and that it is the duty of every right-minded man and woman to do what he or she can to help in this matter.

The hour is rapidly passing, and I shall not be able to go into full details with regard to the prevention of these infectious diseases; I must limit myself to the more important points.

In order to understand the measures which should be taken for the prevention and stamping out of these specific infectious and contagious diseases, it is essential to realise that the germs which produce them are not so far as we know generated *de novo* (afresh), but that they are always transmitted from some pre-existing case of the same kind. The poison of scarlet fever

always comes from a pre-existing case of scarlet fever, that of small-pox from a pre-existing case of small-pox, and so on. If then you can destroy all the poison which is given off from every case, say of scarlet fever, and not allow any of it, while still active, to come in contact with any susceptible person, you will ultimately succeed in stamping out the disease. It must, however, be remembered that the poison of some of these diseases is very tenacious of life, that it may lie long dormant, and that for this and also other reasons (notably that the poison is invisible), it is not always possible for us to trace the exact source of infection or to put our finger on the pre-existing case.

The most important means of stamping out the specific infectious and contagious diseases are as follows:—

1. *The isolation of the sick.* Thorough isolation can seldom be properly carried out in a private house, and is simply impossible in the houses of the poor, where all the members of the family live in one or two rooms. Unless *thorough* isolation can be carried out it is generally advisable, in the case of such diseases as scarlet fever and small-pox, which are both very infectious and very fatal, to send the patient to hospital. I am speaking generally; the special nature and circumstances of each case must, of course, be taken into account.

To provide the necessary hospital accommodation, most of our large towns have fever hospitals. As you are probably all aware, our Edinburgh fever hospital, which was, until quite recently, connected with the Royal Infirmary, has been—most properly, I think—taken over by the Town, and will henceforth be managed by the Public Health Authorities, and supported by the rates. I do most sincerely hope that whatever additional rate it may be necessary to impose, there will be no complaining or demurring at it. Had time permitted, I would have liked to have read to you a lecture by Sir James Paget, in which he shows the costliness of sickness and the enormous money loss which the nation annually sustains from sickness due to preventable disease.* Now,

* *An Address on the National Value of Public Health.* “*British Medical Journal*,” June 21, 1884.

if this is true of the nation as a whole, it is surely true of each one of its corporate parts ; in short, it can, I think, be conclusively shown that any sum, however large, which is legitimately spent in the arrest and prevention of infectious disease is well-invested and well-spent money. I strongly hold that it is a good and sound financial policy to provide for cases of fever and infectious disease the best hospital accommodation, the best medical skill, the best nursing, and the best feeding and medical appliances which can be procured. Unless a fever hospital is conducted on the most approved principles, and officered by the highest class of officials—and that I need not say necessitates a large expenditure—the public will not feel full confidence in it, and will not make use of it ; and the very object for which it is provided, viz., the isolation of the sick and the arrest of infectious disease, will be defeated.

Satisfactory isolation in a private house is only possible when that portion of the house in which the patient is placed can be thoroughly cut off from the remainder. There must be no passing backwards and forwards between the general body of the house and the sick room. Those who nurse the patient must submit to be isolated too. The sick room should be cleared of all unnecessary articles of furniture ; curtains and bed-hangings should be removed—free ventilation is essential, and care must be taken that the air from the sick compartments does not blow into the rest of the house.

2. *The destruction of the poison which is given off from the body of the patient.* — This is a very important point. When, as in whooping cough, the poison is given off in the breath, free ventilation, which dilutes it, and the frequent use of the steam carbolic spray in the sick chamber, are the best means which can be employed. When the poison is given off, as it is in cholera and typhoid fever, from the bowel, a powerful antiseptic—a solution of corrosive sublimate is probably the best—should be freely mixed with the evacuations before they are discharged into the house-drains. When, as in scarlet fever, the poison is contained

in the particles of skin which are thrown off from the surface of the body, frequent washing with an antiseptic solution and the inunction of carbolic oil are probably the best means which can be employed.

The patient must, of course, be confined to the sick chamber until all risk of infection is passed. The medical attendant is naturally the person who decides this point, and in forming an opinion it is always right to err on the side of caution, and to keep the patient strictly isolated for several days longer than may at first sight appear absolutely necessary.

After the patient leaves the sick-room, it, together with all articles of clothing, furniture, bedding, &c., must, of course, be thoroughly disinfected. Books, playthings, &c., which have been in contact with the patient, must be either disinfected or destroyed. But to go fully into this and other points would require much more time than we have at our disposal this evening.

I cannot, however, leave this part of the subject without reminding you that we citizens of Edinburgh are fortunate in this respect, that we have only to make a request to the local health authority, and we can have our houses, rooms, furniture, bedding, &c., disinfected for us. I would strongly advise any of you who are so unfortunate as to have cases of infectious disease in your houses, to avail yourselves of this assistance. You must remember that to carry out the process of disinfection thoroughly and satisfactorily, special knowledge and skill (which few private persons, unless they are medical men, possess) are required. If the assistance of the proper authorities were always called in, we should not hear complaints, as we now not unfrequently do, of bedding and articles of clothing, which have been used by persons suffering from infectious disease—say scarlet fever—being aired and shaken close to the windows of a neighbouring dwelling—a most dangerous proceeding, which cannot be too severely condemned.

3. The third great means of preventing and arresting the spread of infectious disease is *the careful attention to cleanliness, drainage, and all other sanitary matters by each individual for himself.*

The wise saying, "If you want a thing well done, do it yourself," is specially applicable to health matters. Public sanitary authorities and sanitary associations are all very well in their way—and far be it from me to say one word which would appear even to lessen their value and importance—but they can never take the place of individual effort. Unless each member of the community attends, so far as his knowledge enables him to do so, to the sanitary arrangements of his own house and premises, we shall never have that improved and perfect sanitary condition which we are aiming at, and which is so much to be desired.

4. The fourth great means of preventing and arresting the spread of infectious and contagious diseases is *the proper regulation of sanitary matters by the public authorities who have charge of and are responsible for the public health*, such as the regulation of the drainage and water supply, the proper cleansing of the streets, the prevention of overcrowding, the suppression of all forms of nuisance, the compulsory notification of infectious disease, the provision of ample and suitable hospital accommodation for cases of infectious disease, of suitable means for the removal of infectious cases from their own homes to hospital, of disinfecting dwellings, bedding, clothing, &c.

I need not say that to carry out all these requirements an intelligent and active medical officer of health, who should be independent of private practice, and an adequate staff of inspectors and assistants, in addition to an enlightened and energetic health authority, are absolutely necessary. Nor need I add that we citizens of Edinburgh are fortunate in having all those matters provided for us in a remarkable degree.

5. The fifth great means by which an infectious disease may be arrested or stamped out is *by rendering the population insusceptible to it*.

As yet there is only one disease which can be with certainty controlled in this way, viz., small-pox, by vaccination and re-vac-

ination; though the illustrious Frenchman—M. Pasteur—to whom the world is already so deeply indebted for his many remarkable observations and researches, has within the past few weeks claimed to have discovered a means of inoculation by which a person who has been bitten by a mad dog can be protected against that terrible disease, rabies or hydrophobia.

As you are doubtless all aware, compulsory vaccination meets in some parts of the country with vehement opposition. It is impossible this evening to attempt to enter fully into this question, which is one of national interest. But if I do not weary you, I would like very briefly to mention the leading arguments and counter-arguments, and to ask you to think over them and to consider the matter carefully for yourselves. The question is certain to come up before the next or some future Parliament; and it is of the utmost importance that the mass of the population should be thoroughly informed as to its merits, more especially since by the extension of the franchise, the power of influencing legislation has been largely placed in the hands of those who have not perhaps as yet given any serious consideration to the question, and are not therefore, without further information, in a position to form a sound judgment upon it.

Three main objections are advanced against compulsory vaccination. They are as follows :—

(1.) *That it is an unwarrantable interference with the liberty of the subject.*—Against this argument I would say that an epidemic of small-pox is infinitely more destructive than an epidemic of dynamite explosions; and since (as we all know) the Legislature, backed by the unanimous voice of the country, has quite recently enacted, with unprecedented rapidity, the most stringent legislative measures against dynamite explosions, this argument falls to the ground.

(2.) *That vaccination does not protect against small-pox.*—Against this argument I have no hesitation in saying that the results of compulsory vaccination and re-vaccination, both in this and other countries, are absolutely conclusive. I would ask any of you who wish for further information, to study these statistics and

results for yourselves, feeling confident that no unprejudiced person, who is capable of weighing evidence, and who carefully goes into the subject, can come to any other conclusion than that which I may without any exaggeration say, is the opinion of the overwhelming majority of the medical profession.

(3.) *That the remedy is worse than the disease.*—It is alleged that grave injury is caused by vaccination, and that serious disease is propagated by it. Now, I do not deny that serious disease has occasionally been propagated by vaccination, but I say that such cases are infinitely rare, and do not occur provided the lymph is selected with reasonable care, and the operation performed with reasonable care and skill. The danger of propagating disease by a carefully performed vaccination is in my opinion infinitesimal, while the benefits which the operation confers can hardly be exaggerated. Against the careless and improper performance of vaccination the common law provides a remedy, just as it does against any other form of medical malpractice.

It is alleged that the opinion of the medical profession on this question of compulsory vaccination is valueless, for the doctors it is said are prejudiced. It is suggested that we doctors support compulsory vaccination, because it brings us in some few miserable half-crowns. In Edinburgh, where the medical profession is proud to be held in such high esteem, such an argument would, I feel sure, be scouted by the public. I need not say that we indignantly repudiate such an imputation. If any of you should hear such an argument advanced, I would ask you to indignantly repudiate it for us. I would ask you farther to meet the argument on its own low ground, and to say that epidemics of small-pox would pay us infinitely better. Further, I would have you ask whether it is alleged that we doctors care less for the health and lives of our own children than other people—whether it is supposed that we would be so inhuman as to vaccinate our children if we thought that there was any real practical risk of communicating serious or loathesome disease, or indeed any disease whatever, to them by means of the operation.

THE PREVENTION OF CHOLERA.

Before concluding these remarks on infectious and contagious diseases, I am anxious to say a few words with regard to the prevention of cholera, which as you all know has during the past two years worked such terrible havoc and desolation in the southern parts of Europe. I do not want to be an alarmist, but to be forewarned is to be forearmed, and it is more than likely that the epidemic which is happily now subsiding, may during the summer or autumn of next year again burst forth in France, Italy, or Spain; and should it do so, it is not at all improbable that it may be carried to our shores.

Cholera, as you all know from the newspaper reports, is one of the most dreadful scourges which affect mankind. I never shall forget the terrible three weeks' experience which I went through during the autumn of 1866, when as a medical student I was called upon to assist my father, who was in large practice in a North of England sea-port town, which was very severely attacked by the disease. But my object is not to frighten you with an account of the disease, but to endeavour to give you some practical hints as to the precautions which it is advisable to take should we unhappily be invaded by it.

I very strongly agree with those who think that cholera is one of those diseases which is in all probability propagated by a living germ. The great German pathologist, Professor Koch, has, as probably most of you know, actually claimed to have demonstrated the germ (the *Cholera bacillus*), though other authorities—notably the English Cholera Commission, whose report is only just published in the medical papers of this morning—stoutly oppose his views. It would be out of place to enter here into the merits of that most interesting and important question; but, be it as it may, there are, I think, weighty reasons for supposing that the poison is a living organism.

No reasonable man doubts that cholera is carried from place to place by persons who are affected by it; that it follows the lines of communication and traffic. It is also proved that it is pro-

pagated by drinking water which has become contaminated by the evacuations of cholera patients ; further, although the disease is not directly contagious in the sense that scarlet fever and small-pox are, it is admitted that the evacuations from the bowel contain the cholera poison, just as the evacuations from a case of typhoid fever contain the typhoid poison ; washer-women, for instance, who handle the bedding and linen which have been soiled by the cholera evacuations, have been known over and over again to have been attacked by the disease. Some of our army surgeons seem to think that in India, which is the birthplace of the disease, the poison may be conveyed from place to place through the atmosphere, but that this ever takes place in this country seems, to say the least of it, very doubtful. Further, the cholera poison—as indeed the poison of almost all of the specific contagious diseases which I have previously spoken of—delights in filth ; this is undoubtedly one cause of the terrible way with which some of the Continental towns have been decimated by the disease. Now if you have thoroughly grasped these fundamental facts with regard to cholera, you are in a position to understand the more important precautions which it is necessary to take to ward off and prevent the disease.

It is impossible at this late hour to go into full details, but the following are the most important points.

(1.) *Isolation of infected persons and suspicious cases.*—Persons coming from an infected district should be inspected, and if they present any suspicious symptoms they should be isolated in hospital, and placed under medical observation and treatment. Ships, for example, coming from an infected port, are regularly inspected ; if any actual cases of the disease have occurred, or if there have been any cases of suspicious illness during the voyage, they are placed for a time under observation in quarantine, and the sailors and passengers are not allowed to land until proper measures of disinfection have been adopted, and until the medical officer—representing the port sanitary authority—is satisfied that they may be allowed to land and mix with the population without risk or danger. In many of our sea-ports

floating hospitals are provided for the purpose of isolating suspicious cases of infectious disease.*

Almost all the best authorities now recognise the uselessness of sanitary cordons, and of general and indiscriminate methods of quarantine.

The most thorough isolation of the first cases which occur in any district is essential ; after the disease has assumed the proportions of an epidemic, isolation is, of course, impossible.

(2.) *The most scrupulous attention to sanitary arrangements both by private persons and by public authorities.*—It is unnecessary, after what has been said in the previous parts of this lecture, to dwell on this most important means of diminishing the severity of an epidemic of cholera should it unfortunately arise. It is, however, with great satisfaction that I can assure you that our Local Sanitary Authority seems fully alive to the importance of this matter. Never since I have known Edinburgh have our wynds and alleys, which are the sort of places in which the cholera poison might be expected to chiefly locate itself and propagate, appeared to me to be in such good sanitary condition, as they have been during the past year.

(3.) *In times of epidemic, every member of the community should look carefully after his own health, and should endeavour to keep it in the highest possible state of efficiency.*—In particular, the diet should be plain and simple ; all foods should be thoroughly cooked ; articles of food, such as unripe or rotten fruits, which are likely to cause intestinal irritation, should be rigidly avoided. Anything which produces gastro-intestinal irritation and diarrhoea is a most powerful predisposing cause of the disease. *All depressing causes, such as over fatigue, exposure to cold, excesses of all kinds, anything in short which exhausts the nervous energy, or*

* The Tyne Sanitary Authority, of which my father was for many years the medical officer, was one of the first, I speak under correction, but I think I am right in saying the first sanitary authority to adopt this arrangement, the great value of which I had many opportunities of observing during the four and a half years I was visiting physician to the Tyne Floating Hospital.

lowers the vitality and resisting power of the system, should be carefully avoided; for they undoubtedly predispose to the disease. The wearing of a flannel belt round the bowels is highly recommended by many experienced authorities. Amongst the predisposing causes there is none more potent than fear; persons of a nervous temperament, and those who are afraid, should leave the infected locality. *No water should be drunk which has not been previously boiled*, for the cholera poison is usually distributed through water, and boiling is the most effectual way of destroying it. Milk and other fluids, which could by any chance be contaminated with the cholera poison, should also be boiled. The *ventilation* of private houses, both the sleeping and sitting-rooms must be carefully attended to.

(4.) *Should any symptoms* of illness arise, medical advice should be *immediately* summoned. *Diarrhœa* is usually the first symptom. There is some difference of medical opinion as to the treatment of cholera, but I altogether agree with those who think that the diarrhœa should be immediately stopped by appropriate remedies. This was the treatment which was adopted in my own case (for I was attacked with this symptom, which may or may not have been the commencement of cholera, that I cannot say), and it is the treatment which I should again adopt were I to be again attacked with any manifestations of the disease. During an epidemic of cholera every one should apply to his medical attendant, and have the appropriate remedies ready in his house; much depends on the early treatment, for the disease is one which runs a very rapid course, severe cases often proving fatal within a few hours.

(5.) *Thorough disinfection of the cholera evacuations; thorough disinfection, or better still, destruction (burning) of all linen, bedding, &c., which has been soiled by the evacuations or been in contact with the patient; thorough disinfection of infected dwellings, &c.*—Patients affected with cholera, and houses in which there are cases of cholera, should be kept *scrupulously clean*. The cholera evacuations should immediately after being passed be mixed with a strong disinfectant—a solution of corrosive sublimate or persulphate of

iron is probably the best—or after being received in a vessel containing sawdust, should be immediately burned. Linen bed-clothes, &c., which have been in contact with cholera patients, or soiled with cholera discharges, should be immediately immersed in boiling water, or in an antiseptic solution, and should be then boiled. Should the nurse or attendants become soiled with the cholera evacuations, the dress should immediately be changed and disinfected, and the parts of the body which have been exposed to the contagion, or better still, the whole body, carefully washed with an antiseptic solution.

Before meals care should be taken that the hands are scrupulously clean ; dishes, glasses, knives, forks, etc., should be immersed in boiling water before being used.

From what I have said you will have perceived that (*a*) the isolation of early cases ; (*b*) the destruction of the poison given off from infected persons ; and (*c*) scrupulous attention on the part of every individual to avoid introducing any living cholera germs into his own person, through food and drink, together with (*d*) the avoidance of all predisposing causes, and (*e*) attention to general sanitary matters, are the chief means by which we endeavour to limit the spread of this disease.*

My Lord Provost, Ladies, and Gentlemen, I had hoped when I began to think over the subject of this lecture, that I might have been able to tell you something about the indirect or predisposing, as well as of the exciting causes of disease, but that is both a large and important subject, and to treat it at all satisfactorily would occupy at least another hour. I dare not attempt to trespass further on your patience this evening. In conclusion, I can only say that I do most sincerely trust that the information I have given may prove of real helpfulness and usefulness to some of you at least in the conduct of your future lives.

* The quite recent observations of Drs Buchner and Emmerich at Palermo, suggest to them that cholera poison may be introduced into the system through the lungs rather than through the alimentary canal.

APPENDIX.

Memorandum of the Royal College of Physicians of London with regard to the prevention of Cholera.

The following memorandum was drawn up by a Committee of the Royal College of Physicians of London, and issued during the year 1884:—

“The Royal College of Physicians of London, feeling that in the event of the occurrence of Epidemic Cholera in England, the public may properly look to them for advice and guidance, deem it to be their duty to issue the following instructions. These instructions are not intended to supersede the necessity of immediate medical assistance, or to impose any authoritative restrictions on medical practitioners. The College would, above all things, earnestly impress upon every person the extreme value and importance of sanitary measures in preventing the invasion and limiting the spread of the epidemic. Large experience has shown that nothing is of more importance than to secure a due supply of pure water, and to prevent all possibility of its contamination with sewage, or impurities derived from other sources. Free ventilation, avoidance of overcrowding, great cleanliness, and thorough drainage in towns, villages, and dwellings, are also of urgent necessity. The local sanitary authorities or their medical officer should be consulted on such questions. Excess in eating or drinking, or long fasting should be avoided. The moderate use of cooked vegetables, as well as of animal food, is recommended, and, in general, such a plan of diet as each individual has learnt by experience to be most conducive to his health; for any considerable change in the diet to which a person has been accustomed is seldom advisable during the prevalence of an epidemic. Milk and also drinking water should be boiled. The vessels used for the storage of food or drink should be cleansed with boiling water. Raw vegetables and unripe or unsound fruit should not be

eaten. Exhaustion from fatigue, long watching, or deficiency of food, and exposure to cold and damp, render persons especially liable to cholera. The College would therefore urge the necessity of supplying those in need with food, fuel, and clothing. Persons engaged about those affected with cholera are not, with proper precautions, more liable than others to the disease. The fear of direct infection may, therefore, be practically disregarded ; but it is absolutely necessary that some one or other of the ordinary disinfectants, such as carbolic acid, should be applied abundantly to the excretions, soiled linen, and utensils, before these are removed from the apartments of the sick. Extreme cleanliness and disinfection of the discharges from the stomach and bowels cannot be too much insisted upon, as it is generally believed that the disease is disseminated through these. The College would earnestly insist upon the importance of organising, in any district infected by cholera, the system of house to house visitation, and of establishing temporary hospitals for the reception of patients who cannot be properly treated in their own homes. The College would further suggest that such temporary hospitals should be numerous rather than large, and so distributed as to make it unnecessary to convey to any great distance those who are stricken by the disease. Ambulances and stretchers for the removal of the sick should be provided. During the prevalence of cholera, any unusual degree of looseness of the bowels, though painless, should not be neglected, and on its occurrence, the patient should immediately go to bed, be kept warm, and medical advice should be at once obtained. Previously to the arrival of a medical attendant, any of the medicines used at other times for checking common diarrhoea may be taken, such as the chalk mixture, or the compound cinnamon powder."

LIGHT IN RELATION TO HEALTH.

BY JAMES RITCHIE, M.B., F.R.C.P. ED.

COMMON things are not usually esteemed, and the more universally and liberally anything is bestowed, by so much the less is it valued. This is true not only of things material, but of conditions which affect health and life. Because

The self-same sun that shines upon his court
Hides not his visage from our cottage, but
Looks on alike,

because light is so freely and generally distributed, there is the danger of our failing to realise how necessary it is to healthy life. Such a failure might be, often is, a very serious one, affecting the welfare not of individuals only, but of families, and even of communities. Therefore we propose to devote a little time to the consideration of light in relation to health.

Were we to ask half-a-dozen of the uninitiated "What is light?" the answers would probably be different in each case. Possibly the most frequent reply would be, that it is that which is necessary to let us see to walk about and to attend to our daily work. The careful housewife would likely descant upon its destructive effects upon carpets and window curtains. The idea that *light* is energy, power, force, would probably be very distant from the mind of most. They can understand that there is force in a blacksmith's muscle, that there is power in the steam-engine; they can realise that the heat produced by the combustion of the

fuel is a force converted in the steam-engine into so much work done, but they are not at once prepared to admit that in both cases the energy was derived in great measure from the light and heat of the sun. In the one case traced backwards through the beefsteak which nourished the arm, to the grass which fed the ox, to the light and heat which caused the grass to grow. In the other case, that the fuel is the concentration of the sun's rays stored up ages ago either in the wood or the coal used as fuel. I say advisedly the sun, because as far as our earth is concerned we may practically disregard other luminous bodies—the fixed stars and nebulae—as sources of light.

The physics of *light* form a most attractive field of study, and a most extensive one, but all that we can aim at to-night is, by means of a few demonstrations, to fix in your memories some of the properties of light most related to our subject.

In order that we may understand somewhat of this light which is so abundantly diffused, we must examine a small portion. Doubtless on some sunny morning, when the shutters of your bedroom window have been closed, you have seen a ray of light entering at a chink, and you have been able to trace it through your room in *straight* lines with definite borders, till it fell on the wall opposite (Fig. 1). You have also probably noticed the millions

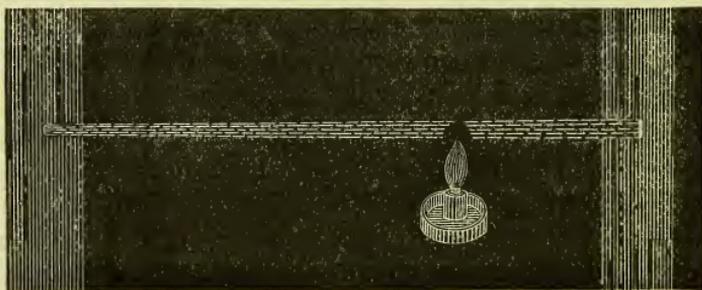


Fig. 1.

of little particles dancing in the same beam of light, but without realising that were it not for these particles the course of the ray would be invisible to our eyes. Our sight is not so acute as to

see the minute particles of which our atmosphere is composed, although we can feel them dashing against our face as wind when we wave the hand in front of us, but we cannot see them. These larger particles, however, we do see, and by them we trace the light. If close beneath the ray at some part of its course we place a spirit-lamp, we observe that at this part the ray becomes invisible, because by means of the lamp we have burned those minute particles, the reflection from which rendered the light visible in its course. By the aid of such a ray you can easily demonstrate that anything held parallel to the ray receives less light than a body inclined towards the source of light, and that one inclined in the opposite direction only receives light reflected from substances on which it falls. You will then be able partly to understand why in our hemisphere ground with its lie towards the south should receive more sun than that which is inclined towards the north.

Now this light which we have demonstrated to travel in straight lines, and to be seen by reflection, is believed to consist of waves of a particular kind ; *molecular vibrations* they are called. I dare say you have noticed that if you throw a stone into a smooth sheet of water, the motion imparted to the water is manifested by a series of waves in the form of concentric circles, ever widening, and at the same time becoming less and less marked, till they can be no longer traced. And you might also notice that if any small bodies, such as chips of wood, were floating within the affected area, these have risen and fallen, now on the summit of a wave, now in the hollow, but not advancing with the wave. So the molecular vibrations, which we call light, are transmitted from atom to atom, while the particles transmitting them do not move forward. Like the little waves just referred to, these vibrations also vary in *intensity*. When the sun is directly overhead, the light is much more intense than after sunrise or before sunset. The reason is not that in the revolution of the earth round its axis we are nearer the sun at midday than at either of the other periods, because in midwinter we are, at sunset, upwards of ten millions of miles nearer the sun than at any time of day in

summer ; but the smaller intensity arises mainly because morning and evening the light has to pass through a much greater thickness of atmosphere than at midday, and in its course loses in intensity. Were we to represent midday light diagrammatically by

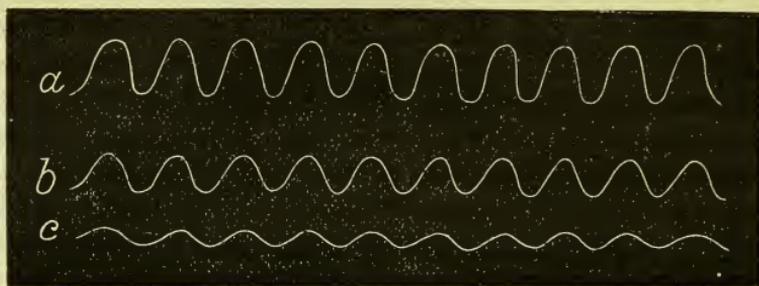


Fig 2.

a curve with high cusps and deep hollows (Fig. 2, *a*), at sunset it might be represented by more shallow waves (*b*), and in fog by still more shallow curves (*c*).

But the waves of light are not all in the same *direction*. Were we to represent the direction of some by a vertical line, a horizontal would indicate the direction of others, that is to say, they may be at right angles to each other. Some probably move in straight lines, some in circular, and some in elliptical waves. Perhaps there is a constant change both in the character and in the direction of the vibrations.

When the vibrations of light fall upon some bodies they are nearly all reflected, some bodies absorb them and convert them into heat, others, such as glass, transmit them, these are said to be more or less transparent. Light does not travel through different transparent media at the same rate, consequently if in passing from one transparent medium to another it enters the second at an angle, it is bent out of its course or refracted. Probably you are all familiar with the appearance of a piece of wood which is dipped obliquely into water, it seems to be bent at the point where it enters the water. When light enters certain transparent bodies such as tourmaline, Iceland spar, &c.,

it is broken up into two portions, and when these are examined it is found that in each portion respectively the vibrations take place mostly in the same direction, and that those in one portion are at right angles to those in the other. In this condition light is said to be polarised. When a certain thickness of tourmaline is used one of these rays is absorbed, the other only is transmitted. If now we pass this polarised ray through a second crystal (Fig. 3), similar in character and position to the first, we find that it passes through almost unchanged, because in this position the crystal transmits vibrations in this particular direc-



Fig. 3.

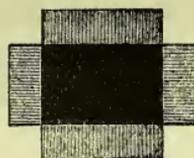


Fig. 4.

tion. But if the second crystal be turned, with the ray of light as its axis, what we observe is that the light gradually fades till the crystal has been turned a quarter of a circle, in which position there is darkness (Fig. 4); no light at all will be transmitted, because now the crystal is at right angles to the position in which it allows vibrations in this particular direction to pass. If we continue to turn it through another quarter of a circle the light gradually returns.

But not only is a ray of white light composed of undulations in different directions, but the waves are not all of the *same length*. If we cause a ray of white light to pass through a prism it is deflected from its course, and because all the vibrations are not of the same length, those which are more rapid are more deflected than those which are slower (Fig. 5). If such a ray be allowed to fall upon a screen it is found to be elongated, and to be no longer white, but to display a perfect rainbow of colour, red at

one end, passing to orange, yellow, green, blue, and violet. The vibrations at the red end are least deflected, and about twice as long as the more rapid ones at the violet end of the spectrum, which are most bent from their original direction. These waves

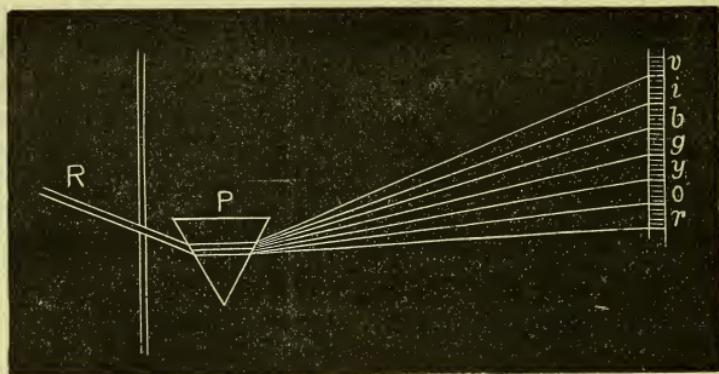


Fig. 5.

have different properties. The light-giving is most marked in the yellow, the heat-giving in the yellow, orange-yellow, and red, and the chemical in the violet. For this reason photographers use yellow glass to illuminate the dark chamber in which they manipulate their sun pictures, because the chemical violet rays are excluded. Beyond the red end, which is visible, are other longer undulations which are unseen, but possess heat-giving properties, and beyond the visible end of the violet are more rapid vibrations, which are powerful in producing chemical action.

If light be due to vibrations or waves of a particular kind, we might expect that if two rays were brought into collision they might interfere with each other, either in the direction of increasing or of diminishing the intensity of the light. Were the crests to coincide the intensity might be increased, but were the crests of one wave exactly to meet the hollows of the other, darkness might result. This effect can be demonstrated as follows:—

If by means of two mirrors (Fig. 6 M, M') almost in the same plane, but inclined a very little towards each other, we throw pencils of light of one colour, say red light, upon a dark screen,

the rays from the one mirror are not quite parallel to those from the other but cross them at a small angle, they *interfere* with each other, and the results of this interference are shown by the appearance on the screen of light and dark bands, one of the

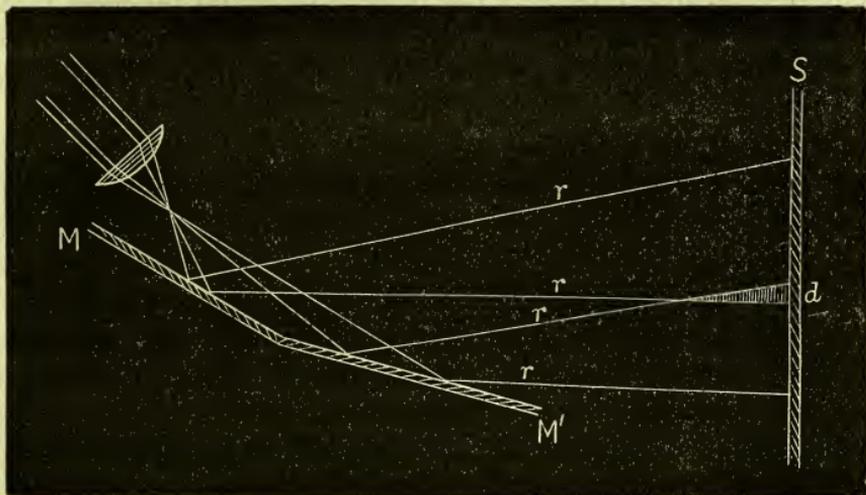


Fig 6

latter is shown at d . If the light from either mirror alone is allowed to fall on the screen, the illumination is uniform.

You have doubtless often admired the beautiful colours exhibited by mother-of-pearl; it is not coloured, but the surface is covered with extremely fine grooves. Reflected light is always more or less polarised, and the waves reflected from these grooves at different angles interfere with each other, so that some of the coloured waves of which white light is composed are extinguished, the residual waves impart the colour. The kind of wave extinguished depends upon the angle at which the light falls, therefore the play of colours varies with the change of position. In this we have a further illustration of the wave theory of light.

It may perhaps enable some of you to realise how it is possible to have these molecular vibrations or waves transmitted while the transmitting agent is at apparent rest, if I recal what you may have noticed in the case of a tuning fork, or of a bell, say a

large bell which has been struck. At first sight the fork or bell seems to be at rest, but if you touch the edge gently with the finger you find that it is vibrating. The waves developed by these vibrations convey the sensation which we call sound, the slower vibrations produce a low pitched note, and the more rapid a higher one. The low note corresponds therefore to the colour at the red end of the spectrum, the higher notes to that at the violet end.

We have seen that this influence travels in straight lines, and is seen by reflection, consists in molecular vibrations which may vary in intensity with the extent of the vibration, that the vibrations are not all in the same direction, neither are they at the same rate. The terminations of the optic nerve in the dark chamber of the human eye are so constituted that when vibrations of this kind fall upon them the sensation which we call light is produced. Certain rates of vibration give the sensation of particular colours, the union of these in definite proportion producing white light.

With waves you are accustomed to associate the idea of power, of force, because you have seen the waves of the sea in their onward course, not only raising those mighty ships which carry so much of our national wealth, but occasionally in the storm wave striking awe into the breasts of all who behold. So when the sunlight shines into your rooms I wish you to think of its complex waves as having in them a mighty power not for lighting only, or for heating, but for promoting chemical and vital changes. I wonder if the poet had in view the violet—chemical—rays when he wrote—

“ The glorious sun
Stays in his course, and plays the Alchymist,
Turning, with splendour in his precious eye,
The meagre cloddy earth to glittering gold.”

Now what is the influence of light upon living things.

Let us begin with **Plant Life**. Germination, *i.e.*, the sprouting of the seed, may take place in the dark, also growth may take

place in the dark, when a store of nourishment has been laid up in the plant; but apart from these exceptions, light is the chief factor in the production of nearly all the phenomena of vegetable life. When a plant (*e.g.*, a potato in a dark cellar in the spring) is deprived of light you know how it pushes out long, lank, pale, sickly looking shoots. The green colour is not developed, little woody matter is produced, the juices are watery, the ordinary secretions (whether starch, acid, sugar, essential oil, etc.) are poorly developed, and the plant does not flower. You know how difficult it is to get anything to grow in the shady sides and corners of our gardens, unless it be ferns, and a few plants that love the shade; and at our room windows, unless they have a sunny exposure, the same difficulty is experienced. Forest trees when much crowded are drawn upwards toward the light with foliage developed mainly or only towards the top, and those grown at the edge of a dense plantation have the foliage most healthy at the side next the light. Potatoes grown in the shade are watery, gooseberries from a bush of which the leaves have been destroyed by caterpillars are very tasteless. The sap ascending from the soil does not produce new wood nor the products characteristic of any plant till it has first passed upwards to the leaves, there under the influence of sunlight green colouring matter is produced, and when that is present other products are elaborated and pass downwards to be deposited in their normal situations, or at least the sap suitable to their elaboration passes downwards. When a fir tree has been barked by squirrels it is at the upper part of the wound that new wood and bark are first and most abundantly produced. The effect of the absence of light in blanching, in preventing hardy growth, and in rendering the juices more bland, is well known to gardeners, and is used by them to render sea kale, celery, and other vegetables more delicate, tender, and therefore more palatable. Before cabbages close in, their leaves are green and robust, but after they close the central parts become pale and tender.

On the other hand, you know how the stems, leaves, and

flowers of plants turn towards the sun. Their colours are far more vivid in the sun than in shade. In a cottage window in the country, growing it may be out of a cracked old teapot, you will find flowers, geraniums for example, which for richness of colour far surpass those grown with most aristocratic surroundings in the town, but with so much less of sunlight. The influence of light in favouring healthy growth is further evidenced by the fact that timber, such as oak, rapidly grown in consequence of free exposure to abundant sunlight is far more durable than that produced under conditions less favourable in this respect.

Low down in the scale of vegetable life are organisms having a different mode of development, different kind of food, and a different function in the economy of nature—their function is to aid in the removal and decomposition of sickly, dying, and dead members, both of vegetable and animal kingdoms; to these light is not an essential. Crusts of bread left in a can in a dark press often become mouldy, and shoes if left in a dark corner of a room, if there be damp, often become similarly affected. Dry rot is caused by a kind of mould, and you know how it flourishes in the dark. When you see a ray of light passing through a dark room you become conscious that the air is a stirabout of minute particles. As we have already seen it is these minute particles which make the ray visible in its course. These are of very varied character, minute fibres of wool, linen, wood, etc., etc., and among them spores or seeds of moulds of various kinds. For example, there may be the one which causes souring of milk, or one or other of the different moulds found on the top of jam. Allied to these are other bodies, some of them very minute, which we now know have a definite relation to, and seem powerful in the production of, different diseases. For example, the mould which produces thrush in the mouths of delicate children, the micrococci of diphtheria, and the rod-like bodies which have an intimate relation with consumption. Many of these organisms not only do not flourish in sunlight, but seem actually to be destroyed by it. Tyndall found that flasks

containing Pasteur's solution (a fluid favourable to the development of lower organisms) which had been exposed to the sun remained more free of germs than those placed in the shade. These experiments have been confirmed by others, and recently Duclaux has shown that sunlight is fatal to those organisms which we consider to be unfavourable to the healthy existence of the human body.

On the Animal World the influence of sunlight is very powerful. Arctic travellers tell us of the depressing effect of the want of it, and of the joy with which its return is hailed. We ourselves have the experience in a less degree of the difference upon our spirits of dull and of sunny weather. Light stimulates the nervous system through the eye, the circulation and other functions are increased. The amount of carbonic acid excreted may be taken as a good index of the extent of this increase; it has been carefully measured by different observers both in rabbits and frogs, and it is found to be increased in sunlight.

In young and growing animals when external influences are so powerful for good or for evil upon their delicate organisms, we have more striking evidence of the value of light than in the case of adults. It is almost impossible to rear healthy chickens in the dark. The frog in the early days of its existence is very different from the mature animal, not only in appearance but in mode of life. It is a fish, with a tail, and breathing by gills (Fig. 7) You know it as the tadpole, and it is very interesting to observe in its development first appearing little buds for the hind limbs, then those for the fore limbs, to see these increasing in size, the body changing shape, the tail being absorbed, till the animal assumes the characteristic appearance of the frog. Meantime other internal changes not less important take place both in the heart and in the breathing apparatus. Dr W. F Edwards enclosed some tadpoles in boxes, so constructed that light was excluded, but the other conditions of life were not interfered with. Out of a dozen tadpoles two developed into frogs, but at a much later period than they ought to have done; the other ten did not develop, they grew in size, but remained tadpoles,

although large ones. When we go into some of the poorer quarters of our large cities, and in the badly lighted underground rooms see the poorly developed, pinched, sickly looking faces of the children, we cannot but wish for them, among other advantages, the blessing of a more abundant supply of the free light of heaven. Perhaps if our children were, at birth, like tadpoles, provided with a long caudal appendage which disappeared only as development proceeded, and in proportion to that development, we would be more anxious to give them every condition favourable to healthy life.

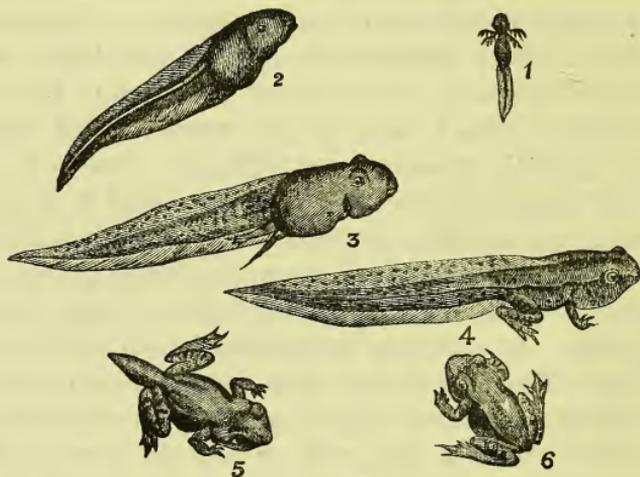


Fig. 7.—Development of Frog.

But even among the adult population of our large towns there is no feature so common as pallor of countenance, which generally means a greater or less degree of poverty of blood; where this exists the general tone of health—the vitality—is lowered. Physicians could readily give examples of members of consumptive families going to reside in a dark house, the general vitality lowered in consequence, and then the onset of the dreadful malady. The want of light rarely acts alone, darkness is very

often synonymous with dirt, or as Sir D. Brewster put it, "Uncleanness and corruption have a vested interest in darkness." Dark colours are chosen that the dirt may not be seen. If a room be dark it is most unlikely that its corners will be swept and dusted as carefully as if it were light. Dust in a house usually means more or less of decaying organic matter, and that is unwholesome. On entering a room with the blinds down, how often are you offended with the stuffy odour, even although no one has occupied it for some time. Why is it close and stuffy? Because the sun's rays have not had admission with their oxidising power. It is in this relation interesting to know that the poison of the cobra, although it retained its virulent properties in the dark, lost them after exposure to the rays of the sun. I have already referred to the influence of sunlight in destroying the lower forms of organisms which are prejudicial to health.

But perhaps after all you ask, How does the miner exist? How do thousands exist who have to live in dark rooms? How do the inhabitants of Arctic climates live during their long night? The question we discuss is not how far may we neglect the conditions of health and yet survive? Some individuals seem almost to defy them and yet live. Illness does not always mean death, but it does mean discomfort if not somewhat of misery; it often increases temptation to indulgence in stimulants, it may mean an enfeeblement of the succeeding generation. You have seen how necessary sunlight is to the healthy development and growth of plants, how the absence of it makes them pale and less hardy, and interferes with the development of healthy products. The young animal is more readily influenced by external conditions than the adult, and you have seen that the absence of light interferes with its development, even with its existence. Then you have noted, I hope, the influence of sunlight in destroying those minute organisms sometimes floating in the air, which play so important a part in the production of disease. If sunlight is so beneficent we should expect that when the vitality of the individual is lowered by illness, its influence and the absence of it would be specially evident. It is with great sinking

of heart that medical men undertake the treatment of many diseases in a dark or dismal chamber, and it is not a matter of opinion, because there are well-authenticated instances of hospitals having a light and a dark side, in which the percentages of recovery have been distinctly greater in the former. In the Roosevelt Hospital there is a glass case for a sun bath to hasten recovery, a revival of the solar bath of the ancient Romans.

Miss Nightingale writes:—"Where are cellars and the unsunned sides of narrow streets, there is the degeneracy and weakness of the human race—mind and body equally degenerating. Put the pale withering plant and human being into the sun, and, if not too far gone, each will recover health and spirit." We regard with great satisfaction the active measures which have been recently adopted by our Public Health Committee to close badly lighted, therefore unhealthy, houses. Much still remains to be done in the same direction.

How, then, is our practice to be guided. Avoid houses in which artificial light is required during the day. Choose if possible a street with a good exposure to the sun. Follow the advice of the old proverb, "Live on the sunny side of the street where the doctor never comes." Do not take a house which never receives the direct rays of the sun. We hope that architects in planning windows and window-panes will never sacrifice health and utility for appearance only. Let our windows be kept thoroughly clean, so as to intercept as few of the sun's rays as possible. Let the sunshine into your rooms every day if possible; do not grudge a little fading of the curtains and of the carpets in order to have a more healthy atmosphere. If your windows be small, or the exposure bad, have the walls and furnishings as light in colour as possible. For ordinary use, a northern exposure will answer quite well for a bedroom, but in the event of sickness, especially if the illness is likely to be a long one, a sunny exposure is desirable. If sunlight is necessary to the healthy, it is still more so to the sick. An invalid should never be in a room with a borrowed light. How depressing it is to have blinds down and shutters shut. There are very few

ailments in which darkness is necessary, and only a few in which more than a subdued light is required. For a large majority, abundance of sunlight is beneficial.

In work rooms and schools the light ought to be sufficient to allow of the occupation being prosecuted without straining the eyes of the workers. It is better to have the window high rather than low, so that the light may fall above the eyes. The pupil or workman should be so placed that he will not be in his own light, and so that when the eyes are raised from the work they will not be strained by a full glare of light, but be rested by falling upon something in comparative shade. For school children who write and for several trades it is best to have the light entering at the left hand side, and above the level of the eye. Children should not be allowed to study by twilight, nor sprawling on the hearthrug to endeavour to read by firelight. Such straining tends to induce short-sightedness.

But we are reminded that certain evils may result from too strong light. Looking directly at the sun or at a powerful electric light, microscopic work with a powerful illumination, long continued travelling over snow, may cause a temporary weakness of vision, or even permanently damage it. The eyes of the newly born infant should be shaded from the full glare of sunlight or of bright artificial light. Passing from darkness to bright light produces dazzling effects.

“The rising sun complies with our weak sight,
First gilds the clouds, then shows his globe of light
At such a distance from our eyes, as though
He knew what harm his hasty beams would do.”

Long continued exposure to bright light is also to be guarded against; those who travel in snowy regions ought to wear preserves.

Bright sunlight falling into a bedroom is very liable to awake those asleep in it, and as children ought to have a large allowance of sleep, it is necessary in the summer time to exclude the sun's rays in the early morning by shutters or otherwise.

Artificial Light.—Although theoretically it may be very good

at certain seasons to go to bed with the lily and to rise with the lark, yet in our climate there are periods of the year when, for opposite reasons, this proceeding would not be convenient. Most people must for a part of every twenty-four hours use some kind of artificial light, and during the winter the greater part of every day we are dependent upon it. It is therefore important that this substitute should be one as favourable as possible to the maintenance of healthy conditions.

Modes of Producing Artificial Light.—Artificial light is produced by heating some material till it becomes incandescent. When we heat a piece of iron it passes through the stages of *black heat*, giving off long waves like those beyond the red end of the spectrum, as the temperature rises the iron becomes *red hot*, and at a still higher temperature it reaches *white heat*. When a quantity current of electricity passing through a large conductor is interrupted in its course and made to pass through a conductor of small sectional area, such as a piece of platinum wire, the small portion is raised to a white heat. Such an arrangement, in vacuo, is the method adopted in the various forms of incandescent electric lamps.

Usually, however, incandescence is obtained by a process of oxidation. The material used is ordinarily some kind of hydrocarbon, that is a body consisting mainly of hydrogen and carbon. Other materials might be used, as magnesium, but the waste product magnesia is so abundant that the lamp used to burn it would soon become clogged. The hydrocarbons which have been most commonly employed are tallow, oil, wax, spermaceti, petroleum, and its derivatives, and more recently gas.

In our ordinary flames there are three zones—an inner gaseous zone, in which there is no combustion; a middle zone, that of incandescence; and an outer zone—that of complete combustion.

Hydrocarbons, as previously stated, consist chiefly of hydrogen and carbon. When they are ignited the hydrogen, meeting with the oxygen of the air, produces a flame only slightly luminous,

but it liberates a considerable quantity of heat, by which the carbon, which is in a state of extremely fine division, is raised to a white heat. This forms the luminous part of the flame, and as these luminous particles pass into the outer zone of complete combustion, they are oxidised and pass off into the atmosphere in an invisible form as carbonic acid gas.

In the electric arc-light two points of carbon are made use of in the lamp, which is so arranged that these points shall be kept as constantly as possible at a little distance from each other. The current leaps from the one point to the other, and in its passage minute particles of carbon are detached, rendered incandescent, and oxidised.

Results of Combustion.—In the incandescent electric lamps there is no combustion, there are no waste products, the atmosphere is not therefore vitiated, and it is not much heated. In the electric arc-light the carbonic acid is in extremely small quantity.

Pure hydrocarbons produce watery vapour and carbonic acid gas, but in the less pure petroleums and in coal gas sulphuretted compounds are also present. In all of them, but particularly in the two last named, there is the danger of the escape of unconsumed material in consequence of imperfectly arranged apparatus. An ordinary burner consumes as much oxygen, and discharges into the atmosphere as much carbonic acid, as two men. The air is therefore by so much the less capable of sustaining healthy animal life. The prejudicial effect of sulphuretted compounds are shown by the tarnishing of silver, the unhealthy aspect, and later, the death of plants grown in a room in which much gas is consumed, and by the destructive effects upon the bindings of books, specially marked in the top rows in libraries which are illuminated with gas.

Characters of Artificial Light.—The light produced by the hydrocarbons is mainly yellowish, and is very poor in violet rays. As there is no white to form a standard of comparison, yellows are with difficulty distinguished in artificial light; it has, compared with the sun, a poor illuminating power, so that those with weak

sight have greater difficulty in reading or working by this kind of light, and there is increased strain upon the eyes. The light is also accompanied by a considerable amount of heat, and those workmen, as engravers, who require much light for their occupation, find it drying and irritating to the eyes unless they use means to intercept the heat.

The electric light very much resembles sunlight ; it is rich in the violet or chemical rays, and numerous experiments have proved that plants grow and fruits ripen under its influence. The fear has been expressed that if this means of illumination were to become general we might wear out too soon. This only time can show. It has not yet been proved, however, that we run down more quickly in the summer than in the winter, nor yet that, in addition to our ordinary slumber, a period of hibernation is necessary to the well-being of those who dwell in the more northern climes.

The Relative Merits of Different Illuminants.—The electric light is undoubtedly the most healthy. It does not vitiate the atmosphere when incandescent lamps are used, or very slightly when the arc-light is employed. It does not heat nor dry the air, and the quality of its light more resembles that of the sun. With the same motor power the arc-light is seven or eight times more powerful than the incandescent, but the latter has the advantages of being noiseless and having a more steady light. In any case the electric light ought to be very carefully shaded in order to protect the eyes from excessive glare. The main objection to it as yet is its cost. At the recent meeting of the British Association it was stated by a gentleman who had illuminated his house by this method, that the cost of fitting up was £7, 10s. per lamp. His apparatus had cost him £400, and for his house the maintenance was from £50 to £60 per annum. The cost of maintenance would be less were several adjacent houses to make use of the same motive power as generator. Meantime, however, this light is too costly for general use in dwellings.

For use in bedrooms and libraries colza oil is the best, because as it contains oxygen it impoverishes the air less, and its waste

products are also less destructive than those of gas, but it is about three times as costly.

Ozokerit candles (which are made of a solid hydrocarbon obtained from petroleum) have also the advantage of being little destructive, seeing that they contain no sulphureous compound, but in order to obtain a light equivalent to gas a large number would require to be burned, and in addition to waste products there would be also a considerable quantity of unconsumed carbon. The cost of such illumination would be about sixteen times that of gas.

Composite candles would be only a little less costly.

Petroleum oil is in cost nearly the same as gas for a light of equal intensity, but those who use it, unless with the best quality of lamps, rarely aim at having an equivalent illumination. Except the purest varieties, its waste products are the same as those of gas, and it has the disadvantage that unless great care be taken in the trimming of the lamp, keeping it clean, and having it properly lighted, an unpleasant smell is caused.

Gas is by far the most convenient illuminant, and with the exception of small petroleum lamps it is the cheapest. We, in Edinburgh, are remarkably well off as regards both the purity and the illuminating power of the gas. By act of Parliament it ought to be equal to sixteen candles. Much of that supplied to London is just up to standard; in Edinburgh it varies from twenty-seven to thirty-one candles.

The amount of light which we obtain from any gas depends upon a combination of conditions, viz., the pressure under which the gas is delivered, the kind of burner used, and the kind of globe, if any. Whatever the illuminant employed, we ought to endeavour to obtain from it as much light as possible, with the minimum of heat and of waste products, and with no waste of material. A sufficiency of atmospheric air ought to be brought into contact with the gas (for all these illuminants are converted into gas) to completely oxidise its elements, but the contact should not be made too hurriedly, in order that every particle of carbon should be incandescent for as long a period as possible

before it is completely oxidised. I suppose that most of you know the Bunsen burner in which air is mixed with gas before it is ignited. In it the carbon is rapidly oxidised. The flame is of small luminosity, but of great heating power. If there be a lack of air, a smoky flame is produced. You may have noticed such a flame when the burner has been accidentally knocked out of a gas bracket.

In large cities gas must be delivered under considerable pressure. In Edinburgh it varies from one to two and a half inches of water. As the consumption varies at different times of the day, there is a consequent alteration of pressure within the pipes, notwithstanding endeavours at the gas works to regulate it. Then it varies with the altitude: for every ten feet of elevation there is an increase of a tenth of an inch. In a city like ours the difference on this account must be great; even in the same house there may be more than half an inch of difference between the pressure in the basement and that in the top flat. Now the pressure at which gas escapes from the jet has a very great influence upon the *character* of the flame, and upon the *healthiness* of the room. If the pressure be high a considerable amount of gas escapes unconsumed, and vitiates the atmosphere; the flame may blow or sing, and not nearly so much light is given as at a lower pressure. This is very evident in the union jet, the flame is too thin, the carbon is too rapidly oxidized or hurried out of the zone of incandescence. On the other hand, if the pressure be too low the flame is unsteady and becomes smoky. The results of actual experiment may give you a better idea of the effect of increased pressure. At half an inch pressure a union jet gave a light equal to 28 candles, while at an inch and a half it was equal to 21; under the higher pressure it gave only three-fourths of the light which it gave at the lower. For equal quantities of gas consumed, a small jet at a high pressure gives less light than a larger jet at a lower pressure. In one set of experiments a number 0 at an inch and a half gave for the same consumption of gas little more than a fourth of the light given by a larger burner at low pressure. There are various means of regulating the pressure. Peebles'

regulator is one of the best, but it is somewhat expensive. For ordinary use "Bray's special" burner is very good. If you are troubled with the gas singing be sure that it is being wasted, and in order to obviate this turn the gas on full at the bracket, check the meter till the gas burns steadily, then further regulate the size of flame by means of the stop-cock on the bracket.

For ordinary use the *union* or *fish tail* burner is the best. "Bray's special," with arrangement for modifying the pressure is perhaps the best for the money. A useful size is No. 3 or 4, but of the ordinary metal-topped burners a smaller size is sufficient. The fish tail is liable to get clogged with dust, but it may easily be cleaned with a hard brush or a small pin. Remember that the two small holes are at right angles to the flame.

The *batwing*, which has a simple slit across the top, is readily cleaned by drawing a piece of writing paper across the slit, but except in some of the newer forms the flame is too broad for globes, and they blow at lower pressures than the union jet.

Argand burners, specially those of Silber, give remarkably good results, but they require constant watching in consequence of their tendency to smoke under increased pressure, unless they are fitted with a good regulator.

All globes diminish the amount of light: a piece of window glass held in front of a gas flame diminishes the light by 10 per cent., frosted glass by 25 per cent., and opal glass from 40 to 50 per cent. But although they diminish the amount of light proceeding from the flame, they do not necessarily diminish the benefit derived from it. When any substance upon which light shines is brought into close relation with one more brilliantly illuminated, it is dark by comparison. This effect is very evident when we use artificial light because its source is a single point, forming a centre of contrast, whereas sunlight is diffuse. Now a frosted or an opal shade, especially the former, scatters the light and makes it more diffused, giving a more equal illumination. The lower aperture of globes should be from 3 to 4 inches. A small aperture causes the flame to flicker, it tends to draw the sides of it up into long tails, to diminish the luminosity of the

flame, and to carry off part of the gas unconsumed. Although an opal shade with small aperture diminishes the amount of light very much, one with a large aperture does not do so to nearly the same extent, because it acts as a reflector, throwing the light downwards and upwards.

Practical Hints.—Never take a house of which the daylight is so deficient that artificial illumination will be required during the day.

Do not for economy endeavour to read in the dark, nor to do work which requires much use of the eyes. The danger to the sight more than counterbalances any saving of gas. Special care should be taken of children in this respect.

Always endeavour to have a good burner, and to keep it clean. A small burner with high pressure will burn as much gas, but give less light, than a larger burner with a lower pressure. If on entering an unoccupied room in which the gas has been burning for a time the atmosphere is unpleasant, you may be sure that gas is being wasted, and that you will have to pay for it even if it has not been burned.

A room with light coloured walls requires much less light to illuminate it than one with dark walls.

If one person only is to occupy a room much light is not required, and it is best to have one jet with a shade, white inside and green outside, that so when the eyes are raised from the book or work they may be rested by being directed to the part in shade.

It is better to use candle and matches when required, than to burn gas in a bedroom over night.

Always have ventilation to rooms in which gas is burning. When we go to the Highlands we visit the shellings, and looking with great curiosity at their peculiar fireplace, and at the hole in the roof which acts as chimney, we mentally assume a position of superiority, "Poor benighted people," we mentally cogitate, "only a hole like that to carry off the smoke." We return to town, and the glare of gaslight vitiating to a great extent the atmosphere in our rooms, less unpleasant to the sense of smell it

may be than the Highland peat-reek, but much more injurious to health, and we have not even the one hole in the roof to carry off these noxious gases. Poor benighted lowlanders! The upper sash of the window drawn down a very small way will suffice for ventilation in the absence of any special arrangement.

Hitherto we have considered the subject as affecting individuals or small groups of them, but it has a far wider aspect affecting large communities, and in this relation it has been and is now engaging the attention of both scientific and practical men. By the kindness of Mr Blackwood, Cumin Place, and of Mr Buchan, of the Meteorological Society, I am able to tell you the relative amount of sunlight obtained in some districts of Scotland. During 1880 the South Side of Edinburgh received bright sunlight during only 30 per cent. of the hours during which the sun shines. The intercepting agents were clouds and fogs, and the relation of the latter to the former is a very intimate one. In 1880 Mr John Aitken, of Falkirk, demonstrated by experiment to the Royal Society of this city that the minute particles of smoke in our atmosphere form nuclei on which watery vapour condenses as fog, and he further shewed that if watery vapour be brought into contact with sulphur fumes a dense yellow fog is produced. We have recently seen this effect upon a large scale when the outskirts of our city were rejoicing in brilliant sunshine from eight o'clock in the morning, while the central portions were still shrouded with a smoke cloud till after mid-day.

The relative influence of the rain cloud and of the smoke we may estimate by comparing the number of hours of sunshine in Edinburgh, in Glasgow, and in Aberdeen. Edinburgh, although it bears the traditional soubriquet of Auld Reekie, is less reeky than Glasgow, but more so than Aberdeen. In Glasgow the observations are made in the smoky part of the city, in Edinburgh at the Grange, where the smoke is less dense than over the city, and in Aberdeen the Observatory is quite out of the town at the Old University. During 1881 the number of hours of bright sunshine was in Glasgow 1137, in Edinburgh 1240, in Aberdeen

1355. But the influence of the smoke in obscuring the sun is brought out still more markedly if we compare the number of hours during the months when most smoke is produced, viz., the three first and the three last months of the year,—Glasgow had only 207·6 hours of bright sunshine, Edinburgh 313·8, and Aberdeen 397·3, that is to say that during these months Aberdeen had nearly twice as many hours as Glasgow. Edinburgh held a position midway between them.

London, in November 1882, received only 24 per cent. of the solar rays, whereas Hastings had 41 per cent., and Edinburgh only 19. It has been calculated that the smoke cloud over London is composed of 60 tons of carbon daily. In the neighbourhood of that city there is an industry in which the sun's rays are used to bleach wax, but in consequence of the great diminution of the amount of light which reaches the city it has been found necessary to remove the works from Shepherd's Bush to Hammersmith. The winter of 1880 was marked by dense fogs. During that time it was noted in the London Zoological Gardens "that the health of the animals was seriously affected by the darkness, plants under glass in the Botanical Gardens ceased to grow, and showed evidence of seriously depressed vitality during this period of darkness, from the absence of the chemical influence of the sun's rays." The death-rate in London was raised by forty per cent., almost exclusively on account of respiratory complaints, an increase equal to that caused by a cholera epidemic; but because the increase was not due to any of the epidemic diseases but only smoke and fog, it did not excite in the minds of the public any serious alarm.

In the Public Health Acts the evil is recognised, and under these Acts we occasionally find the owner of some factory prosecuted for polluting the atmosphere with smoke. Such action is taken not because of damage done to the beauty of our city, but in the interests of the health of its inhabitants, which is affected not only by the deleterious gases which form part of the smoke, but also and in no small degree by the influence of the smoke in diminishing the amount of sunlight which we receive.

Scientists tell us that at an early period in the history of the universe what is now the sun had not its present form, but that its elements existed as a diffused nebular mass. At that period there was only diffuse light, but, as development proceeded, this nebular mass became condensed into what we now know as the sun which ministers so much to the light and life of our planet. In the earlier days of His people's history, He who has compared Himself to Light was not known in the definite way in which He now is, but in the evolution of His plan He has revealed Himself in defined form as the Sun of Righteousness, whose beams have brought light and life to a fallen race. Now as in the natural world many shut out the health-giving light of the sun, so it is possible for us by a wall of pride to exclude the spiritual light, to have our vision dimmed by self-righteousness. There is the danger that the theories of science, while imperfect because incomplete and sometimes purely speculative, because they will not accord—or we cannot get them to vibrate in unison—with our ideas of the Almighty, there is the danger that these theories like a cloud should shut us out from the benefits of that Sun of Righteousness.

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MILK IN RELATION TO PUBLIC HEALTH.

By PETER ALEXANDER YOUNG, M.D., F.R.C.P.

MILK, the fluid which forms the natural food of the young of a large and important class of animals—the mammalia—has the marked peculiarity that it contains all the constituents which are required to nourish the body.

The scope of the present lecture requires us to confine our attention to the milk yielded by one species of the order of mammals only, viz., the domestic cow.

In a previous lecture* delivered before this Society, attention was directed to the rearing of children and the use of milk necessarily treated of. On this occasion the chief object in view is to enforce the importance of milk as an article of diet, and the consequent necessity for the proper arrangement and supervision of the milk supply of large towns.

To this end I shall divide the subject into the three following heads :—1. Composition of milk ; 2. Milk as an article of diet ; 3. The necessity for the proper arrangement and supervision of the milk supply of large towns. On the first two parts I shall require to dwell but briefly, while the last subject will engage our attention more fully, as it is on this point that the Committee of our Health Society now wish the attention of the public to be specially directed.

I. *Composition of milk.*—To the naked eye milk is a homogeneous

* “On the Rearing and Training of the Infant and Child,” by C. E. Underhill, M.B., F.R.C.P.E.

opaquely white fluid, but under the microscope it is found to contain myriads of globules of fatty matter floating in a liquid. When milk is allowed to stand this fatty matter rises to the surface, constituting *cream*. Acted upon by rennet or acids the *caseine* or *curd* is thrown down, separating it from the *whey*. The same thing occurs spontaneously, especially in hot weather, when the caseine is coagulated by the formation of lactic acid, and the milk turns sour, as it is termed. Milk, when fresh, has a sweetish taste, owing to the presence of lactose, or *milk sugar*. *Water* constitutes the largest bulk of milk, and there are also present some *salts*.

The proportion in which these constituents occur in an average specimen of milk, may be given as follows:— *

In 100 cubic centimeters of country milk—

Water,	.	.	.	90·09	grammes.
Fat,	.	.	.	3·16	„
Caseine,	.	.	.	4·16	„
Milk sugar,	.	.	.	4·76	„
Salts,	.	.	.	0·73	„
				102·90	„

When cream is agitated, as in churning, the envelope which surrounds the fatty matter is ruptured, and the *butter* or solid fat is liberated, the remaining liquid is *butter milk*. *Cheese* is the caseine which has been separated and subjected to pressure in moulds. Milk when perfectly fresh is either neutral in reaction or slightly alkaline in acid. The specific gravity is about 1030, and the mean average of solids about 12·45 per cent.

Butter is the fatty part of milk, and is composed of olein, stearin, palmatin, butyryn, and other fats.

Caseine is the nitrogenous constituent of milk. It is not coagulated by heat like albumen or white of egg, but heat favours the coagulation in presence of acid or rennet. Thus milk which has only slightly turned sour will curdle on being boiled. When

* Wanklyn milk analysis.

milk is introduced into the stomach, the first process in digestion is the coagulation of the caseine by the pepsine and the acids of the gastric juice. Caseine is composed of carbon, hydrogen, nitrogen, oxygen, and a little sulphur. Milk contains in addition a little albumen—another nitrogenous principle.

Milk sugar is not so sweet nor so soluble in water as ordinary sugar, and is less liable to vary than any other constituent of milk.

The salts of milk are chiefly phosphate of soda, chloride of sodium, and sulphate of sodium.

The composition of milk varies slightly, according to the breed of the cows that yields it, the Alderneys giving more fat, and the long horns more caseine. As a rule it is the quantity, not the quality, that varies. It was found that the quality of the milk of an ill-fed Bengali cow in India hardly differed from the milk of English cows, although in quantity it differed greatly. Popularly, it is considered that the first milk that flows from the udder is the best for invalids. This is a mistake, as it has been proved that the last milk is nearly double as rich in cream, owing probably to the cream rising in the udder from its greater lightness, and being consequently the last to flow. Therefore, if rich milk is wanted, the strippings or last milked should be selected. It is estimated that afternoon milk is richer both in cream and curd. The kind of food taken by cows alters the milk both in taste and appearance. Madder and saffron will colour it; the odour will be altered by taking plants of the onion tribe, and the taste by such articles as turnips. Milk may acquire medicinal properties by cows feeding on certain plants, and this method of treating diseases has been suggested. Symptoms of poisoning have followed the drinking of milk of cows who have eaten the leaves of the *Rhus toxicodendron*. The colour may be altered by the presence of fungi. The *Oidium Lactis* or *Penicillium* causes a blue milk, and yellow cream being mixed with it produces green milk. There is also a yellow milk resulting from a *vibrio*.

Disease in cows leads to alterations in milk, but these we shall consider at a later stage.

II. *Milk as an article of diet.*—It seems a proposition which does not require proof, that as nature has provided milk as the natural food of the infant, milk is its best food. Yet it is the daily experience of medical men that this simple fact has not yet received general acceptance. It is too frequently the case to find young infants fed with rusks, and the different varieties of farinaceous foods as a supplement to milk, and often to its exclusion. It cannot be too frequently urged upon mothers and all concerned in the rearing of infants that till they are six months old, they should be fed entirely upon milk. If the mother's milk fails, then cows' milk, either fresh or preserved, should be substituted. The simple reason for this is that milk supplies all the ingredients necessary in a food for building up the body. Nature has not yet provided the saliva necessary to digest starchy materials, of which farinaceous foods are so largely composed. I need not enter here into the methods of adapting cows' milk so as to be as near as possible the same composition as mothers' milk, as that has been treated of in the lecture already referred to. But the fact that milk is the only safe food for infants is one that bears constant repetition. The neglect of this leads to endless troubles—sickness, diarrhoea, fretfulness, and malnutrition with all its consequent diseases. Rickets is a disease affecting the bones, and results from a failure of the system to absorb enough bone-building materials. It is a most common affection, and it has been produced at will by excluding milk from the diet of young animals.

M. Jules Guérin took a number of puppies in equally good condition. He let them suckle for a little, and then weaned half of them, feeding them on raw meat. After a short time those who were naturally fed were strong and healthy, while the others pined and vomited, their limbs bent, and in four or five months they showed all the signs of rickets.

Trousseau, the great French physician, says, "Rickets is never so common as it is in babies weaned ere the teething is forward enough, and brought up on pap, vegetables, or even meat."*

* Trousseau, "Clinique Médicale," vol. iii. p. 484.

as children grow older, milk is a most important part of their dietary, and nothing can be put in place of it. Children often dislike fat, the absence of which leads to consumption and other wasting diseases. In such cases abundance of milk, cream, and butter, which can as a rule be easily taken, supplies the want. In view of these facts we cannot too strongly enforce the use of milk. And yet the children of very many of our working classes get but little milk. Some years ago I went into the house of an intelligent, steady, and hard-working man, and found his family of young children at tea. On warning him of the danger of tea for children, and the superiority of milk, he demonstrated to me that with his small wages he could not possibly afford the quantity of milk his family would drink. This I believe to be quite true. What I would suggest would be to use skim milk or butter milk, which are cheaper, and, where new milk cannot be obtained, are excellent substitutes. Yet milk might be cheaper than it is if the following paragraph from a paper of date 19th September of this year be true: "Milk, like cheese, is now a drug upon the market. Cheshire farmers are consigning milk to London, Liverpool, Manchester, and Birmingham distributors at 6d. and 7d. per gallon at the highest, very few farmers obtaining the latter price. As this represents $1\frac{1}{2}$ d. a quart only, the profits netted by the middle men may be pretty accurately estimated on the immense quantities consumed daily by the populations of these large towns alone."

In adult life milk is an important article of diet. In health many do without it, but still the majority of people take milk in some form or other. In Scotland milk, with its natural accompaniment, the "halesome parritch," used to be a universal food. I regret to think it has now all but ceased to be so. Tea, alas! has taken its place. I am told by farmers that now their reapers will not take it, preferring tea, and that among their ploughmen and labourers porridge is a thing of the past. I wish I had the power to impress on every man, woman, and child the immense superiority of porridge and milk over the tea and trash they are substituting for them. They cannot possibly do the same day's

work upon them. The men must work less or worse, and the women cannot attend so well to their families and houses. And, further, I fear results of national importance will follow this neglect of the national diet. The reply to Dr Johnson's sneering definition of oats, "where will you find such men," will no longer hold. Porridge and milk gave the brain and body which led to the dogged perseverance of the Scottish race, and caused it to rise wherever it went. By neglecting this food, I do not wish to prophesy evil, the same stamina cannot be got, and Scotsmen may fail to reach the proud position they have always attained. It is in the treatment of the diseases of adult life that milk plays its most important *rôle*. In fevers, which form so large a proportion of acute diseases, milk is an indispensable article of dietary. The digestive and assimilative functions being weakened in the course of fevers, milk is easily absorbed and nourishes the body enfeebled and wasted by the high temperature in a way that nothing else can. I may mention that beef-tea, which is so largely used in the treatment of many fevers, if prepared in the ordinary way and cooked, is four times less nutritious than milk, while raw beef juice is equal to milk in the nutritive scale. In diseases of the stomach, which bulk very large in the present day as causes of ill health and discomfort, milk is invaluable, and can be taken with relish, fattening the patient, and leaving no unpleasant effects, while almost every other article of diet would lead to trouble and annoyance. In consumption we find milk an essential part of the dietetic treatment, while cream can often be taken when other fats, which are so necessary in this dire disease, disagree and cause nausea. In affections of the kidney, which are classed under the term Bright's disease, milk is a most important part of the treatment, and yields results that are most gratifying and satisfactory. I need not multiply the list, for there is scarcely any disease where milk is contraindicated, and where it does not form a part of the diet table.

I often hear people say they cannot take milk, it is so bilious. I do not believe it is. If it is too heavy for them, lime, soda, or potass water may be added, or skim milk, which is deprived of

the fat, is lighter. Whey, which has no curd, is very easily absorbed, and often agrees where milk may be rejected. We can, in the immense majority of cases, get milk to be taken in some form or other. Milk is usually looked upon as a fluid food, but as I have mentioned at the beginning of this lecture, the first process of digestion is to turn part of this fluid into a firm solid, which has to be re-dissolved before it is absorbed into the system. Invalids often take rum and milk in the morning. Here the milk is the important part, the rum merely giving a flavour.

From what I have said I think I have clearly established the importance of milk in health and disease, and that no single article of diet can in any way approach it as a nutrient agent.

III. *The necessity for the proper arrangement and supervision of the milk supply of large towns.*—Having proved the importance of milk as a diet in health and disease, it is necessary that the milk for this purpose must be good and pure. We therefore now come to consider *how to know good milk*. And first, what standard shall we take to compare milk with? Normal milk is opaquely white, no smell or peculiar taste, reaction neutral or slightly acid or alkaline, specific gravity 1030 more or less, should have no deposit after standing, and should not change its appearance by boiling. Cream about ten per cent., and the quantity of solids varying from twelve to thirteen per cent. This is merely an average composition. Perfectly genuine milk may not come up to this standard, while many specimens may exceed these percentages. In determining the quality of milk many points have to be attended to, and the courts of law must necessarily give a somewhat wide latitude in deciding what is pure and what is adulterated milk.

Many instruments have been invented for testing milk. The principal of these is the lactometer, for determining the specific gravity. This is a glass or brass apparatus which floats in milk, and has on it a scale beginning at zero, the specific gravity of water, and is graduated downwards. Now this instrument when taken by itself is very fallacious. Cream is lighter than milk, and if there be too much cream of course the specific gravity will be less, and we might therefore think the milk was watered if we

trusted alone to this test. While on the other hand, if some cream were removed the reading of the lactometer would be higher, hence we might conclude that we had to deal with an especially good specimen of milk, while in reality it had been deprived of part of an important constituent. To arrive at a more accurate conclusion as to the quality of the milk, the quantity of cream must be determined. This is done by a creamometer, which is a graduated tube with zero at the highest point of the scale and graduated downwards. The milk to be tested is poured into the tube up to zero of the scale, and allowed to stand in a quiet place for twenty-four hours to permit all the cream to rise. The quantity of cream is then read off on the scale. Having the specific gravity and the quantity of cream, we can arrive at a fairly accurate conclusion as to the quality of the milk. In order, however, to be perfectly correct in our estimation of a given specimen of milk, a certain quantity of it should be evaporated down, and the solids estimated as a whole, then the amount of the fats determined and further, by incinerating the solids, estimating the ash, which should amount to 0.73 per cent. As this method involves special chemical knowledge, and would be of no use popularly, I shall not enter into it here. For ordinary purposes, if you are given a suspected sample of milk you would proceed to examine it as follows. Look at its physical properties, its appearance, taste, and smell. Find its re-action by litmus paper. Take the specific gravity and determine the quantity of cream, observing at the same time whether there was any deposit. Boil a portion of it, and if perfectly good there should be no change in its appearance.

When speaking of specific gravity of milk, which varies considerably, I may mention that the specific gravity of the whey of genuine milk varies but little. If the curd is separated by acetic acid and the whey examined, the specific gravity only varies from 1025 to 1028.

A very simple little instrument for the examination of milk by colour has recently been invented in Germany—Heeren patent milk tester. It is made of vulcanite, and on the raised portion

of a round disc a little milk is placed ; over this there is put a glass cover, which spreads out the milk. Round the glass is painted various shades of colour representing cream, very fat milk, normal, less fat, poor, and very poor. The standard seems to be a little low, as I find good Edinburgh milk nearly comes up to the cream colour, but it may be used as a rough and ready method of speedily testing milk.

Adulterations of milk. The most usual, as could be supposed, is water. And this is a most important adulteration, as it dilutes the milk and renders it less nutritious. Starch, dextrine, gum, and glycerine have been found in milk, to make it thicker and richer looking. Annatto or turmeric are sometimes added to give colour. Chalk is a classic impurity in milk. Nitre is sometimes used to take away the turnip taste from milk. A case was tried some time ago in the west of Scotland, where nitre was supposed to have been added to milk. The dairyman pleaded not guilty to using nitre, but said he gave his cows rock salt. The magistrate found the man not guilty of using nitre, but guilty of adulterating his milk, in as much as by giving cows rock salt they were thirsty and drank more water, and thus the milk was diluted by an extra quantity of water. Cream has been found mixed with magnesia, tragacanth, arrowroot, and yolk of egg. In most cases where milk has been tampered with it has been either watered or creamed, or both. Milk is frequently skimmed and then mixed with fresh milk, and sold as whole milk. On this subject Dr Russell, Medical Officer of Health, Glasgow, writes to me as follows :—"The habit of the country being to use sweet, skim, and cream, and not sweet alone as in America, there is no end of juggling, especially as the inspectors are well known. As a rule, two of skim and one of sweet will readily pass as genuine sweet."

A very important subject now presents itself for discussion. Milk may have impurities, the detection of which is often very difficult, and yet these impurities may lead to serious diseases and even death. We shall therefore consider *Diseases of the human subject which may be conveyed in milk.* These diseases are mainly these

—(1) Typhoid fever, (2) Scarletina, and (3) Diphtheria. During the last twelve years or so the number of epidemics of typhoid fever recorded as due to milk is fifty, of scarlatina fifteen, and of diphtheria seven. These epidemics have been tabulated by Mr Ernest Hart of London. During these epidemics the number of cases arising from these different diseases is computed at 3500 of typhoid fever, 800 of scarlatina, and 500 of diphtheria. From these figures it will be seen that this danger is one of the greatest importance. Milk readily absorbs infection and communicates disease to those using it. In 1873 a case occurred in Marylebone, London, which was most carefully and indefatigably investigated by the late Dr Murchison, and clearly proved that 244 cases of typhoid, of whom 20 died, occurred in 143 households taking milk from a Buckinghamshire dairy where the occupier died suddenly of ambulant typhoid. The chamber slops from this patient were buried for safety in an ash heap. Following this, about twenty days after there was a heavy rainfall, and the infected soakings were washed into a well, the water of which was used for dairy purposes. In evidence it was not made out that the milk had been intentionally diluted with water, but simply that the dairy vessels had been washed with the water from this well. The demonstration in this case was so complete that the fact that typhoid can be spread in this way is universally admitted.

In some of the epidemics examined into the intentional dilution of milk with water, which was afterwards found to be infected with typhoid poison, was ascertained. In ten epidemics of typhoid as well as four of scarlatina it was discovered that the same person who nursed the patient was the one who managed the dairy operations. In one case the same dishcloth which was used for the patient suffering from fever was used for the milk cans. In another case infected clothes were washed in the same place as the dairy operations were carried on. In some cases milk cans were taken into the house where disease was present; in yet another case, unclean linen was seen placed side by side with the lids of milk cans.

In *scarlatina* the disease is spread by the bran-like par-

ticles that are thrown off the skin in this affection. This gets into the milk either by the persons engaged in the dairy being convalescent from the disease, and the skin peels into the milk, or else those attending on the sick carry the infected cuticle on their clothes from the patient, and it gets into the milk. A case from the former method of infection occurred in St Andrews in 1876, and was reported by the late Professor Oswald Bell of that city. Twenty-six people took scarlatina, and two died, the probable source of the infection being the skin peeling off the boy who carried the milk and dropping into the cans.

In *diphtheria* it is more difficult clearly to trace the source of infection. An epidemic broke out in the north of London in 1878, which was traced to the milk, but the source of infection was not definitely established. In these epidemics all who drank the milk were not affected by the disease, but we know in all circumstances that only a percentage of those who are subjected to infection take the malady. It is proved, however, that those who drank the milk in the largest quantity were correspondingly more numerous attacked. Children, domestic servants, and large milk drinkers furnished the larger proportion of those affected. Instances are given where visitors at a house getting infected milk were attacked, although their own supply was good.

It is curious to remark how residents in houses in certain streets supplied by the disease-carrying milk were affected, while their next door neighbours were quite free. The chain of evidence is most conclusive, that infected milk was the cause of the disease.

Diseases in animals which may be communicated to man.—The principal of these diseases is *foot and mouth disease* (apha epizootica). In animals the disease is characterised by an eruption of vesicles or blisters over the tongue and inside of the lips, on the skin bordering the hoofs, as well as on the teats and mammary glands.

According to Professor Brown, in a lecture delivered by him at the Institute of Agriculture, South Kensington, the milk presents few abnormal characters in the early stage of the disease,

the sp. gr. is 1024 ; when the disease is fully developed there are found in the milk large granular masses of a brownish yellow colour, numerous pus-like bodies, bacteria, vibriones, &c. The physical character of the milk presented no appreciable peculiarity during this stage, but it rapidly undergoes putrefaction. Boiling delays the change for a few hours. It is now clearly established that this disease can be communicated to man. Three German veterinarians drank the milk from an infected cow, and in three days one had all the symptoms of the fever, followed by inflamed mouth ; on the seventh day blisters on the edge of the tongue, lips, and internal surface of the cheeks. These blisters burst and left ulcers on the tenth day. The two others suffered similarly, but not so severely.

In 1883 Mr John Hammond, a well-known breeder of red-polled cattle in Norfolk, had aphthous fever in his herd. The milk from cows apparently free from disease, or only slightly affected, was used in the household, and for additional safety was boiled. Mr Hammond himself partook freely of the milk, and had an acute attack of fever and vomiting, succeeded by swelling of the glands of the neck and of the throat, soreness of throat and mouth. Two other persons in the house were attacked in a similar way. Following this there was a second outbreak. Six of the family drank the milk and suffered ; two did not, and escaped. One child had the disease severely, the tongue was swollen and protruded from the mouth, and its life was despaired of. Four or five weeks elapsed before the affected persons were completely restored to health. In 1863 Mr G. B. Hislop of Houston, Renfrewshire, published some undoubted cases in the "Edinburgh Medical Journal," and Dr G. W. Balfour of this city, in commenting on these cases, mentions that one of his children, who was being brought up on the bottle, had symptoms of the disease, which he attributed to the milk. In my own practice I have had two families at different times under my care suffering from similar symptoms, which appeared to result from milk, although I could not distinctly trace it.

Anthrax is another bovine disease which has been communi-

cated to man through milk. An animal affected by this disease is dull, tumbles, and is unsteady in its gait, swellings appear in the head, throat, and other parts of the body, with discharges of blood. The disease is propagated by a bacillus, according to Koch, Pasteur, and others. Many examples are on record where this disease has been communicated to the human subject by milk of cows affected by this virulent complaint.

Tuberculosis of cows has recently received much attention. This is the disease popularly known as consumption. If the disease affects only the lungs, as in the affection known popularly as "grapes," it is doubtful if the disease can be communicated from one animal to another. Dr Imlach of Liverpool has investigated this subject experimentally, and has found that animals such as guinea pigs, rabbits, and monkeys fed on milk from cows suffering from this variety of the disease, had not the malady communicated to them, while Professor Bang of the Veterinary College of Copenhagen, and others, have taken the milk from cows in which the udders were affected with tuberculosis, and animals fed with it for some time have developed the disease, as was shown by post mortem examination. In Scotland, cows suffering from tuberculous udders are known as "piners." At the outset of the disease the milk does not fall off in quantity, but rather increases, and microscopic examination reveals the presence of the bacillus of tuberculosis, which has been demonstrated by Koch of Berlin to be so closely associated with consumption. In cases where half the udder is affected, it has been thought that the milk from the non-affected side is innocuous, but it has been found that this milk is full of bacilli, and that the disease is communicated by it. It is difficult to establish accurately the communication of this disease from man to animals, but from a bovine form of tuberculosis having been found in man, there is a very strong presumption that it can take place.

Having discussed the adulterations of milk and the diseases which may be communicated through it, we shall now consider *what precautions should be taken and legally enforced, in order that our milk supply may be pure and uncontaminated.*

Precautions against adulteration.—At present the authorities have the power to prosecute any one selling adulterated milk. But in order to get a conviction as the law at present stands, the case must be a very glaring one before the authorities are successful. I have said that good milk should contain from 12 to 13 per cent. of solids. The Society of Analysts has fixed the percentage at 11·5, a very moderate standard indeed. In a prosecution, if the suspected milk barely comes up to this standard, the defendant can send a sample of the milk to Somerset House, and as the chemists there are the ultimate court of appeal as regards analysis, if they declare the milk pure the case breaks down. Now, the Somerset House authorities have never yet declared what is their standard; all that is known of it is, that it is a very low one. For the ends of justice and for the sake of the public, it is time that this state of matters should cease, and that some recognised standard should be declared by the authorities, so that medical officers of health and analysts might have some grounds for recommending a prosecution. At present, under this most unsatisfactory arrangement they are uncertain except in a very bad case what to do, and adulteration goes unpunished. Mr Falconer King, City Analyst for Edinburgh, tells me that three-fourths of the specimens of milk sent to him for analysis, are adulterated. This surely is not as it ought to be, the more especially as this adulteration is principally found in the poorer districts of the town, whose inhabitants are not too well fed, and where the hygienic conditions tend to the deterioration of health, especially of the infants and children who chiefly drink the milk, and who require the best food they can get.

Milk may be adulterated at many points on its way from the cow to the consumer. Therefore it is best to take milk for analysis just as it is to be handed to a customer in a milk shop or at the door of his house. The Aylesbury Dairy Company, whose average milk yields 13 per cent. of solids, retain an analyst constantly in their service, and have inspectors going about taking milk as it is distributed to the customers. In this way they know exactly what is being supplied, the distributors are deterred

from adulterating, and the high standard mentioned is maintained. If the milk is in a large can, and a vessel dipped into it to serve out the milk, the cream is always rising, and the first portions of the milk will be the best, while the last will be much poorer. This must be taken into account in estimating the quality. If, on the other hand, the milk is distributed from a can with a tap at the bottom the reverse will hold good.

Precautions in Byres. — Inspectors are appointed by the authorities, whose duty it is to inspect byres in order to see that the cattle are in a healthy condition, and that the sanitary state of the byres is attended to. By the order issued by the Privy Council on the 15th of June of this year, all dairymen must be registered, and they must satisfy the Local Authority that the lighting, ventilation, including air-space, cleansing, drainage, and water supply of their byres are properly arranged for. And they cannot begin to occupy new premises before they give a month's notice of their intention to do so. This order also provides for the health and good condition of the cattle, for the cleanliness of milk vessels used for containing milk for sale, and for protecting the milk against infection or contamination.

It further provides that no swine must be kept in a byre.

If disease exists among cows in a byre, the milk from these cows must not be mixed with other milk ; it cannot be sold for human food, and if used for feeding animals it must first be boiled. If a cow shows signs of disease it is removed, and the milk from it is not sold. It is very important that a thorough examination of the cows should be made, and in a case of doubt a skilled veterinary surgeon should be called in. In a case of tuberculosis of the udder, formerly referred to, it is very difficult to diagnose between it and ordinary inflammation of the gland, and yet a mistake may lead to very serious symptoms, and even involve life. Tuberculosis is not one of the diseases coming under the Privy Council order, and the inspectors cannot compel a cow suffering from this complaint to be destroyed, nor yet is there power under the order to

prevent tuberculous milk being sold.* This appears to me a point which should be attended to at once, so as to remove a source of obvious and momentous danger to the public. Cattle are giving off large quantities of impure air from the lungs, which, if there be not sufficient ventilation, is reintroduced into the lungs, and the animal falls off; the quality of the milk is deteriorated. It is the duty of the inspectors, therefore, to insist on the proper cubic capacity in byres for each cow, "but according to the provisions of the Local Government Board twelve cows may be huddled in the space of under ten thousand cubic feet, which amount, it has been shown by physiological considerations, is barely sufficient for the maintenance of six in vigour of health" (Professor Axe in *The Veterinarian* for June 1885). It is also of the greatest importance that byres should be kept clean. Cleanliness is as essential to the health of cattle as it is to man. Cows should be kept dry, and all discharges removed at short intervals to a distance from where the byres are. In towns cows cannot get out to the fields, which, of course, is the natural and therefore the best condition for them, and the best for yielding the richest milk; they should consequently have their hygienic surroundings carefully looked after. And I am certain if this was more attended to, cows would require less food. If a cow, though not very ill, is yet under the action of certain medicines, the milk may lead to unpleasant symptoms in those drinking it. This milk should therefore not be sold.

Cows should have good water. It is frequently the practice in towns for dairymen to have special wells of their own in order to avoid the expense of the town's water. This may prove a source of danger, as the wells are very easily contaminated from the percolation of liquids from the byres. Cows should be well fed. The question of sewage grass, especially in Edinburgh, is

* On this point I have received the following memo. from Professor Walley, Royal Veterinary College:—"I have received a communication from the Privy Council office, confirming the statement I made to you *in re* the prosecution of parties selling milk from diseased cows. Prosecution can only be instituted when animals are suffering from diseases recognised in the Contagious Diseases (Animals) Act as contagious." Tuberculosis is not one of these diseases.—P. A. Y.

important. Mr Swan has pointed out that milk from cows fed on sewage grass went putrid and stank in thirty-six hours. Dr Voeleker considers that there are no grounds for suspecting it under proper management. I do not think there is usually risk in employing it, although there may be special circumstances where its use might be attended with danger. It is not such a good nutrient agent, I feel sure, as grass more slowly grown. The cows' udders should be kept clean, as well as the hands and persons of the milkers. All vessels for receiving milk should be thoroughly washed in boiling water, and the water pure and uncontaminated.

Precautions in dairies and milk shops.—The order already referred to provides that all dairies and milk shops must be registered; that no one suffering from infectious diseases, or who has been in contact with such an one, shall handle vessels or take part in the business. No water closet or cesspool shall communicate with the place where milk is stored. No milk shop can be used as a sleeping apartment, or used in any way incompatible with the preservation of the milk. It also makes provision for the cleanliness of the vessels used.

We have in Edinburgh a compulsory registration of disease, and medical men attending cases of infectious disease must intimate the same to the Medical Officer of Health. This has worked admirably, and is of the greatest service. In all cases the responsibility of notifying the disease rests on the medical man, but the Edinburgh Municipal and Police Act provides that in addition the keepers of dairies and byres must intimate to the authorities the existence of infectious diseases in their premises. This is a wise and necessary provision.

Many of our dairies are in the country, where no compulsory notification of infectious disease exists. It is therefore absolutely essential for the proper supervision of the milk supply of towns, that this rule should be extended to counties, and that all local authorities should be informed of the existence of infectious diseases.

This order will be of great use in securing proper premises for the sale of milk and preventing contamination. An inspector

has already been appointed in Edinburgh, and it is to be hoped that good will result from these much-needed enactments. If the licenses to be granted after inspection of the premises would remain in force only for one year, and to be renewed if seen fit at the end of that period, it would make milksellers more careful, and keep them watchful lest from some breach of the order they might lose the privilege of selling milk. Milk very easily absorbs contamination, and as the emanations from many articles which are sold in shops not solely devoted to milk might injuriously affect the milk, the authorities here have asked milksellers to state generally the articles they sell besides milk.

The thorough cleanliness in dress and person of all who have to do with milk is most essential. All vessels used for holding and conveying milk should be washed in boiling water or water that has been boiled. The boiler which is used to heat the water should not be employed for domestic purposes. All covers of vessels after they are washed should be removed, and the vessels turned bottom up to dry and get a free current of air through them.

Precautions in the distribution of milk.—Milk is frequently contaminated on its way to the consumer. Particles and germs are floating in the air which easily get into a badly covered can, and are thus a source of danger. Cases are recorded where disease has arisen from this cause, and where the strictest and most minute investigation has proved that this was the only source of contamination. To obviate such a contingency Dr M'Vail of Glasgow has introduced his patent vented can, where, by special precautions, the can and milk are freed from germs, and the air which enters the vessel to supply the place of the milk taken out by a tap at the bottom passes through a porous substance which thus filters it. If there is any reason to suspect the purity of milk, it should in all cases be boiled in order to kill the germs. This precaution is most important for all, more especially when the milk is used for feeding infants. Milk cans must be thoroughly cleansed with pure boiling water and dried in the way already mentioned for dairy utensils; and it would be an additional precaution if the cans were locked to prevent milk being tampered with, and the keys kept by

responsible people. Cans should have taps at the bottom, and the milk run from them into measures. I cannot too strongly condemn the practice which obtains in Edinburgh, of having milk carried in open cans, where the lid is taken off at every door when milk is handed in, exposing it to dust and other impurities. The lid may not fit well or be carelessly put on, leading to the risk of further contamination. Above all, I cannot speak too severely against the custom of dipping the measure each time milk is given out into the can, causing the hand of the distributor to be introduced into the milk, and thus you have gradually a milky infusion of hand, and that frequently by no means a clean one. The danger of communicating skin diseases and other forms of malady is very evident, and the uncleanness of the operation is, to say the least of it, most disagreeable. To obviate this, cans with taps at the bottom, or wooden barrels with taps, as they have in the west country, should be used.

If infectious disease exists at a house served, there should be suspension of the supply by ordinary service. A special messenger who should not enter the dairy ought to be sent, and cans in which the milk is delivered ought to have a special and separate cleansing and disinfecting. By these means the risk of the disease spreading to other families supplied from the same source is abolished.

In order that milk may be handed to the consumer pure and in a wholesome state, it is necessary that the greatest care and cleanliness should be exercised by all who have the handling of the cows and the milk they yield.

In conclusion, I have to tender my best and heartiest thanks to all the officials and others I have consulted on the subject of this lecture, who have lent me their willing and courteous assistance—Dr Littlejohn, medical officer of health ; Dr Stevenson Macadam ; Mr W. I. Macadam ; Mr Falconer King, city analyst ; Dr Russell, Medical Officer of Health, Glasgow ; Mr Cotton, Secretary, Edinburgh Dairy Supply Company ; Principal Walley, Royal Veterinary College ; Mr Williams, New Veterinary College ; Mr Scoullar, inspector of markets, and the Manager, Aylesbury Dairy Company.

APPENDIX.

MILK-SHOPS, DAIRIES, &c., IN EDINBURGH.—
DECEMBER 1885.

No. of Places Selling Milk.	Other Com- modities.	Milk only.	Connected with House.	Apart from House.
787	533	254	521	266

THE DAIRIES, COW-SHEDS, AND MILK-SHOPS'
ORDER OF 1885.

At the Council Chamber, Whitehall, the 15th day of June 1885.

By Her Majesty's Most Honourable Privy Council.

PRESENT :

Lord President.
Mr Trevelyan.

THE Lords and others of Her Majesty's Most Honourable Privy Council, by virtue and in exercise of the powers in them vested under The Contagious Diseases (Animals) Act, 1878, and of every other power enabling them in this behalf, do order, and it is hereby ordered, as follows :—

Short Title.

1. This Order may be cited as The Dairies, Cow-Sheds, and Milk-Shops' Order of 1885.

Extent.

2. This Order extends to England and Wales and Scotland only.

Commencement.

3. This Order shall commence and take effect from and immediately after the thirtieth June, one thousand eight hundred and eighty-five.

Interpretation.

4. In this Order—

The Act of 1878 means the Contagious Diseases (Animals) Act, 1878.

Other terms have the same meaning as in the Act of 1878.

Revocation of former Orders.

5. The Dairies, Cow-Sheds, and Milk-Shops' Order of July 1879 is hereby revoked: Provided that nothing in this Order shall be deemed to revive any Order of Council thereby revoked or to invalidate or make unlawful anything done before the commencement of this Order, or interfere with the institution or prosecution of any proceeding in respect of any offence committed against, or any penalty incurred under, the said Order hereby revoked.

Registration of Dairymen and Others.

6.—(1.) It shall not be lawful for any person to carry on in the district of any Local Authority the trade of cow-keeper, dairyman, or purveyor of milk unless he is registered as such therein in accordance with this Article.

(2.) Every Local Authority shall keep a Register of persons from time to time carrying on in their District the trade of cow-keepers, dairymen, or purveyors of milk, and shall from time revise and correct the Register.

(3.) The Local Authority shall register every such person, but the fact of such registration shall not be deemed to authorise such person to occupy as a dairy or cow-shed any particular building or in any way preclude any proceedings being taken against such person for non-compliance with or infringement of any of the provisions of this Order or any Regulation made thereunder.

(4.) The Local Authority shall from time to time give public notice by advertisement in a newspaper circulating in their District, and, if they think fit, by placards, hand-bills, or otherwise, of registration being required, and of the mode of registration.

(5.) A person who carries on the trade of cow-keeper or dairyman for the purpose only of making and selling butter or cheese or both, and who does not carry on the trade of purveyor of milk, shall not, for the purposes of registration, be deemed to be a person carrying on the trade of cow-keeper or dairyman, and need not be registered.

(6.) A person who sells milk of his own cows in small quantities to his workmen or neighbours, for their accommodation, shall not, for the purposes of registration, be deemed, by reason only of such selling, to be a person carrying on the trade of cow-keeper, dairyman, or purveyor of milk, and need not, by reason thereof, be registered.

Construction and Water Supply of New Dairies and Cow-Sheds.

7.—(1.) It shall not be lawful for any person following the trade of cow-keeper or dairyman to begin to occupy as a dairy or cow-shed any building not so occupied at the commencement of this Order, unless and until he first makes provision, to the reasonable satisfaction of the Local Authority, for the lighting, and the ventilation, including air-space, and the cleansing, drainage, and water supply, of the same, while occupied as a dairy or cow-shed.

(2.) It shall not be lawful for any such person to begin so to occupy any such building without first giving one month's notice in writing to the Local Authority of his intention so to do.

Sanitary State of all Dairies and Cow-sheds.

8. It shall not be lawful for any person following the trade of cow-keeper or dairyman to occupy as a dairy or cow-shed any building whether so occupied at the commencement of this Order or not, if and as long as the lighting, and the ventilation including air-space, and the cleansing, drainage, and water-supply, thereof are not such as are necessary or proper—

- (a.) for the health and good condition of the cattle therein ; and
- (b.) for the cleanliness of milk-vessels used therein for containing milk for sale ; and
- (c.) for the protection of the milk therein against infection or contamination.

Contamination of Milk.

9. It shall not be lawful for any person following the trade of cow-keeper or dairyman or purveyor of milk, or being the occupier of a milk-store or milk-shop—

- (a.) to allow any person suffering from a dangerous infectious disorder or having recently been in contact with a person so suffering, to milk cows or to handle vessels used for containing milk for sale, or in any way to take part or assist in the conduct of the trade or business of the cow-keeper or dairyman, purveyor of milk, or occupier of a milk-store or milk-shop, so far as regards the production, distribution, or storage of milk ; or
- (b.) if himself so suffering or having recently been in contact as afore-said, to milk cows, or handle vessels used for containing milk for sale, or in any way to take part in the conduct of his trade or business, as far as regards the production, distribution, or storage of milk—

until in each case all danger therefrom of the communication of infection to the milk or of its contamination has ceased.

10. It shall not be lawful for any person following the trade of cow-keeper or dairyman or purveyor of milk, or being the occupier of a milk-store or milk-shop, after the receipt of notice of not less than one month from the Local Authority calling attention to the provisions of this

Article, to permit any water-closet, earth-closet, privy, cesspool, or urinal to be within, communicate directly with, or ventilate into, any dairy or any room used as a milk-store or milk-shop.

11. It shall not be lawful for any person following the trade of cow-keeper or dairyman or purveyor of milk, or being the occupier of a milk-store or milk-shop to use a milk-store or milk-shop in his occupation, or permit the same to be used, as a sleeping apartment, or for any purpose incompatible with the proper preservation of the cleanliness of the milk-store or milk-shop, and of the milk-vessels and milk therein, or in any manner likely to cause contamination of the milk therein.

12. It shall not be lawful for any person following the trade of cow-keeper or dairyman or purveyor of milk to keep any swine in any cowshed or other building used by him for keeping cows, or in any milk-store or other place used by him for keeping milk for sale.

Regulations of Local Authority.

13. A Local Authority may from time to time make Regulations for the following purposes, or any of them :

- (a) For the inspection of cattle in dairies.
- (b) For prescribing and regulating the lighting, ventilation, cleansing, drainage, and water-supply of dairies and cow-sheds in the occupation of persons following the trade of cowkeepers or dairymen.
- (c) For securing the cleanliness of milk-stores, milk-shops, and of milk-vessels used for containing milk for sale by such persons.
- (d) For prescribing precautions to be taken by purveyors of milk and persons selling milk by retail against infection or contamination.

Provisions as to Regulations of Local Authority.

14. The following provisions shall apply to Regulations made by a Local Authority under this Order :

- (1.) Every Regulation shall be published by advertisement in a newspaper circulating in the District of the Local Authority.
- (2.) The Local Authority shall send to the Privy Council a copy of every Regulation made by them not less than one month before the date named in such Regulation for the same to come into force.
- (3.) If at any time the Privy Council are satisfied on inquiry, with respect to any Regulation, that the same is of too restrictive a character, or otherwise objectionable, and direct the revocation thereof, the same shall not come into operation, or shall thereupon cease to operate, as the case may be.

Existence of Disease among Cattle.

15. If at any time disease exists among the cattle in a dairy or cowshed, or other building or place, the milk of a diseased cow therein—

- (a) shall not be mixed with other milk ; and

- (b) shall not be sold or used for human food ; and
- (c) shall not be sold or used for food of swine, or other animals, unless and until it has been boiled.

Acts of Local Authorities.

16—(1.) All Orders and Regulations made by a Local Authority under The Dairies, Cow-Sheds, and Milk-Shops Order of July 1879, or any Order revoked thereby, and in force at the making of this order shall, as far as the same are not varied by or inconsistent with this Order, remain in force until altered or revoked by the Local Authority.

(2.) Forms of Registers and other forms which have been before the making of this Order prepared for use by a Local Authority under the Dairies, Cow-Sheds, and Milk-Shops Order of July 1879, or any Order revoked thereby, may be used, as far as they are suitable, for the purposes of this Order.

Scotland.

17. Nothing in this Order shall be deemed to interfere with the operation of "The Cattle Sheds in Burghs (Scotland) Act, 1866."

C. L. PEEL.

HOW TO LIVE LONG.

BY DR JAMES.

OF the advantage of a long life to the individual who enjoys it, there can be no doubt, and it is equally certain that to the society in which that individual is an item, longevity is equally valuable as affording to it the benefits of a long life's work and experience. From our neighbour's, as from our own point of view, then, we are all justified in striving to obtain it.

But here you will perhaps be inclined to make some qualifications. You may say, for example, that with long life health must be associated, if it is at all to be desired. This specification is, however, not necessary, for, as we shall see by-and-bye, the one in the main includes the other and cannot exist without it. It is quite true that we all either know or have heard among our acquaintances of people who though always complaining yet manage to live to a good old age. Such cases of ailment, however, afford no argument. They are not unusually associated with mental peculiarity; they involve little or no physical suffering; and, further, we must remember that although the age to which such cases attain may be a comparatively advanced one, still in consequence of the artificial life led it is assuredly not so great as under natural conditions it would have been. In connection with such cases it may be mentioned that at the close of the convivial meetings which we doctors now and again indulge in, the toast "Floreat res medica" is always proposed and drunk with proper enthusiasm. This, of course, literally means "may medicine flourish," but by a late physician of Edinburgh it was perhaps as

aptly translated, "long life and ill health." As a fact, however, this is more of a pecuniary than of a scientific interest, and we may rest assured, therefore, that when we seek to obtain for ourselves a long life we are also seeking a healthy one.

In connection, further, with this desire for long life, it may be said also by those of us who are inclined to be critical, that in the present imperfect state of humanity it is doubtful if, on the whole, we are fitted to appreciate and make full use of the benefits of a longer life than that which is now granted to us. This consideration again need not affect us, for we are sure that the means by which we strive to make our lives better, are precisely those which will add to its duration. As is well known disease and crime are in many ways closely related; by striving to avoid the one we render ourselves less liable to the other.

And now how should we act so as best to attain our object?

Knowing that there is no "royal road" to anything worth having, you will not require to be told that there is no such entity as an elixir of life, and that the labours of philosophers and alchemists to discover such, although like all labour, not without value, have been, as far as this object is concerned, futile.

You will be prepared to hear that if our efforts are to be successful they must be based solely on a careful consideration of the many and complex conditions which affect human life, and you will understand that long life is a gift which is given to those only who are prepared honestly and intelligently to work for it. You will not expect that in the short space of time at our disposal to-night very much information can be obtained, but what you may expect, and what I trust I may be able to convey to you, is a general idea of what a long life means, and I must leave to your own energies and intelligence to work for further information and to adapt your lives to the information you obtain.

I propose then to subdivide the subject as follows:—

1. To ascertain what is the natural limit of human life.
2. To ascertain why there should be a limit, and on what this limit seems to depend.

3. To ascertain why the natural limit is so seldom reached.

4. To ascertain how we can best act so as to attain it.

1. *What is the natural limit of human life?*—On this a great deal has been written and said. In the Bible we find, Genesis vi. 3 and 4, “Yet his days shall be an hundred and twenty years;” and again, Psalms xc. 10, “The days of our years are three score and ten, and if by reason of strength they be four score years, yet is their strength labour and sorrow, for it is soon cut off and we fly away.”

Ecclesiasticus xviii. 9, “The number of a man’s days are at most one hundred years.”

Among the many writers on this subject, from Aristotle downwards, we find great difference of opinion, but for the most part they give a duration longer than those we have just mentioned. In recent times the subject has been discussed in this country critically and scientifically, among others by Lankester in his work on “Comparative Longevity” (1870), and by Thoms in his “Longevity of Man” (1873). The latter gives a long list of men and women said to have lived much longer than 100 years. We need not detail these, but the best known among them is Old Parr, who was said to have reached the very patriarchal age of 152 years and some odd months and days. This man, known as the “very old man,” and whose name we have heard associated with certain pills, had his life written by Taylor, the water poet, and in this biography certain rather amusing, but decidedly incredible episodes are mentioned. Of him, and of others who were said to have lived much over the 100 years, Thoms shows very conclusively either that there is no real evidence that they have lived so long, or that all evidence points to the conclusion that their ages have, intentionally or unintentionally, been much overstated; and he points out that we may look upon 100 years, or a little over, as being, in the most favourable circumstances, the limit of human life.

Into the evidence which Thoms brings forward we need not enter. He points out, for example, that such phenomenal ages as 130 or 140 years are stated to have been reached in olden

times and among people in a comparatively low station of life, and that they have not occurred in modern times and among the upper classes. Now, in olden times birth registers were not kept at all, hence a source of error, for we know that since they have been kept—although, as we shall see by-and-bye, human life has been steadily increasing in duration—100 years, or a little over, has been the limit. Again, the absence of such cases among the wealthy or distinguished is conclusive, for, as Plate I. shows, these are as a class longer lived than the poor.

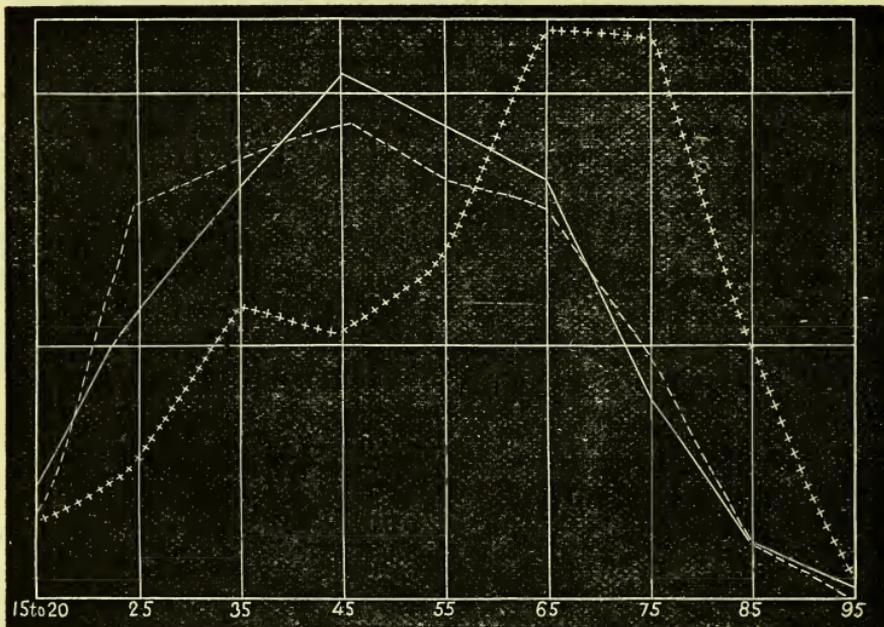


PLATE I.—MORTALITY AT DIFFERENT AGES.

Artisans. - - - - Tradesmen. ——— Gentlemen. + + + +

(After Guy.)

We may therefore conclude that, as stated in Genesis, 100 years is about the natural limit.

2. *Why is there a limit? and why should this limit be, in the most favourable cases, 100 years?*

First, let us see why there must be a limit. This need not take much time. It is simply because living means a using up

of material. You all know that an engine does work as the result of the burning of the coal in the fire-box, and that as long as you provide the coal and keep it burning, work can be done; but you know also that, as the result of working, in time changes take place in the engine itself—axles and bearings get worn down, boiler-plates get thin—in consequence of which it gets useless and has to be taken to bits, and the metal probably melted down again to take part in the formation of a new machine. So with man and animals; every act, every thought, indeed life itself, means a using up of material, the food; and as long as we get food, mental and bodily, work can be done; but as time wears on the man himself wears out—joints become stiff, muscles feeble, bones brittle, heart weak, vessels thin and degenerate—so that he is incapable of sustaining existence, and dies; his body decomposes and is broken down into simple substances, which in time go to form the bodies of new living beings.

This is simple enough; but now let us pass to the second part of our question: Why should the limit be, in the most favourable circumstances, about 100 years? This is a little more complicated; but to come to some understanding on the matter, let us see if we can obtain any information by studying the duration of life in other animals than man.

First. Notice that among animals the higher the position they occupy in the scale, the greater the longevity. This is simply because, as a rule, the higher animals are better looked after as regards food, warmth, &c., than the lower.

Secondly. The size of the animal seems to be important in this respect. Thus, the longest livers are the whale and the elephant, 300 and 150 years respectively. Then, while the ox lives to about 16 (Bacon), the sheep seldom reaches 10, the dog 20, the cat between 6 and 10. Small animals such as mice, and smaller still, insects, live a very short time.

But other circumstances than size affect longevity. Thus the dog lives longer than the sheep or even than the ox, then the lion lives a long time, though not a very big animal (according

to Bacon, because many lions have been found toothless); further, the parrots are very long lived—120 years. Now, neither dog, lion, nor parrot, are as big as the ox. What, then, is the explanation? Here longer life may be supposed to result from these animals living on a more concentrated form of nourishment, animal food or flesh such as the dog or lion eats, or fruits and seeds such as the parrot eats, being bulk for bulk, much more nourishing than the grass, &c., which forms the food of the ox. The result is that the lion, dog, or parrot get the energy they require from the food at a much smaller cost to their digestive organs than the ox, and consequently live longer.

A practical point here is that food which is inappropriate in quality, or which has not been properly cooked, will simply demand a greater amount of work from our digestive organs, and that the same thing will happen if, through hurry, bad teeth, &c., the food is not properly prepared in the mouth before being swallowed. Of course when we are young we do not notice this, we have plenty of energy to come and go upon, but we must remember that by neglect a needless expenditure has been incurred, and what we have been saying will enable us to understand that as we grow old it must make a very important difference in our chances of growing older. A *third* condition affecting longevity then, is the nature of the food: the more easily this can be transformed into our tissues, *i.e.*, the less the energy we require to expend in the process, the greater will be the duration of life. As a deduction from this we are led to a *fourth* element in connection with our subject, and that is the amount of work or expenditure which an animal has to meet. The crocodile, for example, is a very long liver, so also is the tortoise, and, considering its size, the frog. The explanation is that such animals are torpid, and expend very little energy, sleeping a large portion of their time. For somewhat similar reasons the shark and the pike, among fishes, generally are long lived. Although these lead active lives we must remember that they have less expenditure in many ways than animals which live on land. Their bodies are supported by the water and they have no high temperature to keep up.

Hence, then, the less the expenditure in the form of work or heat which an animal has to meet the longer will it live. This statement, however, requires qualification. Although little work may have a good effect, we must remember that if there is too little it may readily lead to disease, and as we shall discover later on, this often occurs. By little work we therefore mean not too little. Here also it is important to observe that although hard physical work tends to shorten life, hard mental work has nothing like the same effect for evil. Indeed the longest lived are those who do a large amount of intellectual work. A further practical point is to be noted in connection with the expenditure to the body in the form of heat. As you have heard at a previous lecture, proper clothing is to be looked upon as an equivalent for food; in the same sense it by diminishing expenditure favours longevity. In connection with the use of the cold bath we shall say a little more about this later on. From such considerations then it would seem that human and animal longevity depends to a large extent on two conditions, which may be termed income and expenditure. When the income is good, *i.e.*, when an animal can readily acquire nourishing food, and when the expenditure in the form of work and heat is not excessive, the duration of life is correspondingly increased.

Now notice that the period in an animal's life when the income is most likely to be best and most ample, and when the expenditure in work and heat is most likely to be least, is when that animal is young or growing, hence in answer to the question why the duration of life should be 100 years in man, and something else in other animals, a law has been enunciated by Buffon, Flourens, and others, that "the duration of life is five times the duration of growth." Thus, in man growth is complete about 20, in the horse at 5, in the ox at 4, in the dog at 2. This gives for the duration of life in man 100 years, in the horse 25, the ox 20, the dog 10.

Of course these numbers only approximate to the reality; there are exceptions, still a law can in this way be deduced.

From this law an important practical conclusion can be drawn.

Seeing that the duration of life seems to depend on the duration of growth, we should be careful not to curtail that period. Now in this age of competition, this is unfortunately often done by giving to boys and girls an amount of work, physical but more especially mental, beyond their years. They may accomplish it, and for a time all may go well. Later on, however, the penalty must be paid.

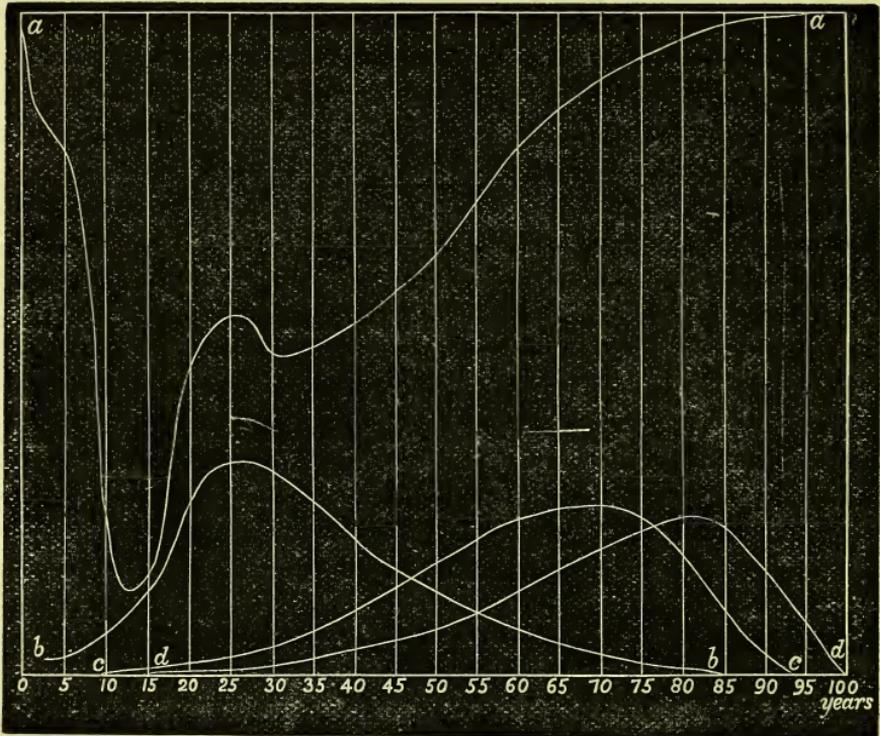


PLATE II.—MORTALITY AT DIFFERENT AGES.

a a From all causes.

b b From Consumption.

c c From Heart Diseases.

d d From Paralysis.

(After Quetelet.)

Let us now pass to the third question—*Why is the natural limit so seldom reached?* Of course it is because the great majority of people born into the world die at earlier ages. To understand this, however, let us in the first place notice at what ages deaths are most likely to occur. This is shown by Plate II. which is taken from Quetelet's book on man, and which

demonstrates first, that the chances of death are at about their maximum immediately after birth. It has been shewn that of all the children born, one-tenth die during the first month of life ; that by the end of the first year only three-fourths are alive, and that in the towns nearly a half of the total number born die before the fifth year. As age advances, however, things get better, and about the eleventh or twelfth year the chances of death are least. After this, however, they increase, and go on increasing rapidly till about the twenty-fifth year, when they are a little less (in man) till the thirtieth or thirty-fifth year, when they gradually increase with age.

But you will ask, is it not hard that such losses should year by year be entailed ? Into the precise meaning of these sacrifices which have been ordained for us we need not attempt to enter ; but let me tell you that even from our own worldly point of view it can be shewn to be for the best, for it is only by such that human progress can be made. As year after year passes by we are rising in the scale of being. Disease, crime, and death are diminishing, and although we know that for these benefits struggles are required and sacrifices are entailed, we know also that it is within our power individually and collectively to make these struggles less severe, and these sacrifices less numerous for ourselves and for those who come after us.

But now you will want to know what causes the increased liability to death or the diminished chances of long life at these ages. Into all these causes it is utterly impossible to enter ; and, further, to a great extent it is unnecessary, inasmuch as all of you from previous lectures have an acquaintance with the various diseases which are apt to supervene as the result of the violation of the laws of health. What I propose to discuss with you is the ages at which disease or death is most apt to occur, what these diseases are, and how best they may be avoided. I propose specially to consider the period of adult life, and since we cannot possibly say something about all the diseases which occur then, I have thought it best to single out three—consumption, heart disease, and paralysis. These are all extremely com-

mon ; they severally occur at distinct epochs in life, and although they are special diseases, we have to remember that what is said of them will apply to many others of the numerous ails to which flesh is heir.

Let us first, however, say a little about the early years of life. As the curve shews, the mortality after birth is very, very great. How is this ? In a general way it is easily explained. Before a child is born, we have to remember, in the first place, it has no expenditure in the way of digesting its food, its nourishment is conveyed directly through its tissues. It has no work to do, its heart is beating, and this means work, but its voluntary muscles are at rest, as also are its breathing muscles. Next of course it is kept warm ; it does not require energy to keep up its own temperature, and in this way also expenditure is diminished. But by its birth all is changed, it has to take, digest, and to prepare for assimilation its own food, and it has to keep up its temperature. It has, therefore, much more work to do, work, too, to which it is quite unaccustomed, and which has been suddenly thrown upon it. The change is not agreeable to it, and there is no doubt that the squalling which ensues, however delightful to the mother's ears, is simply the vocal manifestation of the fact that this alteration in its circumstances is decidedly unpleasant.

Now what are the causes of death in those early years of life. As we should expect, one is an inflammatory affection of the stomach or bowels, the result generally of food, improper as regards quantity or quality, given at a time when the digestive organs are unaccustomed to their work, and consequently weak. You can understand, therefore, the value of the natural milk diet for infants.

Another cause is *bronchitis*. This is due to cold, the evil effects of which you can quite easily understand when you remember that the infant has to maintain its own temperature—a process to which it is not accustomed.

Again, after birth, and for some time, growth is very active, and this means a greater requirement for food and a lessened

power of resisting unfavourable surroundings. So important is this growth, that it is said to be the cause of the fact that the mortality of male children after birth is greater than that of females.

Next, observe that as age advances the mortality gradually diminishes. This is, doubtless, mainly because the child is gradually getting accustomed to its little world. Of course it has its troubles. It has to get its teeth and to accustom itself to digesting solid food, it has to learn to walk, and to run the risk of sundry knocks and exposures. Then it has to run the gauntlet of the various infectious diseases—hooping cough, measles, scarlet fever, &c., the causes of which, and how to avoid them, you all know; and I would impress upon you the special necessity of avoiding any of these in the case of delicate children in the early years of life.

In spite of all this, however, the child's chance of living gets better and better, till about 12 or 13 it is at its best. But now comes a change. The mortality after 13 or thereabouts rises rapidly till about the twenty-fifth year, when there is a slight fall, and then a gradual rise till the end. How is this?

Well, by the twelfth or thirteenth year the boy or girl has become accustomed to be a boy or girl; growth has been comparatively slow for some years, and the amount of mental and bodily work is not excessive. But after 13, growth and development into manhood or womanhood has to occur, and a great increase in the amount of mental or bodily work has to be incurred. This is something new, requiring increased expenditure of force. Hence the mortality rises rapidly to about 25. After this the store of energy with which we have been provided at birth is gradually diminishing, so that the mortality gradually increases to the end.

Now, what are the diseases which are likely to curtail life just before and during the period of manhood or womanhood? They are, certainly, many, but, as I said before, I shall describe only three, remembering that they may be looked upon as types, and that what is said of them applies to other diseases as well.

CONSUMPTION.

Notice that, as the curve shows, it is comparatively infrequent in the early years of life, increases rapidly after the fifteenth year, and is most common about the age of 25 or 30, gradually diminishing as years advance. Consumption is, therefore, a disease which affects man at the most useful period of his life. Consumption is emphatically a sacrifice required for the progress of humanity. As has been said, "The naked savage, whatever ills he may have to bear, rarely finds consumption among them, but with every addition to his clothing and to the comfort of his tree or cave, his proneness to it increases. In this respect in an advanced civilisation the effeminacy or luxury of the rich and the necessities of the poor bring about the same result." How is this? Simply because consumption is apt to come on when men are brought together in one place, when the atmosphere becomes less pure, and when movement is rendered more limited. In these circumstances there is less need to exercise our lungs, less oxygen required, less CO_2 is given off. The lungs, therefore, are less used; and just as in a factory any machinery which is not in daily use is apt to go bad from rust, dust, &c., so with the lungs. Curiously enough, too, that part of the lungs which is least used, the apex, usually goes wrong first. Well, now, since civilisation can only occur when men are brought together in societies, it may be looked upon as being, more or less directly, the cause of consumption. When, as in savage and semi-civilised peoples, men are constantly in the open—moving about, hunting or fishing, and breathing the pure country air—they are secure from consumption; but when, as in towns, men have to spend their days, and perhaps their nights also, in the factory, shop, or office, leading sedentary lives, and breathing along with others a confined air, only the fittest or strongest can escape its ravages. Further, wherever the crowding is greatest and the occupation most sedentary, there consumption is most prevalent. Mechanics, watchmakers, compositors, printers, clerks, are very prone to it, and Dr Guy showed very clearly the influence of physical work

on consumption, for he showed that, in London printing establishments, of compositors and pressmen, the former were more prone to the disease. Both work in the same heated impure atmosphere, but whilst the former had little physical work to do, the latter (pressmen) had every now and then to perform work requiring a good deal of physical exertion. Even this little seems to have rendered them less liable to consumption.

Another interesting point is, that anything like sudden change of temperature is injurious. In the case of the savage or semi-civilised there are, of course, changes in this respect, between day and night, winter and summer, but altogether his surroundings are more equable. In towns, however, it is different; bakers, smiths, firemen, &c., are at one time exposed to high temperatures; in a few minutes afterwards they, in a state of fatigue and profuse perspiration, have to face the cold outside air.

In many occupations, as knife or needle grinders, potters, stone-masons, &c., the air is impregnated with a fine dust. This gets breathed, carried into the lungs, and mechanically irritates them, causing consumption. Such causes are, of course, comparatively non-existent among savage or semi-civilised peoples.

Another important point is, that if the benefits of civilisation are sought to be extended too rapidly, the tendency to consumption is increased. Let me explain this. There is no doubt that the inhabitants of Great Britain are more civilised than the African negro tribes or the Indians of America. There is no doubt also that the average longevity in Britain is greater than among the Africans or Indians, in spite of the fact that consumption kills about one-third of ourselves, and is comparatively unknown (or was) among the others. This is because among the latter other causes of death occur which far more than counterbalance. If a savage gets sick, or gets hurt, or gets too old to be able to look after himself, he is allowed to die; or epidemics break out and carry off whole tribes, or they are killed off by one another or by wild animals. Still, they do not suffer from consumption.

Well, now, say one hundred of them could be brought over to

this country and set to work of the same kind as our own people apply themselves to, what would almost certainly happen would be that although these men were perhaps bigger, and physically more powerful than our own, and had no history of having had relations dying of consumption, they would succumb to that disease in a much greater proportion than our own would do.

This is simply because our own people have passed through the mill, as it were, have gradually got more accustomed to indoor life and occupations, and have already paid for this advantage by the loss of many of their fellows by consumption in former years. They are therefore as regards consumption fitter to survive.

A practical point in connection with this is the possible explanation of what we sometimes see, viz., in a town, a fine, tall, strong man, perhaps from the country, die of consumption, when a shorter, less powerful man, in the same circumstances, will keep healthy. This is simply because the latter is by constitution more fit for a town life than the former.

DISEASE OF THE HEART AND LARGE VESSELS.

This, as the curve shows, is a class of disease which carries off its victims at a later age than consumption. Like consumption it may be ascribed to human progress, but acting in a somewhat different way, for whilst the former may be said to be to a large extent the result of too little physical work, heart disease is too often the result of its excess. Any occupation which necessitates severe and continued physical strain—as in smiths, hammermen, railway workers, &c.—is apt to bring it on. If these men are at the same time working in a close, confined, or heated atmosphere so much the worse, but even in men enjoying an outdoor life it is common as the result of strain—as in shepherds, soldiers, and sailors. In soldiers, the tight-fitting clothes and accoutrements are also blamed as associated with the physical work.

Any sudden strain seems to be specially injurious. For example, a man for eleven months in the year follows a comparatively sedentary occupation in his office or in his shop, doing

very little physical work. He then takes a holiday, and begins it by walking twenty or thirty miles a day on a hilly road or on the hills themselves. His heart, unaccustomed to have a strain anything like this thrown upon it, gives way and he is an invalid for the rest of his days. So much is this the case, that I have heard a late physician to the infirmary, and a well-known authority on heart disease, say that it would be far better for many men when they get a holiday, that they should spend it in their beds.

The third class of affections which tends to shorten life may be exemplified by that disease of the nervous system which is termed *paralysis*. This, as the curve shows, comes on very much later in life, and correspondingly the mortality from it is to be regarded less as the necessary requital for progress and more as the general effect of old age. Indeed its occurrence might almost be looked upon as showing the benefits of civilisation, for it occurs only when civilisation has progressed sufficiently to allow to man a considerable duration of life. Perhaps the best view to take of it is to regard it as the normal mode of death, as the fit termination of life, occurring however, at present, prematurely; and what we may expect to do, is not to eliminate, as we hope to do with consumption, heart diseases, fevers, &c., but to cause its onset to be postponed, say till about the hundredth year.

In this connection, what we have said of paralysis applies probably to another disease—cancer. You have all perhaps heard that cancer is increasing. This has been accounted for in several ways, but possibly one item in the explanation is that many individuals who in previous years would have died about 25 or 30 from consumption, now, owing to better surroundings, get over this danger and die later on of cancer. The increase in this disease may mean an improvement rather than the reverse.

And now we come to the question, how can we best act, so as to prolong life?—how we can best avoid such diseases as consumption and heart affections, and how may we defer the necessary changes which bring on the close of life to the latest possible limit?

But first you may ask, are we making progress in this direction? To give you an idea of what has already been done, let me read you the following:—"At the epoch of the Reformation (1530) the average longevity was 21·21 years, between 1814 and 1833 it was 40·68; as large a number of persons now live to 70 as lived to 40 three hundred years ago."

"In 1693 the British government borrowed money by selling annuities on lives from infancy upwards, on the basis of the average longevity. The contract was profitable. Ninety-seven years later another tontine or scale of annuities on the basis of the same expectation of life as in the previous century was issued. These latter annuitants, however, lived so much longer than their predecessors that it proved to be a very costly loan for the government. It was found that while 10,000 of each sex in the first tontine died under the age of 28; only 5772 males and 6416 females in the second tontine died at the same age 100 years later." This of course is far short of 100 years duration of life, but it shows great progress, and is an earnest of further success.

How then should we act to obtain further improvement?

In the first place, by taking every precaution that our health is kept as perfect as circumstances will permit. We must remember that if we are to be helpful to our neighbours, we must be *able* to be so.

Our sensations usually tell us when our health is good, or the reverse, and in the latter case we should find out the cause and endeavour to avoid it in future.

It has been said, "A man is either a fool or his own doctor at forty." This is very true, but I should be inclined to put the age of such knowledge earlier. Of course we know that, as the saying is, we "must take it out of ourselves" occasionally, but we, in all such circumstances, should carefully consider both sides of the question. Of great consequence is the food, and every doctor knows of cases where something wrong here causes trouble which might easily be remedied, but which is allowed to go on for weeks or months. There is no doubt that in town life, involving little or no exercise, and breathing a close, confined air, the

digestive powers are apt to be sluggish. In such cases food, which might do well enough in the country, is quite out of place; what is required is concentrated, nourishing food, and skill on the part of the cook to make it palatable and digestible, is a simple necessity. Then it should be arranged that meals, at any rate the important one, should be taken without hurry, and an important requisite is regularity.

If, as age advances, mastication cannot be properly performed owing to the teeth being unequal to their duty, the services of the dentist are indispensable. We cannot be sufficiently mindful of the fact, that as age advances every little item tells in the race of life.

As medical men, we soon find out the tremendous effects for evil of alcohol, and I well remember my own surprise, when I first began student work in the medical wards of our infirmary. It seemed to me that almost every patient in the ward had to thank over-indulgence in alcohol for having brought him there. In small quantities, in a dilute form, and as age is advancing, it may do good, but in no other circumstances should it be habitually taken; and the mortality statistics show that by producing exposure, interfering with proper feeding, and generally rendering the system less capable of resisting the effects of injurious surroundings, it leads to consumption, heart disease, &c., in cases where good old age might certainly have been reached had it been avoided.

As regards consumption specially, much can be done in the way of protection, and in individuals liable to it precautions should be taken from early life.

The time when the choice of a life's work has to be made is just the time when there is the greatest risk of consumption supervening, great care should therefore be exercised in choosing. Of course a country or open air is the best, but few can get this. In a town life ventilation should be carefully attended to, and open air exercise systematically taken—walking and climbing,—and for those who are young and strong, cricket, football, and tennis are of the greatest value.

The risk of chills, which in the ordinary routine of life cannot altogether be avoided, may be diminished by the systematic use of the cold bath. Let me explain this.

A chill or a cold results from the abstraction of energy in the form of heat from the body when it is exposed to cold or wet. Now when a thoroughly healthy individual is subjected to this exposure suddenly, what happens is that the small blood-vessels of the skin contract and drive the blood from it to the internal parts, so preventing the great loss of heat which will occur if the skin contains a large quantity of blood. What frequently happens, however, what always happens, if the body is weakly or fatigued, is, that when this exposure occurs these small vessels do not contract rapidly enough, and so much heat is lost. By the morning cold bath we keep these small blood-vessels of the skin in condition, we give them the advantage of systematic exercise, so that if we are exposed any time during the day, they at once act and save loss of heat. Of course, in this also moderation is to be observed. The water need not be absolutely cold all the year round; its temperature should be sufficiently low to cause a glow afterwards.

As to what sort of clothing is best, I need not tell you, as this has been described in previous lectures. It is important to remember, however, specially in connection with consumption, that it should be loose enough to allow free movement of the chest and limbs. In this matter, women of the middle and upper classes are supposed to be the chief delinquents, and, in spite of all that has been written and said, the mischief to a large extent goes on. It is reasonable to suppose, however, that as civilisation progresses this will remedy itself, for everything points to the view that women will in the future have opportunities given them of doing work which they have not at present. Animated by the desire to excel, they will soon learn to discard whatever seems to interfere with their success, so that a style of dress which causes discomfort and impedes freedom of movement will soon be relinquished. My opinion is that the opening up of avocations to women as clerks, in shops, or in the professions, and

the introduction of such recreations as tennis, have done more to improve their dress and carriage in a few years than all the precepts that have ever been enunciated on the subject.

The risk of heart mischief can also be to a large extent avoided. I have already referred to the injurious effect of sudden strains, and we know that the need for continuous physical work is being gradually rendered less by the introduction of machinery. A question here occurs as regards the effects of athletics. There is little doubt that the main danger is from such work being undertaken when the individual is not in "condition," or when he is too old. A game like football should be played regularly, if played at all, and there should be a life calendar of games for the different ages of man, beginning perhaps with football, and running on with cricket and tennis, to bowls, golf, and archery.

I should also mention that for those who have much physical work to do, two articles in common use ought to be very carefully indulged in—tobacco and alcohol, inasmuch as they have a decidedly weakening effect on the heart.

As regards the risk of paralysis, &c., I need say very little. Such an affection is rather the result of a degeneration, and is a disease only when occurring at too early an age; and we may hope, certainly, that if precautions have been taken in early life, its onset will be correspondingly deferred.

As civilisation progresses, the number of deaths from this cause will probably increase. This, however, is not a bad sign; it will show rather that longevity is increasing.

And now this is all we have time to say on the subject of "how to live long." As you will have remarked, I have dealt with general principles, and I leave it to yourselves to work out the practical details. I have done this because I believe it to be for the best. I have only to express the hope that what we have discussed may appear to you to have been of interest and value.

WORK AND REST.

By JOHN SIBBALD, M.D.,
COMMISSIONER IN LUNACY FOR SCOTLAND.

WE all recognise that there are two kinds of work and rest, which may for practical purposes be distinguished from one another as bodily and mental. But when we look at the matter closely we see that the distinction between the two is not rigorously scientific. We generally speak of walking, digging, weaving, and hammering—such work as that of the postman, the gardener, the weaver, and the smith—as bodily work; and we speak of debating, banking, and teaching—such work as that of the lawyer, the banker, and the schoolmaster—as mental work. And it is mainly in this ordinary sense of the words that I propose to deal with them this evening. We need not, however, lose sight of the fact that few, if any, kinds of bodily work are accomplished without some exertion of the mind, and also that few, if any, kinds of mental work are accomplished without some action of the body. For instance, even in walking, when we are scarcely conscious of any mental action, we do not keep in the direction we wish to go, or avoid the obstacles which lie in our way, without some use of our minds; and on the other hand, when we merely think or listen, and are unconscious of any movement of our bodies, the expression of the face changes according to the nature of our thoughts; and these movements, slight though they are, represent a certain amount of bodily action. In most of our actions it is more evident than in these

instances, that both our bodies and our minds are engaged; but though we recognise that this is true, we are still justified in speaking of certain kinds of work as bodily, and of certain other kinds as mental, because the bodily effort in the one case, and the mental effort in the other, so far predominates as to be their distinctive feature.

I cannot hope to deal fully with the subject before us in the course of a single lecture. I propose, therefore, to limit my remarks to a few considerations which bear on the relation of work and rest to the preservation of health and the prevention of disease

WORK OF THE MUSCLES.

The chief agents in bodily work in the restricted sense of the words, as you are already aware, are the muscles,—those fleshy masses which lie beneath the skin, and which by their contractions and relaxations effect the movements of the body. The

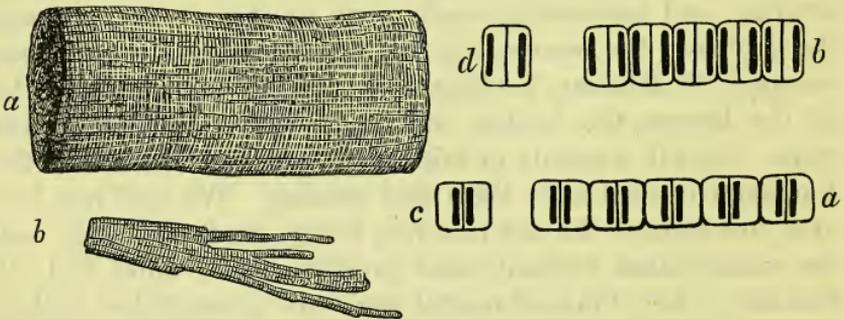


Fig. 1.
a. Muscular fibre.
b. Muscular fibrils.

Fig. 2.
a. Muscular fibril relaxed.
b. Muscular fibril contracted.
c and *d.* Muscular elements.

familiar illustration of the action of a muscle is the raising of the forearm by the contraction of the muscle in the upper arm. Every one can feel this muscle contracting by grasping the upper arm when the movement is made. I need not detain you with a description of the muscular substance. You see it daily in the flesh of animals used for food. It is that fibrous substance which

we call the lean part of the meat. I show you on this drawing (fig. 1) a representation of a portion of one of the fibres of muscle as it appears when greatly magnified by the microscope. Even these fibres, which are very minute themselves, can be split up into more delicate fibrils such as are represented below the fibre. And by using a still higher power of the microscope, it is found that these minutest fibrils are composed of particles, set end to end as is shown in the next drawing (fig. 2). It is by the shortening and broadening of these particles that the contraction of the muscle is effected. The general appearance of muscular fibres under the microscope with their transverse stripes of light and dark is very beautiful; and there is much that is interesting to say about them if my object were to describe their structure fully. I have said sufficient, however, to prepare the way for a few words regarding the work which they perform.

I have to ask your attention to this fact in the first place,—that every time a fibre contracts, that is, whenever muscular or bodily work is done, a change takes place in the chemical constitution of the particles of which the fibre is composed, and a certain portion of material is thrown off. If the contraction is frequent or prolonged, a time comes when so much material has been thrown off that the muscle will no longer contract until such a period has elapsed as will enable it to draw a fresh supply of nutriment from the blood. After even the slightest contraction, however, there is a certain amount of loss which requires to be restored before the muscle returns to its previous condition. These processes of throwing off material and of drawing fresh material from the blood are known as the processes of waste and repair; and it is important to bear in mind that no bodily work can be performed without such waste and repair.

WORK OF THE BRAIN.

I shall be briefer still in my account of the manner in which mental work is performed, that is to say, of the changes which occur in the brain when its energies are called into action. What

it is necessary to understand is that every thought which we think, every desire which we form, and every resolve which we propose to carry into action involves a loss of material in those parts of the brain which are concerned in these mental operations; and the changes consequent on these losses of material in the brain are analogous to what occurs in the muscles when any work has been done by them. But there is this important difference between the changes which take place in the brain and those which take place in the muscles,—the material which is thrown off from the brain is different in composition from that which is thrown off from the muscles. Its chemical constituents are different, and the nutriment which is drawn from the blood by the brain in its process of repair is consequently different from that which is required for the repair of the muscles.

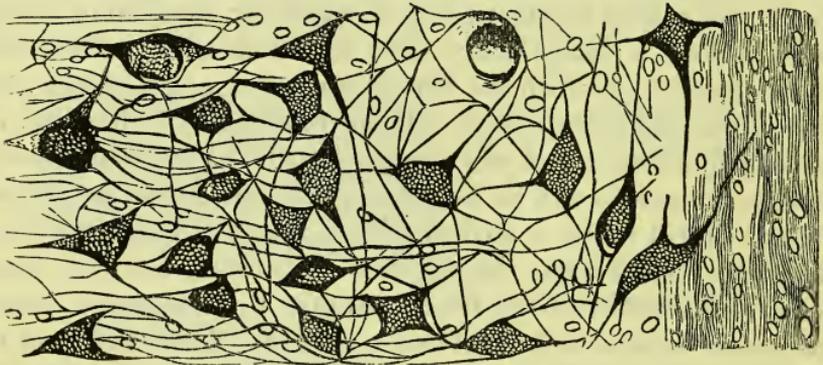


Fig. 3. Brain cells, showing their forms and their network of fibres.

I show you here (fig. 3) a drawing which represents an extremely thin paring or slice of a very minute fragment of one of the parts of the brain which are concerned in mental work. And what I wish you to bear in mind is, that no thought passes through the mind without some of those minute particles, which we call brain cells, undergoing a change and parting with some of their substance.

The two prominent facts, then, which I have endeavoured to bring before you in this short lesson in elementary physiology are, that both bodily work and mental work occasion a waste of material, and that the material which is thrown off by bodily work is different in kind from that which is thrown off by mental work.

RELATION OF WORK DONE BY THE MUSCLES AND THE BRAIN TO THE CONDITION OF THE BLOOD.

Before leaving the physiological aspect of the subject I should like to point out the relation which these facts have to the condition of the blood. The blood is, you must understand, a living fluid; and like everything which has life it is continually undergoing change. It is continually receiving nourishment which it makes part of itself: and it is continually throwing off part of the material which it has elaborated. And it is necessary, if life is to go on healthily, that the nourishment and the waste should go on in due proportion to one another. The process of waste, you must observe, is as essential to the life as the nourishment is. It is so important for our present purpose that you should understand this fully that I shall venture on an illustration.

You all know in a general way what goes on in a gas work. A certain quantity of coal is brought in; and gas is manufactured from it, and sent away in pipes to be used for lighting. But in the process of manufacture there are other substances produced besides gas. My friend Mr Watson informs me that in the Edinburgh Gas Works there is produced from every ton of cannel coal 10,000 cubic feet of gas, which if weighed would be something over 7 cwt. And there is also produced 10 cwt. of coke, and over 2 cwt. of tar and ammoniacal liquor. Now it is necessary for the proper working of the establishment that all those products should be regularly removed,—both the gas, the coke, and the tar and liquor. Let us confine our attention for a moment to the solid and the liquid products, that is, to the coke, and the tar and ammoniacal liquor. For every ton of coal

supplied there must be 10 cwt. of coke, and 2 cwt. of liquid removed; that is to say, five times as much coke as liquid. And whatever quantity of coal may be used, the coke that has to be removed will always be five times the quantity of liquid. If only three times the quantity of coke were removed there would be a quantity of coke left in the works, and this would encumber the processes of manufacture. Let us apply this illustration to the life of the blood. A certain amount of nutriment is supplied to the blood; and, as a result of the processes which go on in the body, certain products are formed and are removed. One organ removes one kind of product, another organ removes another, no two organs removing the same kind. We call these products, as they are formed in the body, waste materials; but they are none the less substances which must be produced if the operations of life are to go on. They are the products of the vital processes, just as gas, coke, and liquid are the products of the operations of a gas work. And from the nutriment that is supplied to the blood these substances will be produced in certain definite proportions, just as gas, coke, and liquid are produced in certain definite proportions. You will understand therefore that the organs by which products are removed from the blood must act in such a way as to remove each product in its proper proportion. If they act so that too much of one kind, or too little of another is removed, the proper balance of the constituents of the blood is disturbed, and the vital processes will be interfered with.

I do not wish you to suppose that by these remarks upon waste I have unfolded the whole secret of the interdependence of all our functions and of all our faculties on each other. But they illustrate that interdependence in a way which is easily understood; and they will serve their present purpose if they show how inevitably a course of conduct which disregards it must result in injury to our health. I should enter on an almost boundless field of exposition if I were to try to explain fully the network of influences which are involved in the interdependence of the various processes of which our life is made up. For not only is the action of one organ influenced by the action, or want

of action, of any of the others, but within the several organs themselves the action of their several parts must be each in due proportion to the rest. This is true of the brain, as well as of the organs concerned in the other processes of life. Our emotions, our imagination, our perceptive, our retentive, and our reasoning faculties must all be exercised in due proportion if our minds are to be kept in their highest state of health and vigour. For the present I must ask you to accept the statement I now make without further explanation. I have dwelt upon the necessity for this harmonious action of all our powers, both mental and bodily, because it is one of the most important principles which we have to guide us in the regulation both of our work and of our rest. Indeed there is no part of our conduct which can be properly excluded from its influence; and if you duly consider it, you will be able to make useful application of it to many details in the regulation of your lives, which we shall not have time to refer to on the present occasion. The broad lesson which we can draw in regard to bodily work and mental work is, that if we regulate them in the way most conducive to health, we must devote a certain portion of our time to the one and a certain portion to the other.

THE NATURE OF SLEEP.

But we cannot go on with work continually. While work of either kind is actively going on, the energies of our system may be said to be fully occupied. Waste is going on, and little opportunity is afforded for the processes of repair. Opportunity must be given for these; and it is provided for us by sleep. Let me ask your attention to a few observations on the nature of sleep before I go on to complete what I have to say about the nature of work.

During the day we work, and our muscles and our brains lose a portion of their substance. During the day we also procure a supply of nourishment for the blood. During the night, when we give ourselves up to sleep, the muscles and the brain are busy

absorbing nutriment from the blood, and replacing the lost material by a fresh supply. In one sense therefore, and that a very important sense, even in sleep we are not at rest. Though it is a period of rest from conscious work—that is, from work which we do while fully aware that we are doing it, and expending our energies upon it—we are engaged during sleep in work which makes a most important demand on our energies. To regard sleep as a state of quiescence is altogether to misunderstand its nature. The force required for building up is not less than that which is required for taking down; and the vital energy which must be expended in the processes of repair is not less than that which has been expended in production of waste.

The important practical result of this consideration is that when the energies of the body are devoted to the processes of repair, they must be relieved as far as possible from other work. If we look at sleep from this point of view, we shall probably feel more forcibly than we have hitherto done the importance of taking certain precautions to secure that it is sound and undisturbed. I shall only mention three of the most important of these. 1. During sleep the organs concerned in the digestion of our food must be relieved from work. To this end no food should be taken within two or three hours of retiring to rest; and the last meal should be moderate in quantity and easy of digestion. 2. The air of the room in which we sleep should be pure in quality and of a comfortable temperature. If the air is impure, or if it is either too hot or too cold, the work of the heart and lungs is interfered with. To secure pure air the room should be scrupulously clean; it should be well ventilated before bedtime; no gas should be burnt in it longer than necessary, and the room should be large enough for the number of people who are to sleep in it. It is a good rule, especially if it is found necessary to put a greater number of persons than is desirable into a bedroom, to leave the window a little open at the top. Miss Florence Nightingale, than whom there is no higher authority, said very truly of the dread which some people have of what they call night air, "What air can we breathe at

night but night air? The choice is between pure night air from without, and foul night air from within. Most people," she adds, "prefer the latter. An unaccountable choice. What will they say if it is proved to be true that fully one-half of all the disease we suffer from is occasioned by people sleeping with their windows shut?" I need not say that in the neighbourhood of leaky soil pipes and imperfect drains pure air is impossible.

3. The last precaution that I shall mention is, that when the mind has been concentrated for a considerable time upon one subject, we should divert the energies for a few minutes into a different channel by engaging in some occupation which involves thoughts of an altogether different character, and which is of a nature to fully absorb the attention. This renders the circulation in the brain more equable, and thus tends to produce that tranquillity of mind which is the best preparation for healthy sleep.

THE TIME REQUIRED FOR SLEEP.

It is often asked how long a time should be occupied by sleep. The answer to this question must be different for different individuals, and it will depend on more than one consideration. One of the chief of these is the different rates at which the brains and muscles of different individuals can gather in a fresh supply of material. No two persons are constituted quite alike. Some have more power in one direction, and some in another direction. Thus, many persons under ordinary conditions require only six hours for the work of repair; but with the majority of people the time required is nearer eight hours. Some persons, it is true, such as Frederick the Great, John Hunter the famous surgeon, and Sir George Elliot the defender of Gibraltar, required only four hours. It is probable that most people could find among their acquaintances persons who require exceptionally short periods of sleep. And such short periods seem to be quite consistent with the preservation of health. Sir John Sinclair mentions the case of a person named James Mackay, of Skerry, who only slept four hours. This man died in Strathnaver at the

age of ninety-one, and he is said to have been a remarkably robust and healthy man. With reference to the time required for sleep, it is well to keep in mind that it will always be influenced by the nature of the work which each individual performs. But perhaps the most important thing for us to know is that where the precautions I have mentioned are duly attended to, the time required is shorter than where they are neglected.

THE SPECIAL IMPORTANCE OF SLEEP FOR CHILDREN.

In connection with the question of how long the period of sleep should be, we should not lose sight of the fact that children and growing persons require more sleep than those who have arrived at adult life. You are now not only aware of this fact, but you know the reason of it. You have ascertained that it is during sleep that the processes of repair are carried on with the greatest vigour. Now, the process of repair is only a modification of the process of growth; and, consequently, the process of growth like that of repair requires the body to be asleep to permit of its being carried on with vigour. It is not surprising, therefore, that during the first year of life when the infant increases to three times its weight at birth, the greater part of its time should be spent in sleep. After the first year the growth goes on less rapidly; but during the whole period of growth the energy that is expended in the increase of material is very great. And when we remember that all this energy is in addition to what is required for the processes of daily repair, we easily perceive the necessity for much longer periods of sleep for the young than for the adult.

We can also perceive how important it is for the young that the precautions I have mentioned as necessary to obtain healthy sleep should be carefully attended to, so that the processes of growth may go on vigorously. Very few people seem to be aware of the importance—I may say the national importance—of giving fresh air to children during sleep. Many of the weak-

nesses of constitution, which result in disease and early death, would be prevented if the processes of growth were not interfered with by children being made to breathe impure air during the period of sleep. And much of the evil effect which life in towns has upon children, decreasing their stature and enfeebling their energies, might be avoided, if the children were supplied with pure air when asleep. Food and clothing and many other things have no doubt great importance in regard to our health. But though everything else may be done in the best possible way, we shall never see a vigorous, good-sized, and capable population growing up around us, if, at the time when growth should be most active, its progress is checked during sleep by embarrassing the breathing and the circulation, and by restricting the supply of one of the most important requirements of the blood.

SPECIAL IMPORTANCE OF SLEEP FOR THE HEALTH OF THE BRAIN.

Before leaving the subject of sleep, I should remind you that though it is required for the due repair of all our organs, it is required in a special manner for the repair of the brain. We can give the muscular system almost complete rest while we remain awake; but it is otherwise with the brain. We can lie down, or sit down, and thus obtain rest for the body; but as we are told was said the other day by Lord Rosebery's little daughter, "we cannot make our minds sit down." So long as we remain awake our brains continue in a state of greater or less activity. Sleep is therefore especially necessary for the repair of the brain. Those little particles in the brain which I have spoken of as brain-cells continue to lose more and more of their substance so long as we keep awake. But there comes a time, if sleep does not intervene, when something more than mere loss occurs. If sleep does not come on, and the process of repair is not allowed to come into play, the brain-cells begin to disintegrate or break up; and when that takes place they not only cease to perform their share in the operations

of the mind, but they lose their capability for repair, and permanent disorder or enfeeblement of the mind is the result. Nothing need be said to impress upon you the importance of avoiding by all the means in our power such a catastrophe as this. But it may be well to warn you of the danger of delay in dealing with sleeplessness. It may be necessary and proper, on special occasions, to curtail the time of sleep; and if this is not persisted in too long, we may make up for deficient repair by subsequent rest and recuperation. Prolonged want of rest leads ultimately, however, to an incapability of falling asleep; and this condition is always one of incalculable peril to our mental health. Sleeplessness may be caused in various ways. Most frequently it is brought on by inattention to our bodily health. Disorders of the digestion frequently produce it; and in such cases if the cause is not quickly removed, the sleeplessness may reach a dangerous degree. One of the most common causes of sleeplessness is dissipation, especially that form of dissipation which is the cause of so many of the evils from which this country suffers—the intemperate use of alcohol; and the sleeplessness produced by alcohol is one of the most difficult to cure. The importance of sleep in relation to our mental condition will perhaps be best realised when I say that a very large proportion of the cases of insanity begin in sleeplessness, and that if sleep which is sound in character and sufficient in amount can in such cases be restored in time, the progress onwards towards insanity will very often be averted.

THE AMOUNT OF WORK MUST VARY FOR DIFFERENT INDIVIDUALS AND DIFFERENT CIRCUMSTANCES.

I must now say a few words about work. Speaking generally, we may say that the portion of our time which is not occupied in sleep is appropriated to three things—(1) the taking of food, (2) work, and (3) recreation. I shall say nothing to-night on the subject of food except where it may require to be alluded to in relation to work. Even as to work, I can only touch briefly on a

few of its aspects. As I have said, we have two kinds of work to consider, mental work and bodily work. But one or two observations may be usefully made which are applicable to both of these. 1. In determining the amount of work that can properly be done, and the way in which it should be varied, no rules can be laid down which would be applicable to every person. Each individual begins life with capabilities which, both in their character and in their degree, are distinctively his own. Some are born with a capacity for developing great physical strength; others are born with a capacity for developing great mental strength. And some will, in regard to both their physical and mental constitution, have special aptitudes in certain directions, while others will have special aptitudes in other directions. It is therefore found that certain kinds of work are easy to some individuals which are difficult to others. It results from this that any rule as to the amount of a certain kind of work which is consistent with health, must be either an over-estimate or an under-estimate for a great many persons. In an ideally perfect system of work, each person would have the amount and the kind of work which he is called on to perform, calculated to suit his individual capacities. 2. Another observation which I may offer, is that the circumstances in which work has to be performed differ in very important respects, and much more work can be performed in some circumstances than can be performed in other circumstances. Differences of climate, differences of food, and differences in the social condition of communities, have important bearings on the amount of work that can be done.

THE MENTAL WORK OF ADULTS.

Of the mental work of adults I shall only say that those who engage in it must bear in mind what has been said about the necessity for a duly proportioned exercise of all our powers, and especially the necessity for alternating mental work with bodily exercise, that is, for keeping the work of the brain and the work of the muscles in due proportion to each other. The clerk or the

professional man must keep his blood pure by taking a sufficient amount of exercise if he is not to fall into weak health, and become the prey of disease. An excellent illustration of the good effects of well regulated mental and physical exercise was afforded by that fine old man and eminent physician, Sir Robert Christison, who was only recently removed from among us. And a living example of what can be done to preserve health while performing a great amount of mental work is to be found in the condition of a man who has reached a ripe old age, and is still the foremost figure among the statesmen of Great Britain. I am told that Mr Gladstone regulates the proportions of his mental and his bodily exercise with the most scrupulous care, and that the felling of the trees at Hawarden is part of a regular system which all must admit has been amply justified by its results.

I may say in regard to overstraining of the mind, that if bodily exercise is not neglected, what is called purely intellectual work seldom produces any untoward result, however great it may be, unless it is accompanied by a strain on the emotional or the moral feelings. Unless there is anxiety, or worry, or some overwhelming emotion accompanying the intellectual labour, the brain seems to be capable of very great exertion without sustaining injury. And when a healthy brain is exhausted by intellectual labour unaccompanied by emotional excitement, sleep will be found to intervene, with a power which it is impossible to resist. It is in its emotional part that the brain is vulnerable. The excitement of ambitious desires, the depression due to disappointment, the fear of impending evil, the raptures, the anxieties, and the desolations which circle round our affections,—it is when our mental processes are engaged in these directions that there is apt to be overstrain, and that there is danger of irremediable exhaustion to the functions of the brain.

SCHOOL WORK.

The only other kinds of work about which I wish still to speak are the work of the young during the educational period, and the work of the artizan or labourer. I should have liked to add a

few words about the work of women, but I find our time will not permit.

No part of the work of our lives is more important than that which is spent at school. Upon the way in which our several faculties are exercised during the process of growth depends the tracing of those lines on which our future career is to be formed. In regulating the work to be done at that time, the object of education should be kept carefully in view. All true education is directed to making the child grow into a happy, a good, and a useful member of the community. For this purpose it is not necessary merely that he have so much information put into his head. He should be trained to *desire* to be useful, and he should learn *how* to be useful ; but neither of these will be of much avail if he is not made strong in mind and body so as to be *able* to be useful. I need not say that if we are to produce a strong and capable man, attention to the health of the growing child is indispensable. An unhealthy and ill-developed population cannot do much good, however much knowledge it may have. It is therefore the interest not only of each individual member but also of the community as a whole, that everything should be done that can promote the health of children at school. One of the cardinal principles of school work is therefore that it should be not hurtful, but if possible beneficial to health. In school work, where the occupation is not, as the occupations of adult life often are, associated necessarily with danger to health, we should expect an approach to an ideally perfect regulation of work. All the faculties of the mind should be exercised in their due proportions, and the respective amounts of bodily and mental effort should be carefully adjusted. There, also, we should find the conditions under which the work is to be done, of the most favourable character. We should have pure air, suitable temperature, and abundant light. But we must admit that such perfection has not been generally attained,—that we have indeed much to do before we get near it. An enormous advance, it is true, has been made from the position we were in before the passing of the Education Act of 1872. We have in our Board Schools (and I

propose to speak only of them) a system of teaching in which the arrangement of the time devoted to different kinds of work is a great improvement on what existed previously; and the schools in which the work is done are greatly superior to their predecessors. But many improvements have yet to be made. Many things, such as increased playground for our urban schools, are sadly wanted. I cannot now dwell upon the details; but I hope I have said enough to show the importance of encouraging every effort that is made to render school work more healthy. By such means we not only develop a more vigorous population, but we enable the children to perform the work of acquiring knowledge in a less laborious and more efficient manner. Such money as is really required to make education beneficial to health ought to be freely granted. At least, let not those who would grudge it, talk as if they had a tender regard for the future greatness of their native land.

As a matter of course, care should be taken not to attempt too much work at school. And this leads us at once to ask whether the statements about children suffering from over-pressure are true. In answer to this it may be said that if children are made to perform, after school time, tasks which occupy the greater part of their afternoon and evening, there can be no doubt that their health will be injured by the mere want of physical exercise and open air. And if to this is added the anxieties connected with the competition for marks of distinction which young people of eager nature subject themselves to, actual injury to the health, both mental and bodily, may, and does sometimes result. If, however, it is asserted that the present School Board system leads in some special way to evils of a kind which have been avoided in other systems, I know of no evidence which will support such an allegation; and I know of much which inclines me to the belief that the allegation is baseless. Of course when a whole army has to move forward by successive stages, the tendency will be for the weaker and less energetic to be pressed on, and for the stronger and more eager to be kept back. But for children who come to school well developed and healthy, who are well fed

and well clothed, and who have opportunities of invigorating out-door play, there is no doubt that they will get nothing like over work at the board schools; and for those who are stunted, ill-fed, and ill-clothed, and who are cooped up in overcrowded, ill-ventilated, and wretched homes, I believe that the pressure to which they are subjected is seldom, if ever, carried to a hurtful degree in the apportionment of their work. We cannot hope to cure the effects of semi-starvation, by keeping a child from school, and leaving him at home amid dirt, squalor, and foul air. I am not prepared to say how far it is the duty of the State to deal with the evils of under feeding and under clothing. But while such questions are being discussed, there is cause for thankfulness that agencies for providing food and clothing, such as Miss Flora Stevenson's in Edinburgh, are in operation; and I would commend the work of Miss Stevenson's committee as worthy of your cordial support, and as of far greater importance than many agencies for which much larger sums of money are subscribed.

THE WORKING-MAN—HIS WORK.

The last subject to which I have to direct your attention refers to the work done by what it is usual to call the working-man. There are certain aspects of this subject which come up for discussion from the politico-economical point of view, and it is no doubt of great importance that sound views should prevail in regard to these aspects of the subject. We have not, however, to deal with them to-night; but I believe I would have the support of all great political economists when I say that whatever is favourable to the health of the community, in its best and broadest sense, is also favourable to its industrial prosperity.

Looking at work, then, in relation to health, it is clearly desirable that a man should not work too much. But as I have already said, no definite rule can be laid down in regard to this which would be applicable to every individual, and to every kind of occupation. It is necessary, however, in the practical working of civilised communities that great industrial organisations should

conform to certain rules so as to keep the social machine in orderly movement; and these rules must be adapted as far as possible to the capacities of an average man. The more successfully this adaptation is accomplished, the greater will be the advantage both to employers and employed. A greater amount of useful work will be done by a man in the course of a year if his daily time of work is duly proportioned to his strength, than if he were called upon to overtask that strength. And the man who, without overtaxing his energies, gives his working power full play, is happier as well as more useful than if he were less active.

There is a charming symmetry and completeness about the scheme which is expressed in the lines—

Eight hours to work,
Eight hours to play,
Eight hours to sleep,
And eight shillings a day.

But I do not think that we can consider it as fixing either the times or the wages. Nor can I venture to name the precise times that may be best for any class of workmen. I feel safe, however, in saying that there are many trades in which the hours are too long, and I know of none where the hours are too short except when the trade itself is in a state which neither masters nor men consider satisfactory. Striking examples of occupations in which the hours are too long are certain classes of railway servants, tramway servants, and perhaps most of all, in some districts, the bakers. I believe that it would be ultimately as much for the interests of the employers as of the employed that hours should be shortened where they are excessive, and I am glad to know that some improvement has been taking place in the case of the railway servants. I see also that the time of tramway servants has been reduced in Birmingham to twelve hours. It is right to add that in regard to a great many trades, it seems to me the arrangement of hours at present existing cannot be regarded as an unreasonable one. One of the most

instructive facts bearing on the questions that arise with regard to the hours of labour, is one that is mentioned by Sir Thomas Brassey. "On the Great Northern Railway," he tells us, "there was a celebrated gang of navvies, who did more work in a day than any other gang on the line, and always left off work an hour and a half earlier than any other men. Every navvy in this powerful gang was a teetotaller." *

To my mind, the interests of those working men who work indoors, as well as the interests of most other persons engaged in indoor occupations, are more affected by the conditions under which work is done than by the time it occupies. In some occupations an attempt is made to work for ten hours a day, or even longer, under conditions which are inconsistent with five hours of proper work. Attempts, sometimes successful, have, it is true, been made to remedy these evils; but in many cases work is still done in circumstances in which the health of the workmen suffers extremely from working in unhealthy conditions which are in no way necessarily connected with the work that is done. I need only refer to such instances as the worst class of tailors' workshops, the so-called "pit shops" in the basement floors of buildings, where the men are crowded in rooms where the atmosphere is foul and hot with gas, and from which they emerge after labour, jaded with work, poisoned with impure air, and only too often tempted to relieve the consequent nervous exhaustion by the treacherous help of strong drink. I believe, indeed, that far more injury is done to the health of the working population by the bad conditions in which they often work, than by the work they do being above their strength; and in many cases the conditions are bad chiefly because the evil that they do is not sufficiently perceived. The important fact from the hardest business point of view for the employer to consider, is that better work and more of it is got in healthy than in unhealthy conditions; and the important fact from the workman's point of

* "On Work and Wages," by Sir Thomas Brassey, M.P., p. 17. George Bell & Sons, 1874.

view is that it would be better to earn lower wages than to bring upon himself that most costly of all burdens,—disease and inability to work.

THE WORKING-MAN—HIS RECREATION.

The effect upon the workman of the way in which he spends his time after the day's work is done has also a very important bearing on his health. The portion of the day when work is over should, in some measure, be a time for rest. But when the workman has not been exhausted by overwork, it should also be a time for change of occupation—for the healthy exercise of those powers and faculties which have not been exercised during the hours of work. It is therefore of importance to health that the time of leisure should be regulated for each individual, according to the nature of the work in which he has been engaged. I need not say anything of the bad effect of dissipation of any kind. That is admitted, even by those who most obstinately continue to indulge in it. Neither is it necessary to point out to you that for those who have been breathing impure air during work-time, one of the most necessary things is to breathe pure air when work is over. I wish, however, to ask your attention to what I think is not so generally recognised as it ought to be, that is, the need that the working-man has of some recreation which will give healthy exercise to his mind. I do not fail to remember that many persons who belong to what is called the working-class do work which gives abundant exercise to their minds. The work of an engine-driver, for example, though it may not require a man to be learned, is in many respects mental work of a high character. And many other occupations of the working-class involve a considerable amount of mental exercise. But for the average working-man, it is the bodily energies that are chiefly exercised by his avocation; and, as I have tried to explain, this makes it necessary that his recreation should provide in some way for the exercise of his mental faculties. The best form of mental recreation is that which is furnished by the higher

class of literature, and by the social intercourse of a cultured household; and I am glad to know that among working-men there are many who avail themselves of the benefits which are to be obtained from good reading, and whose households are examples of culture in its truest and best sense. I hope also that such instances will become more numerous as the effect of recent educational reforms tells more and more on the condition of the people. I believe, indeed, that one of the greatest benefits which may be expected to result from the spread of education among the working population will be the capabilities which the working-man will possess for obtaining and enjoying mental recreation. At present, however, the great majority of the working class in cities have not the opportunity, and perhaps the great majority will never have the opportunity, of taking mental recreation in this, its best form; and it is therefore to be desired that there were some means of supplying it in some other way that would be good, though not the most perfect way. To be recreation, mental exercise must be exercise that will be enjoyed, and I wish I could put at once before you some practical plan by which a pleasant hour of mental exercise could be given to the working man every evening. If I could do so he would not only spend a happier evening, but his work next day would be better done, and done with more cheerful spirit. The mental exercise that I have in view is not severe intellectual study, though in cases like that of Elihu Burritt,* this has been found the most suitable, nor do I wish that he should, night after night, attend courses of lectures such as the Health Lectures, though they may be of use on an occasion. I should like to be able to suggest something which would be a

* The following account of the way in which this distinguished man apportioned his time during his apprenticeship is taken from George Combe's Educational Works, collated and edited by Mr Jolly (Macmillan, 1879). "Elihu Burritt, a blacksmith in New England, learned Latin, Greek, French, Spanish, German, Italian, Celtic, and Hebrew during his apprenticeship. He kept a journal of the application of his time, and he proceeds in this order of study on four successive days:—Hebrew, Celtic, forging; Hebrew, Celtic, forging; Hebrew, Celtic, French, stars, forging; Hebrew, Celtic, French, stars, forging."

recreation and not a task, but a recreation altogether healthy. I am the less regretful, however, that I have no such ready made plan, because I believe that no plan will be permanently beneficial which does not originate with working-men themselves. I should therefore be satisfied to-night if I could convince working-men that such a thing is desirable. This is the first requirement in the circumstances. There is apathy among working-men themselves in regard to the question. They still require to realise that there is need for such a thing. But when that has been accomplished, I have little fear that a satisfactory way of providing it will be discovered. To some extent the working-men's clubs have made provision of the kind that I desiderate; and perhaps the full solution of the question may be found in an improvement and development of them. A useful suggestion was made a few years since that the Public Libraries Act should be brought into operation in Edinburgh, and I was disappointed to see how inadequately the suggestion was supported by working-men. I hope that as the influence of the Education Act penetrates deeper into the body of public opinion, the need for such things will be more widely felt, and that we may see before long not only a Central Library in each of our large towns, but also branch libraries in the several quarters of large towns as well as in neighbouring districts. It may be that the end which is desired in regard to mental recreation may be attained through institutions developed in connection with such branch libraries.

SICK-ROOM FOOD AND COOKERY.

By TEACHERS FROM THE EDINBURGH SCHOOL OF COOKERY AND DOMESTIC ECONOMY, Superintended by The Honorary Secretary of the School.

OF late years increased attention has been paid to food for the sick, and doctors give much more minute directions about diet than they used to do. A large class of diseases directly affect the digestive organs; many diseases are now treated by diet alone; and in all forms of disease which cause general debility, the stomach is necessarily involved. You will, therefore, easily see how important a matter it is to understand how to prepare and to administer food for the sick. We begin by impressing this upon you, because, in the course of this evening's lecture, we have nothing new or striking to bring before you, but chiefly to draw your attention to a series of details by which this may best be achieved.

Miss Florence Nightingale, to whom we owe so much for improvements in sick nursing, tells us that "There are four causes, any one of which will cause a patient slowly to starve to death from want of nutrition:—

1. Defect in cooking.
2. Defect in choice of diet.
3. Defect in choice of hours for taking diet.
4. Defect of appetite in patient.

The remedy for the first is to cook better; for the second, to choose other articles of diet; for the third, to watch for the hours when the patient is in want of food; for the fourth, to show him what he likes, and sometimes unexpectedly.*

* "Notes on Nursing for the Labouring Classes," by Florence Nightingale, price 6d.

The chief aim of sick-room cookery is to give the largest amount of nourishment with the least trouble to the patient's digestion. As a general rule, the special foods for severe sickness, especially fevers, are liquid or semi-liquid foods, as these have been proved to be the easiest of digestion, and the most readily absorbed into the system. Beef-tea, milk, and eggs are the great stand-by of doctors.

BEEF-TEAS.

Quickly made Beef-tea.—To 1 lb. of freshly cut lean beef allow 1 pint of water. Cut the meat with a sharp knife into small pieces, put it with the water, and a good pinch of salt, into a pan, and bring very slowly to almost, but not quite, the boiling point, bruising and stirring it with a fork all the while. Then draw it to the side of the fire, and allow it to simmer very gently for about five minutes, stirring the whole time. Pour it off and remove any spots of fat from it, by passing small pieces of clean kitchen paper along the top. It is now ready for use. If not all wanted at once, the beef-tea should be allowed to cool; it should be kept covered in a clean basin, and warmed as required.

Ordinary Beef-tea.—Allow the same proportions as above. Cut the meat into small pieces, put them into an ordinary jelly-can with the water and a good pinch of salt, cover tightly with a well-greased piece of kitchen paper, and let it stand for about ten minutes. Then put the jelly-can into a pan of cold water, the water coming two-thirds up; cover the pan and let the water boil slowly for about two hours—longer if a larger quantity of beef-tea is needed. Pour off the beef-tea, and remove any spots of fat as in quickly made beef-tea. The paper cover is greased to prevent the steam of the boiling water getting through the moistened paper. To prevent the beef-tea from boiling, it is a good plan to raise the jelly-can a little, say on a little iron or wooden rest, to allow the water to be under it. Instead of the jelly-can, a special beef-tea jar may be used, with tightly fitting lid.

Raw Beef-tea.—Proportions, 2 oz. lean beef to 1 gill of water.

Remove all skin and fat, cut the meat into small pieces, put it

into a basin or jug, pour the cold water over it, and let it stand for half an hour; then strain off the liquid and serve. Raw beef-tea should be freshly made each time it is wanted, as it soon becomes putrid.

Beef-tea is very easily digested, is stimulating, and has a specially restorative power; it is also sometimes acceptable to a patient when the more nourishing milk and eggs are refused,—but, taken alone, beef-tea is quite insufficient to keep up strength for any length of time. To make a more nourishing food, you may add a little gruel to beef-tea, but they must be cooked separately, because gruel must be well boiled, and beef-tea must on no account be allowed to boil; if it does, its qualities are changed, and its value greatly lessened. *Boiled* beef-tea is *spoiled* beef-tea. If permitted by the doctor, you may vary the taste of beef-tea by using half beef and half mutton; by adding a little sprig of several herbs, such as thyme, marjoram, mint, and sage; celery seed is also a pleasant flavouring, so to some tastes is an onion, which, for an invalid, should be soaked in boiling water for ten minutes before adding. All these flavourings should be removed before serving the beef-tea. As the patient progresses, a little well-boiled rice may be added, or the mealy part of a potato, —or you may turn the beef-tea into a pudding thus:—

Beef-tea Pudding.—Required 1 gill of beef-tea, 2 table spoonfuls of bread crumbs, 1 egg, about $\frac{1}{2}$ oz. of butter. Soak the bread crumbs in the beef-tea for about ten minutes, beat them well with a fork, add the egg, previously well beaten. Grease a small basin with the butter, pour in the mixture, cover with buttered paper, put the basin into a pan of boiling water, the water coming half way up the basin, and steam thus for twenty minutes.

Another strengthening way of serving beef-tea is in a

Savoury Custard.—Required 2 yolks of eggs, 1 white of egg, 1 gill of beef-tea, a piece of butter or fresh dripping the size of a thimble, a small pinch of salt. Whisk the two yolks and the white of egg well together in a basin, stir in the cold beef-tea and salt. Grease slightly a cup or small jelly-can, put the mixture in,

cover with a slightly greased paper. Place this in a pan of boiling water, the water coming half way up the cup. Steam thus for about twenty minutes, taking care not to shake the jar, which would curdle the egg. The water must boil slowly, to prevent the custard from becoming honey-combed.

Instead of steaming beef-tea pudding and savoury custard, they may be baked in a slow oven for about fifteen minutes.

EGGS.

To those in health it is chiefly a matter of taste whether an egg should be hard or soft boiled, but to the weak stomach of the invalid it may be a very serious matter if an egg is taken in a hard indigestible state. The white of egg resembles the liquid part of meat, and like it its qualities are both changed and injured by boiling. Every cook has her own views as to the cooking of an egg; for an invalid we recommend that an egg should be cooked but not boiled.

Directions.—Put the egg into a small pan, with enough of cold water to cover it. Bring this slowly to boiling point; when reached, at once lift out the egg, which is then ready.

Note.—A newly laid egg may be allowed to remain (according to size) from half to a whole minute longer in the water.

Raw eggs are more digestible than cooked eggs; and the yolk and white used separately are rather more digestible than when taken together.

An egg may be added to tea, coffee, cocoa, or milk thus:—Break the egg into a teacup, beat with a fork till well mixed, pour in the hot liquid gradually, stirring all the time.

Egg Drink.—Required 1 yolk of a fresh egg, 1 teaspoonful of sugar, 2 tablespoonfuls of warm or cold milk, and about half a pint of soda or potash water.

Break the egg, separate the yolk from the white; work the yolk and sugar together with a wooden spoon for a few minutes, when they will form a creamy mixture; add the milk, stir till smooth, pour into a tumbler, and fill it with the soda water.

If the doctor has found it necessary to give stimulants, the

quantity ordered may be used instead of the milk in this recipe, but you should on no account give stimulants unless they are specially ordered. They give no strength, and although of use under certain circumstances understood by doctors, they may produce very serious and sometimes fatal results if given ignorantly.

MILK.

Of all foods milk is that most used and of most value in illness. It is the one natural food which contains all that is necessary to support life, and though wanting in the solidity required by a healthy stomach, it is in many cases amply sufficient for a sick person. Some sick persons cannot digest milk in its natural state. It is then usual to add a little lime, potash, or soda water. We spoke to you last winter of the need of attention to thorough cleanliness of the dairy, of the milk-cart, and of the basins and jugs milk is kept in. This, while important for preserving health, is still more essential in sickness, when the patient is doubly susceptible to every evil influence.

When a slightly more solid food is wanted, thick milk is a useful preparation, and is made by mixing a little flour with cold milk, slowly heating and thoroughly boiling it. A still more digestible preparation is the following:—

Thick Milk.—Tie some flour tightly in a cloth, as if it were a pudding; put it into boiling water and boil for about four hours, when it will be quite hard. Scrape the flour as it is wanted, mix the proportion of half a pint of milk slowly and smoothly with two teaspoonfuls of flour and half a teaspoonful of sugar. Place in a pan, and stir over the fire till it boils; let it boil for three minutes.

Arrowroot is of comparatively little value as a nourishing food, except for the milk that is mixed with it; but it is soothing, and therefore useful in some illnesses.

Arrowroot.—Required half a teaspoonful of arrowroot, half a pint of cold water, 1 teaspoonful of sugar.

Add the cold water very slowly to the arrowroot, stirring all the time to make it smooth. Put this and the sugar into a pan,

stir till it boils and thickens, then boil for two minutes. Serve hot. Milk may be used instead of water.

Tapioca, corn flour, and sago contain little nourishment in comparison to flour, semolina, barley, and rice, which rank much higher. Any of these may be cooked with milk, with or without the addition of an egg, but you must take great care that they are slowly and thoroughly cooked, for if any of these starchy foods are insufficiently cooked, they may cause much irritation and suffering to a patient of feeble digestion.

Milk and Suet.—Required half an oz. of suet and 1 pint of milk.

Chop the suet finely, tie it loosely in a piece of muslin, place in the cold milk, bring slowly to boiling point, and simmer gently for about fifteen minutes. Then strain and serve tepid or warm, taking not more than a gill at a time.

DRINKS.

Gruel.—Required 1 good handful of oatmeal, 2 breakfast cupsful of cold water, a teaspoonful of sugar. Put the oatmeal into a basin, pour over it the cold water, let it stand for about half an hour. Pour off the water into a pan, pressing the oatmeal with a spoon, so as to leave it as dry as possible. Put the pan on the fire, stir till it boils, then let it simmer for ten minutes, taking care not to let it burn. Add the sugar and serve hot. A small piece of fresh butter may be stirred in before serving, in addition to the sugar. If preferred, milk may be used instead of water; also half a teaspoonful of salt may be used instead of sugar. Medium oatmeal is better for gruel than either coarse or fine.

Barley Water.—Required 1 tablespoonful of pearl barley, 3 pints of cold water, 2 lumps of loaf sugar. Put the barley into a pan with 1 pint of the water, bring to boiling point, boil for ten minutes and pour away the water. Put the remaining 2 pints into the pan with the softened barley, bring to boiling point, and boil slowly for about two hours; add the sugar, strain, and serve cold. If allowed, a few drops of lemon juice are a pleasant addition, or a thinly cut piece of lemon rind boiled with the barley, or the juice of an orange, or a few tamarinds.

Rice Water.—Required a tablespoonful of whole rice, 2 pints of cold water ; wash the rice by pouring cold water on it, and straining it off, until the last water poured off is clear. Put the rice into a pan with the 2 pints of cold water ; bring to boiling point, boil (covered) for half an hour, strain, and serve cold. If permitted by the doctor, a teaspoonful of sugar may be added, and an inch of cinnamon stick cooked with it, and removed before serving, to give flavour.

Lemonade.—Required 1 lemon, half a pint of boiling water, 2 teaspoonfuls of sugar.

Roll the lemon to soften it ; pare the rind very thin ; cut the lemon in two, squeeze the juice into a jug, keeping back the pips as they are bitter. Add the lemon rind and the boiling water ; cover the jug, let it stand till cold, strain. Add half a glass of this to a tumbler of water or of potash water.

Apple Water.—Required 3 apples, 2 teaspoonfuls of sugar, 1 pint of boiling water.

Wipe the apples with a damp cloth, neither pare nor core them ; cut them in slices and put them into a jug with the sugar. Pour the boiling water over them, cover the jug, and let it stand till cold. Strain off the liquid. The addition of a piece of lemon rind to the apples is an improvement.

Linseed Tea.—Required 1 teaspoonful of whole linseed, 1 quart of water, rind of half a lemon.

Boil these together slowly for one hour, strain and sweeten with honey. Serve either warm or cold.

We have shown you most of the dishes used during severe illness. As the patient regains health, whiting or haddock, boiled or steamed, generally comes first on the list of foods allowed, then a grilled chop, boiled tripe, mutton, boiled or roasted, and so on, taking especial care to avoid new bread, currants, pastry, and all other indigestible preparations. It is sometimes difficult to get a fire and a cook for a good grilled chop ; an excellent substitute is—

A Steamed Chop.—Have a pan half full of boiling water ; on it,

instead of a lid, place a well greased plate, trim the chop neatly, removing all fat, place it on the heated plate, and cover this with a basin or saucepan lid. Let the chop cook thus for about 10 minutes ; then lift the cover and turn the chop, and allow the other side of the chop to cook thus for ten minutes ; it is then ready. A very thick chop takes a little longer. This is a digestible and easily cooked substitute for grilled chop. Fish may be cooked in the same way.

Tripe is an easily digested and nutritious dish, that is, if it is carefully cleaned and well cooked, and it has the additional recommendation of being very cheap, and so within the reach of all.

Tripe.—To 1 lb. of tripe allow 1 tablespoonful of flour, half a pint of milk, a pinch of salt and one of pepper.

Lay the tripe to soak all night in cold water ; next day wash it in warm water with a piece of soda in it the size of a pea, but do not let it soak in this, as the soda will harden the tripe. Place the tripe in plenty of cold water, bring to boiling point ; if the water has not a pleasant smell, pour it away, and place the tripe again in cold water, bring again to boiling point : repeat this until the tripe and water are quite sweet. Then simmer gently for five or six hours, till the tripe is thoroughly tender. Break the flour with the milk, add pepper and salt, and half a pint of the liquor the tripe has been boiled in, bring to boiling point, and boil for five minutes.

The liquor tripe is boiled in is nutritious, and may be used instead of water for some of the cheap soups ; or it may be used instead of water for gruel.

If the patient is well enough to have onions, to the above proportions three onions should be skinned, scalded, and added one hour before the tripe is ready, chop them and add to the sauce.

Baked Tripe.—To $\frac{1}{2}$ lb. of boiled tripe allow 4 slices of thin bread soaked in some of the liquor in which the tripe was boiled, one egg, a small piece of butter or dripping, 1 gill of the liquor.

Grease a pie-dish, lay in it one slice of the bread, then some of

the tripe cut in small pieces, another slice of bread, and the remainder of the tripe; cover entirely with the two last slices of bread. Beat the egg well with seasoning of pepper and salt, and the gill of liquor pour over the bread. Break the rest of the dripping or clarified fat into small pieces, place them on the top, and bake for fifteen minutes.

Tea is of value in the sick-room, if properly prepared and if not used after six o'clock in the evening. It is peculiarly refreshing after a restless night.

A Cup of Tea.—Half fill the teapot with thoroughly boiling water, let it stand two minutes to heat the teapot, pour it away. Put in immediately a teaspoonful of tea, add about half a pint of freshly boiled water, let it stand in a warm place for five minutes, pour off. Do not let it stand on the hob, as tea stewed or boiled is most hurtful.

We have hitherto spoken of the preparation of food for the sick; a few general rules, in conclusion, as to the preparing and giving of food will not be out of place, and to help you to remember these, we shall give them thus—

1. Do not, if possible, cook the food within sight of the patient.
2. Serve the food punctually at the hour expected; not more than is likely to be eaten should be offered at one time, and all uneaten food should at once be removed.
3. If the patient is ill enough for the doctor to prescribe the kind and quantity of food, you cannot too rigidly adhere to his directions. An experienced nurse has told us of cases where death was caused by the friends of patients giving them forbidden foods.
4. Give the nourishment ordered at regular intervals, and in cases of extreme weakness be sure you understand, from the doctor, whether unbroken sleep or food is of the greater importance. In some cases sleep is all important; in others, the apparent sleep is from weakness, and life may be saved by rousing the patient to receive the prescribed food.
5. Be careful that every article used in cooking and serving is perfectly clean. This affects the appetite at all times, but most

especially in sickness, when patients are easily affected by appearance.

6, and lastly. You must consider no points too trivial to merit strict attention ; in preparing and serving food for the sick, as in other parts of sick nursing, it is a test of excellence to attend carefully to the smallest details. By so doing you become invaluable helps in the great struggle with disease and suffering.

C. E. G. W.

(Most of the preceding recipes are taken from the School Cookery Book, Macmillan & Co., price 1s.)

ANNUAL MEETING.

THE Annual Meeting of the Society was held in the Free Assembly Hall, on the evening of Saturday, 13th February 1886. On the motion of Dr Byrom Bramwell, Councillor Cox was called to the chair. Apologies were intimated by the Chairman from Sir Alexander Christison, Dr William Smith, Mrs Fraser, Mrs Trayner, and Miss Guthrie Wright. Rev. Alexander Webster wrote: "Owing to another engagement, I very much regret that I cannot be present at the annual business meeting of the Health Society, in which I feel greatly interested, knowing from frequent intercourse with the working-classes that the Society's lectures are highly prized by them, and have been the means of diffusing much useful knowledge. I join with all other friends in wishing continued and increasing usefulness to a society so Christian in its spirit and aims." Mr Walter A. Smith submitted the Annual Report, from which he read a few extracts.

The CHAIRMAN said:—Ladies and Gentlemen,—The Report which has been read at once justifies our existence and encourages us to further efforts. The chief use of the Edinburgh Health Society and its fellow societies here and in other parts of the country, is to stir up the people to the importance of the objects that they seek to attain. Ignorance and apathy have much to answer for, and to-day we suffer from many evils born of these parents. Public opinion is now all-powerful, and the aim of this Society is, by means of lectures, publications, and representations to the authorities, to mould and guide public opinion into the channels from which national health and happiness flow. (Applause.) At the end of the fifth year of its labours the Health Society is fairly entitled to its country's gratitude, in-

asmuch as it can show a clear record of good and useful work. But sparingly blessed with money, nevertheless by the energy of the officials, and the disinterested kindness of the medical profession, it has been the means of imparting much solid information to many people. Since 1880 no less than 526,000 copies of individual penny lectures have been sold,—their circulation extending far beyond this city and country, and reaching even to the Colonies. (Applause). During the past session there has been a great increase of public interest in the lectures delivered. Ten hundred and three new members have joined, and the cash balance is on the right side. This is good so far, but it is not enough, and I trust that every member will leave this hall to-night with a revived sense of the sacredness of the work which the Society is doing, and will strive without ceasing to induce his friends to join it. Compulsion to this end would indeed be “blessed.” Although much may be done, and is done, by interesting people in their own health and in the laws that govern it, we shall never attain to universal knowledge and to widespread practice of these all important laws, till the happy day comes when they shall be made a part of the national education code, when the child shall eat of the tree of the knowledge of his body, when he shall know good from evil, and well qualified teachers shall lay open to his receptive mind the mysteries of his being. George Combe, that robust thinker and far-seeing man, was of opinion that physiology was the gate to all knowledge. Through it he read nature, and he greatly desired that it should be taught in schools. He held that youth should be instructed in all the laws of God that govern his physical condition, and that “Government has a right to insist that its subjects should be instructed in every species of knowledge, and trained to every mode of action which directly affects the welfare of society, and which is prescribed as a duty equally by Scripture and the natural laws of the body, of the mind, and of external creation.” In a letter which he wrote to Mrs Whateley in 1847, he says—“A striking illustration of the principles advanced in this letter presents itself

while I write. In the official report of the mortality of Edinburgh and Leith for 1846, the following results appear :—The mean age at death of the first class, gentry and professional men, was $43\frac{1}{2}$ years ; of the second class, merchants, master tradesmen, clerks, &c., $36\frac{1}{2}$ years ; of the third class, artisans, labourers, servants, &c., $27\frac{1}{2}$. As I read this document, it is an intimation that these different classes have fulfilled in widely different degrees the conditions on which God offers us the boon of life, and my benevolence and veneration are strongly stimulated to inquire into the nature of these conditions, to unfold them, when discovered, to all of these classes as God's institutions, to appeal to their benevolence and veneration to respect them as such, and to enforce the study and practical application of them, in order that the Divine boon of life may not, by so many of my fellow-citizens, continue to be trampled under foot and forfeited." (Applause.) That, Ladies and Gentlemen, was a noble ambition, and worthy of him who cherished it. In my opinion an agitation on this question ought forthwith to be begun. Public opinion, happily, rules our land, and the national will is surely, if somewhat slowly, tending in the direction indicated. While much remains to be done, we rejoice that the state of the national health is so much better than it was twenty years ago. The Public Health Act of 1865 is a powerful instrument for good were it properly carried out. Some day the Lord Advocate will succeed in passing his Burgh Police and Health Act into law. But he should beware of hearkening to the crotcheteer, a well meaning but frequently mischievous person, and the committee to which the Bill may be referred should eschew the pernicious habit of hearing evidence on an all-important public question in private. (Applause.) The Edinburgh Police Act of 1879 has been in many ways a blessing to the town. It gives very full powers to the Town Council in dealing with matters connected with health and disease, and, although as a member of that honourable body I must beware of undue praise, I must say that the Health Committee takes a deep interest in its work. (Applause.) Dr Littlejohn is always busy doing good, and Mr Cooper, the burgh engineer, has his heart in

his work. One of the most important clauses in the Bill is number 208,—that by which every medical man practising in the burgh is enjoined to report, within twenty-four hours, to the Medical Officer of Health, every case of typhus or typhoid fever, diphtheria, small-pox, scarlet fever, and measles which occur in his practice, and to state the house or place where the patient is being treated. This is going very nearly to the root of the matter, and to show you the good resulting in a great degree from the operation of this clause, I quote from a tabular statement by Dr Littlejohn, to the effect that while from the year 1869 to the year 1874 the average death-rate due to these diseases was 25·55 per 1000, the rate from 1879 to 1884 was only 11·90 per 1000. During the latter five years, 29,279 cases of infectious disease were reported, of which only 3170 were removed to the Hospital. Had a larger proportion of these cases, especially those occurring among the poor, been taken to the Hospital, the death-rate would doubtless have been still less. (Applause.) I take this opportunity of publicly and urgently calling attention to the excellence of the newly-established Fever Hospital. When unhappily infectious disease breaks out in a family, earnest consideration should be given to the question, whether it would not be safer in all points of view, that the patient should at once be removed to it. Within its walls are to be found skilful medical treatment, trained nurses, and an amount of comfort for the patient in many cases unattainable at home. (Applause.) Remember that every time a patient is taken to the Hospital a source of public danger is removed. (Applause.) The public wards are good enough for all, but for those who prefer it, private wards are provided at small cost, while the patient may, if he choose, be treated by his own medical man. While there can be no doubt that the reduced death-rate is largely owing to the clause of the Police Bill that has been quoted, other causes have been at work. Not least of these is the Improvement Act of 1867, due to the energy and public spirit of Lord Provost Chambers, to whose memory it is passing strange that no monument has been erected in that grand Cathedral Church which he restored and made a joy for

ever. (Applause.) The Town Council has not allowed the other clauses of the Bill dealing with public health to remain a dead letter. For instance, during the year ending 30th September 1885, they have shut up 300, and caused to be repaired 58 houses; have introduced sanitary fittings and sinks in 247 cases; have inspected 471 tenements; have overhauled or inspected 18,600 yards of drains, and abolished 108 of our old enemy the cesspool. Further, they have investigated 4884 complaints, and dealt with but slight success with 79 cases of smoke nuisance. It was, I doubt not, a sense of duty, and not the near approach of the Royal Commission on the Housing of the Poor that stirred up the Health Committee to an abnormal activity among unhealthy houses during last year. (Laughter.) From these causes we have the gratifying result, that while from 1865 to 1875, the general death-rate averaged 26·26 per 1000, from 1875 to 1884 it was no more than 19·94 per 1000, and that Edinburgh is one of the healthiest as it is the fairest of large towns. (Applause.) The Burgh Engineer is anxious to have the help of the public in his work. He and the Health Committee highly appreciate the work done by the Social and Sanitary Association. It is a source of grief to him, as it is to the Committee of this Society, that the knowledge disseminated by it rarely reaches down to the inhabitants of those parts of the town where dirt and disease dwell in dark companionship. It is much to be desired that the self-denying men and women who visit in these places, would call the attention of the people to the Saturday evening lectures. Our Municipal Bill is, however, by no means perfect. It does not ensure that our streets shall be wide enough either for health or comfort, and it leaves too many loop-holes through which an ignorant or greedy builder may climb to fortune over a long-suffering people. (Applause.) The air space which it enjoins shall be left in a given plot of building ground is not nearly enough. The clause which deals with it is further ornamented by the ingenious and elastic phrase that, "under special circumstances," the insufficient space may be further curtailed. Professor Chiene struck at this iniquity in his lecture

on Civil Sanitation delivered to the Society in 1883, and pointed out the remedy, viz., that all feuing plans should go through the hands of the Health Committee before they are passed. Meanwhile the town is to be congratulated on having a resolute body of men in the Dean of Guild Court. The subject of the housing of the poor naturally arises here, and a most interesting but perplexing subject it is. In following it out, one thoroughly recognises how destructive to the poor is their poverty. Full many a time, when considering the state of uninhabitable houses, has the Health Committee had its mind divided between its sense of duty and its feelings for suffering humanity. Frequent inquiry was made whether there were enough empty houses to shelter those who must be displaced, and in no case, to my knowledge, were any obliged to go shelterless. But the difficulty lies here. The class of people who inhabit those decayed fragments of a former world are miserably poor, and some have nasty customs. They cannot pay for, and desire not, any of the resources of sanitary civilisation, and frequently good and improving landlords, after a tenancy by persons of the classes spoken of, have, in the words of the Poet-Laureate, "blessed themselves and cursed themselves, and rested from their labours." (Laughter and applause.) Till the child is instructed that dirt is disease and that soap is sanitation, no thorough cure for the uncleanly and destructive habits of this class is possible.

From the report of the Royal Commission on the Housing of the Poor we learn (as testified by Mr Colville, manager of the Edinburgh Co-operative Building Company) that there is a sufficient supply of houses for the working-classes, but that there is a want of houses for the very poor. He thinks that flatted houses for this class could be built to pay, if it were not for the high rate of feu-duty. This seems to be the chief obstacle. It is a question, however, too large for discussion here. In the course of his evidence I find this curious and interesting information:—"In Scotland they have a bed recess in the kitchen; they cannot do without that; a Scotsman always likes to lie in the kitchen, and of course that saves fires." Mr Goschen thereupon asks if

that is the favourite bed in the house, and the answer is "Yes." From the same report I have here a tabular statement by Dr Littlejohn of the number of one-room houses in Edinburgh, and of persons living in them in 1871 and 1881.

Number of Persons in each Family.	1871.	1881.
1	4,014	4,495
2	4,091	3,800
3	2,457	2,248
4	1,822	1,590
5	1,289	1,087
6	823	647
7	398	324
8	208	143
9	60	35
10	23	15
11	6	8
12	4	1
13	2	...
14	1	1
15	...	...
16-20	...	1
21-25	...	...
26-30	...	...
31	...	...
Total . .	15,198	14,393

This proves that 17 per cent. of the inhabitants of Edinburgh live in one room houses. In Glasgow the proportion is 25 per cent. Although there is such a large number of single-room houses it does not follow that these should all be done away with. It will be observed that in 1881 there were 4495 rooms inhabited by one person, and 3800 by two persons only. As the report points out, there is no harm in that, but they suggest that the standard of cubic feet of air required for each person should be raised, and that provision should be made for vigorously enforcing the standard. By our Municipal Act, no one-roomed house which contains 700 cubic feet of air space, can be interfered with, provided

it was used as a house before 1879—a condition which applies to an immense majority of such houses. A room measuring 9 ft. in length, breadth, and height, containing only 729 cubic feet of air-space, without deducting that taken up by bed and furniture, and which is not large enough for one person, may thus under our act, be inhabited by a greater number. According to De Chaumont (who made 473 analyses of foul air), a highly trained sense of smell gives a very fair index to the state of the atmosphere in a room. He arrived at the conclusion that 857 cubic feet of air-space was the minimum per head, while Dr Parkes considered 3000 cubic feet of fresh air per head and per hour as necessary for healthy sleep.

The report of the Commission lays stress on the statement made by the president of the Edinburgh Trades' Council speaking on behalf of the working-classes, to the effect that he strongly opposed the Town Council in any sense becoming responsible for the housing of the people. The natural effect would be to paralyse the efforts of private persons. Inasmuch as local acts have caused the neglect of general public acts, the Commissioners are of opinion that a uniform system of administration in sanitary matters is required. They suggest that building bye-laws should be enforced throughout the country, that if possible the cost of the transfer of land and of small houses should be reduced, "the present system rendering the building of workmen's houses very expensive and putting great difficulties in the way of the labouring classes either possessing their own houses, and obtaining good accommodation at a low rent." (Applause.) Further, they commend to the favourable consideration of the Government, the statement made by an experienced official in the Register House, that the stamp duties and fees connected with such transfers might with advantage be reduced, and that without loss to the Revenue. Many benevolent people are at work on the problem, and I am not without hope that it will be happily solved. It is of the first importance to the enjoyment of good health that the bedroom should have a full supply of fresh air, as mankind passes therein one-third of his life. Some even take more advantage of it than that! One has the ven-

tilation of his bedroom in his own hands and can keep the window open an inch at the top if he so please—it will be to his advantage.

But when an audience fills a public hall, or a congregation shuts itself up in a church, matters are no longer satisfactory. The Philistines, in the shape of carbonic acid gas, are upon them. (Laughter.) In warm weather they gasp as Dives, and in winter the genial north-east wind seeks out their tender spots, and finds them. Good men have been known to sleep in church even when there was no dry-rot apparent in the pulpit or any other part of the wood-work. (Laughter.) Woes unnumbered have come, and are still coming upon us, owing to the scandalous neglect of the necessities of human nature in regard to temperature and fresh air which obtains in almost every church and public hall in the town. True it is that many were built at a time when the elders were careful to shut the doors immediately after kirk skailin', so that the building might be warm in the afternoon, and the builders, knowing no better, are therefore to be excused. But in these enlightened times there is no excuse whatever why these places should be allowed to continue to sin against humanity.

Learned judges have been heard to complain of draughty courts, and not long ago it was reported that a justice of the peace dispensed justice with his hat on and his greatcoat collar turned up on account of the joyous east wind which swept the court and judgment seat. (Applause.) Now, Ladies and Gentlemen, I feel strongly on this point; I have suffered, and I desire your moral support to the end that these things may be improved. Would that every one who may henceforth be chilled or asphyxiated in a public building would send anathema to the proprietors, and a written complaint to the Town-Clerk. Remember the importunate widow, and keep pegging away.

Having found the state of the atmosphere in the Music Hall during the orchestral concerts sufficient to deprive me of all pleasure in the concord of sweet sounds, and having overheard a statement (which I could corroborate) that there was a draught at one side of the hall fit to lift a cart-horse, I set to work under

a clause of the Municipal Bill, and got the Town Council to instruct the Burgh Engineer to report on the heating, ventilation, entrances, and exits.

The following pleasing state of matters was then revealed. This is a minute, Ladies and Gentlemen, of a meeting of the Town Council on 15th April 1884, in which we have a very elaborate report by the Burgh Engineer, Mr Cooper, and the Fire-master, Mr Wilkins. It deals with the accommodation, egresses, danger from fire, and so on. I only propose to read the part dealing with the ventilation.

“The ventilation of the Hall is very inadequately provided for on such occasions as those when the Hall is filled. With all the gas-lights burning, the atmosphere rapidly becomes impure, and in the galleries in particular oppressive and stifling. The natural result is the enervation of the human system, and the danger to less strong constitutions and even to the most healthy, in being transferred from a suddenly highly-heated hall to perhaps an arctic temperature outside, with the whole tone of the system seriously deranged, requires no comment. The existing mal-arrangement in this respect appears, however, to have been an afterthought, as it is evident from the disused flues and pipes still to be seen that a much more elaborate system of ventilation and heating had formerly been in operation. Whether this system had been discontinued on account of its failure, or on the score of expense, has not been ascertained. The heating apparatus is now out of order and disused: the temperature of the Hall depending upon the heat generated by the gas lights, or evolved from the audience. The existing provision for ventilation is as follows:—Outlet ventilation is afforded by means of two tubes with 18-inch outlets immediately over the large sunlight in the centre of the roof. To one of these is joined a 10-inch tube from the gallery ceiling, which ceiling has also a number of small perforations to allow foul air to escape into the attic. The orchestra has no special outlet. For the influx of fresh air four “Tobins” tubes have been fitted up in the corners of the side seats, each tube measuring 18 inches by 10. The three large windows on either side are available

(of course when the Hall is empty) for the more thorough aeration of the premises. As already indicated, experience proves beyond question that something in this direction is wrong. The Reporters have not had opportunity to determine by experiment the rate of efflux of fouled air, and as the temperature of the Hall is variable it might be unreliable to give such data from calculations, but an approximate estimate of the requirements of a full house in this direction, and of the existing supply of fresh air, will show the inadequacy of present arrangements. The total capacity of the hall is 260,000 cubic feet, or thereby. During the winter season, in particular, it would not be desirable that the air of this hall, unless properly warmed, be renewed more than three or four times an hour, otherwise discomfort from cold draughts would ensue. Supposing it be renewed three times, there would be required a supply of 13,000 cubic feet per minute, with a corresponding efflux. But low as this estimate is, the Reporters are of opinion that the existing efflux of fouled air is not more than from 2000 to 3000 cubic feet per minute, even under favourable circumstances. If this estimate be correct, it can readily be understood how it is with an audience of 1800 persons, and with, say, 170 gas jets burning, that in less than half an hour from the commencement of an assembly, the air is perceptibly tainted even on the lower levels. There is no doubt that, aided by the large sunlight, the existing outlets work effectually so far as their capacity admits, but in view of the enormous amount of air fouled or vitiated, it is evident that they do not accomplish even a sixth part of what is required, and it has to be recommended that the extractive power be increased to that extent either by the aid of additional sunlights or mechanical extractors, with corresponding fresh air supply suitably distributed. At the same time it must be perfectly evident that it is not a sufficient arrangement when a large public hall such as this is, with internal capacity of some 260,000 cubic feet, has to depend for the raising of its temperature in cold weather upon its gas lights, or the warmth derived from the audience, because the air thus warmed is at once deprived of its best and healthiest elements. While it

is possible, therefore, to do a great deal in the improvement of the existing ventilation by increasing the outlets, and aiding their extractive power as far as possible, and by a judicious distribution of additional inlets for fresh air, all of them being under the regulation of a skilled attendant, there is a probability of creating thereby cold draughts, an evil which can only be overcome by a combined and effective system of warming and ventilation. It does not appear out of place to insist on the desirability of this arrangement, as an efficient warming system at once promotes ventilation and abolishes cold draughts."

The Council remitted the report to the Plans and Works Committee, with powers. The proprietors were enjoined to remedy both structural defects and those connected with ventilation. In a half-hearted way they did so, but the result is unsatisfactory, and according to his position one is still comfortably chilled or overheated. One man (of whom I have nothing but good to say) has the sole charge of the whole place, of heating, ventilation, and gas. With the present arrangements, no single man can secure comfort. I have also got a report on the Oddfellows' Hall in Forrest Road, and I am about to turn attention to others, believing that in securing fresh air and comfort, along with sufficient means of entrance and egress, I am doing a useful work. (Applause.) The efficient working at all times of any system of heating and ventilation can, in my opinion, only be secured by mechanical means. The Calton Jail and the cells of the chief office of Police are at present being heated and ventilated by Mr Keith, on a system which may be trusted to work in all states of the atmosphere. By means of Blackman fans placed high up in the buildings, and driven by steam engines in the jail and by a gas engine in the police office, pure warm air will be gently and continuously drawn through each cell, and expelled directly to the outer air. I do not grudge this comfort to such of our fellow-citizens as dwell in these places; I only plead earnestly that intelligent proprietors of halls would give free humanity a little of it. (Applause.) The mechanical system of ventilation should also be applied to schools. The gas or water engine

makes it easy to do. The open window and consequent draught has served its day, and has shortened the lives of many generations. Science knows how to do it in a better way than that, and were the architect to consult the physicist, and he the engineer who knows his work, the difficulties would vanish.

There are many other points of interest that forcibly present themselves to me on an occasion such as this ; but time flies. I have already detained you too long, and Dr Russell, convener of the Health Committee of the town, has yet to say something to you. There is one thing more, however, that I should like, with your permission, to speak of briefly.

The way in which we dispose of our dead has an important bearing on the health of the living. By many earnest physicians and chemists, it has been proved beyond the possibility of doubt, that air and water in the neighbourhood of cemeteries have in many cases been converted into deadly poisons. Persons breathing this air or drinking this water are certain to have their vital powers lowered, even if they escape actual virulent disease. The diseases which make their appearance near cemeteries are generally headaches, diarrhoea, and ulcerated sore throats. The French Academy of Medicine reports that the putrid emanations of Père-la-chaise, Montmartre, and Montparnasse have caused frightful diseases of throat and lungs, which destroy many persons yearly, and that a dreadful throat disease which baffles the skill of medical men, and kills its victims in a few hours, is traced to the absorption of vitiated air into the windpipe, and rages most violently near the cemeteries. Burying-grounds may have a system of drainage or they may not. In either case they are a source of danger and disease. In the former case the earth becomes saturated with poisons, which are either slowly but constantly giving off, or, if the burying-ground should be in a church, then by sudden rushes. There is a case recorded by Dr Copeland of a gentleman who was poisoned by such a rush of air from a church grating. He died of a malignant fever in a few days. His wife took it from her husband, and died also. On the other hand, if the ground be drained, the danger to health is not less.

In towns, cemeteries must drain into the common drainage system, and thus poisonous gases may be distributed far and wide. In Manchester a main drain ran through a graveyard with results that I shrink from mentioning. But enough of a disagreeable subject. Only I ask you to remember that the evil effects of air and water contaminated by cemeteries have been established by a cloud of trustworthy witnesses.

Why then do we still bury our dead? Only because public ignorance or apathy and misguided theological sentiment stand in the way of change. Science and the laws of health, which are the laws of God, point clearly to the process of purification by fire. The change which takes place in matter decaying in the ground and in matter consumed in a furnace is the same. In both cases it is combustion, only in the former it lasts for years and centuries, while in the latter it can be completed in an hour, and gases which by burial poison the living are by fire delivered harmlessly into the upper air. *Cremation is not illegal.* There are no horrors connected with it; the time-hallowed words, "dust to dust and ashes to ashes," may still retain their place in the service over the dead, while all theological doubts should be quieted by consideration of the question asked by the Earl of Shaftesbury of Sir Spencer Wells—"If utter obliteration follow cremation, what has become of the blessed martyrs?" May I express the hope that no more cemeteries may be laid out here, until the whole subject of cremation has been reverently and carefully enquired into by the public authorities? (Applause.) The next duty, Ladies and Gentlemen, which devolves upon me, is to move the adoption of the Report which has been read to you. I will not say more about it but call upon Dr Russell to address you. (Applause.)

Dr RUSSELL said—Mr Chairman, Ladies, and Gentlemen, it is matter for congratulation that the report, the adoption of which I rise to second, shows a large increase in the membership of the Health Society. (Applause.) Its membership may still be considered small—it stands somewhere about 1000—but it must be remembered that it is composed of selected persons—

persons of intelligence and earnestness—who in a word are the governing classes, and who by their example and authority exert a powerful influence over their fellow-citizens. It is no small matter to have informed intelligence, and quickened the perceptions of such persons regarding the evils which surround us. They have received exact information on many subjects from the lectures—such as the influence of alcohol, questions of ventilation, and isolation of the sick, and many other matters, and we are undoubtedly reaping the advantage of this information, not merely in the private conduct of the persons so instructed, but by their influence on public opinion, and in the government of our city. (Applause.) I am myself able to bear testimony to the extraordinary change in public opinion which has occurred within the last six years. Six years ago I was put upon the Dean of Guild Court, and was able to come in contact with the opinions of those who were providing houses for the public in relation to the sanitary arrangements which they considered satisfactory. I also saw what was in the minds of the members of that Court, and what they considered sufficient and reasonable, and I am able to tell you that what was considered very good six years ago, would not be listened to for one moment to-day. (Applause.) Not only has the Court changed its opinion most vitally on this important question of the sanitary arrangements of houses, but the public have been so informed, partly through this Society and kindred societies, and partly through the action of the Dean of Guild Court, that the houses which were erected in former times, with less perfect sanitary appliances, have now to be re-arranged in many cases before they can be relet or find a purchaser. I heard the other day of a builder who was forced to expend a large sum on certain villas, because he found they were left on his hands during last year, simply for the reason that they had not their sanitary arrangements planned in the way now enforced by the Dean of Guild Court. I believe owners of property are finding that houses planned on the antiquarian system have to be let at reduced rents when they are brought into competition with those of recent construction. Now, it is a great

matter for public opinion to have come to this point, and for this Society to have had such a share in producing that change. Since we last met at our Annual Meeting the Town Council has taken on itself the entire provision in the hospital for cases of infectious diseases, and I had the honour, before this Society, of advocating that course some years ago. (Applause.) At that time I received considerable opposition, and undoubtedly through the ascertained opinion of the public outside those persons who promoted this change, we were enabled to have their wishes carried into effect, and now there is better provision made than there ever has been at the disposal of the citizens of Edinburgh. Formerly the poorer classes had, through the Managers of the Royal Infirmary, provisions which might in a certain sense be termed adequate, but now all classes of the community have provision made for them appropriate to their position and their wishes. As has just been told you by our Chairman, there are provided wards which are at the disposal of persons who desire privacy. That is the only advantage that we are able to offer them over their poorer fellow-citizens, for I am glad to say that everything that can be done is done for the very poorest, and all one can secure by having a private ward is that exclusiveness which is so dear to many persons. (Applause.) I think that now public opinion is very nearly ripe for a further advance, and that we shall shortly feel ourselves able to promote a clause in some Bill to amend our present Burgh Police Act in the direction of improving our laws with regard to new buildings, and of buildings in old streets. Vested interests are, of course, always troublesome, but as public opinion advances, the sacredness of vested interests is not allowed to have such a malignant influence as it has hitherto had. (Applause.) I trust we shall shortly be able to forbid the erection of buildings in enclosed squares, through which no light or air is allowed to penetrate; and to insist that all such enclosed spaces have more than one opening to allow the wind to blow through. I hope that we shall soon not have the scandals which we see in many of the new streets, owing to a defect in one of the clauses of the

Police Act, which does not allow the Town Council to force proprietors to pave a street until three-fourths of it have been built, the consequence of which is that if a builder lays out a street sufficiently long for the building of it to last till the times of his grandchildren, then he can defy the Council, and keep the street as a slough of despond, in spite of the danger to the occupants. All of you must be well acquainted with streets in this position, which have not attained, and show no signs of ever attaining, the amount of completion which will enable the Local Authority to interfere. There are many other points in which our Local Act is very defective, and in regard to which it can be amended, and will be amended as soon as you bring sufficient public opinion to bear and strengthen the hands of those who will be your agents in effecting this reform. (Applause.) Owing to the changes already made we have—as you have been told by our Chairman—a very steady reduction in the death-rate of the city. That reduction has advanced by a great bound in the last year. Our Chairman did not tell us that the death-rate in 1885 was fully 17 per 1000; while in the previous five years it was over 19, so that there is a saving of 2 per 1000. As we lower the death-rate the harder it is to get a further decrease, for as you approach perfection the harder it is to make any advance; everyone knows that. There is abundant room for our work not only in dealing with the one-room tenements—which cannot be called houses—where the one room is sleeping-room, parlour, dining and drawing-room all in one, where all the functions of the family are discharged at the cost of all feelings of decency and propriety; where birth and death jostle each other; and where there must be a blunting of feelings and a lowering of the moral tone; and which must render the inhabitants more prone to fall into vices of all kinds. (Applause.) But we find that there is a great contrast between the different parts of our city. We have one part in which the death-rate is steadily higher than it is in the other parts. We have in the old town a death-rate for last year of 20 per 1000, as against a death-rate in the new town and southern suburbs of 14 per 1000—the southern suburbs being a little ahead of the new town, but

both not far apart; and both of them very much in front of the old town—about 6 per 1000 for last year. There is a reduction in all parts of the town, but it is the same proportion. There is a reduction in the death-rate of the old town as compared with itself. It has not gained appreciably in the new town or southern suburbs, and here there is a great field for the operations of the Society and for the authorities who are moved by the public opinion formed by the Society. Until we effect a very large reduction of the death-rate of the old town we shall not have discharged our duty as intelligent, earnest, and conscientious citizens towards our poorer brethren. Such a reduction as this would imply a great improvement in the moral and material circumstances of the persons affected. I think myself that we require to apply a number of different remedies coming from different directions to the complex evils which affect our poorer fellow-citizens, and among all the evils which affect them, and for which some remedy must be found, there is no greater than the diversion of their money from the payment of rent to the purchase of whisky—(applause)—and if we could bring them to spend the money which they already have in the purchase or the rent of improved dwellings, we should no doubt save the means which at present are spent on the consumption of alcohol, and bring them in all respects into a much better and more desirable position. (Applause.) This I have put in the first place because it is the most prominent, as I conceive, of the evils that affect them, and we cannot, therefore, afford to ignore it in anything we do for their elevation or advancement. I have much pleasure, Ladies and Gentlemen, in seconding the motion for the adoption of this report. (Applause.)

Mr WILLIAM C. SMITH, advocate, said—I have been asked to submit a resolution to the meeting, which I am sure you will accept with much pleasure, but before I submit the resolution, I would ask your leave to make just two observations on what we have been listening to this evening. We have heard a good deal about overcrowding the single-room houses, and we have heard a good deal in praise of the Edinburgh Police Act. Now, for my part, I entirely agree that the public law ought to fix the

number of people who should be allowed to live in a single room. But I say that if the public law undertakes that duty and comes forward as a ruler and instructor in sanitary matters, we ought to take care that it is correct; and I believe our Edinburgh Police Act—which is no doubt worthy of much praise—sins most grievously in this respect, because, as I think the Chairman mentioned, it gives only 300 cubic feet of space to each individual occupying a single-roomed house, whereas I believe, according to all competent sanitary authorities, 600 cubic feet is the minimum of space that ought to be provided. It would be better to have no regulation at all than to have a standard erected by public authority, which is unscientific and misleading. The other matter on which I wished to make an observation is this,—I wish to express my gratification that the Chairman has seen his way to bring forward in so moderate and reverent a way that most important subject of cremation; and to take this, the earliest public opportunity afforded to me at a public meeting in Edinburgh, to say that for my part I entirely support the movement for cremation, and that on two grounds quite distinct from the sanitary grounds which have been so forcibly stated by the Chairman. (Applause.) I believe the process of cremation is one much more in harmony than the process at present followed with those sacred feelings that surround the awful fact of human death; and in the second place, on this lower consideration, but one of much importance,—that if a free system of cremation were established in this country, it would result in this great benefit to the poorer classes of the community, that it would very greatly decrease the cost of burial. (Applause.) The subject is no doubt one of some extent and difficulty, and has associations which disincline people to discuss it publicly. The Home Office has also suggested that some guarantees in connection with the administration of justice may be required. But these facts afford no reason why individuals should not express the convictions they have formed after careful study of the subject. I have now to submit this resolution, which I have no doubt you will receive with acclamation without any speech from me,—

“That Mr Cox, Mr Campbell, Madame Kunz, and Mr Smith Clark be re-elected members of the Committee, and that Dr Byrom Bramwell be elected a member in place of Professor Annandale.” These are all very good names for the Committee. I am sure, after the address you have heard to-night, you must recognise that our Chairman not only worthily represents what I might call the administrative authority, the Public Health Committee, but that he has a mind entirely in sympathy with the objects of this Society, and that he not only would administer the law thoroughly, but would influence it where that is possible. (Applause.) It is very important to have Mr Campbell on the Committee, for he is one of the most prominent Catholics in Edinburgh, and these lectures are largely addressed to the poorer classes in the old town, who are to a great extent Catholics. Of Mr Clark’s qualifications for this post I can speak strongly, for he has been an active member not only of this Society but of the Social and Sanitary Society. He prepared the evidence laid before Sir Charles Dilke’s commission on the housing of the poor by that Society, and drew up the memorandum presented by the three Societies to the Town Council, suggesting that house proprietors should be compelled to give a certificate of the sanitary condition of their houses. (Applause.) Of Madame Kunz, I merely say this, as it was said long ago in somewhat similar terms of Lady Mary Montagu, that to know Madame Kunz is of itself a liberal education in sanitary matters. (Applause.) Although it is matter of regret that Professor Annandale, who has interested himself in the Society for many years, should now retire, yet I must congratulate the Society on having obtained the services of one in so high a position in the sanitary world as Dr Byrom Bramwell, and who has already earned the gratitude of the city, by delivering two of the most interesting lectures to which we have listened. (Applause.)

The motion was unanimously adopted.

Mr PRINGLE, C.A., said—I have very great pleasure in moving a vote of thanks to the Committee for their services during the past year. I am sure we all feel that we have had an interesting

course of lectures. Our Society has now been in existence for six years, and I state what is the fact when I say that every season we have had presented to us lectures on different subjects. (Applause.) I think that of itself shows that our Committee have given a amount of thoughtful care in thinking over what would be most suitable for an audience such as the present. I have wondered that they have been able to suggest something which is always fresh, racy, and practical; and I am sure they are well entitled to a cordial vote of thanks. (Applause).

The CHAIRMAN said,—In name of the Committee, I beg to thank you for this continued vote of confidence in them. Every one of us follows this as a congenial work, and we joined the Society for the purpose of doing what we could for the benefit of our fellow-citizens. That spirit will still continue to animate us. (Applause.) I would like to mention that our Secretary, Mr Walter A. Smith, and our Treasurer, Mr M'Cuaig, owing to the increasing amount of work which they have undertaken, have found it necessary to resign their offices. It is with regret I have to say this, especially as to the retirement of Mr Smith, who has so long,—since the beginning, indeed,—filled an important place in this Society. (Applause.) There are many qualifications which go to make a perfect secretary, and I may say before Mr Smith, that he has approached as near perfection as it is given to human nature to do in the filling of that office. I am sorry that he is no longer able to fill it; but I know enough of his character to be sure that when he says a certain course of procedure is necessary, that it is so, and that there is nothing more to be said about it, but to express our sincere regret. (Applause.) The Treasurer has also filled his office with the very greatest acceptance to the Society, and has done everything that could be done to advance its interests; and I am sure I may convey to him also an expression of your regret that he has ceased to act. (Applause.)

The SECRETARY (Mr Smith), said—On behalf of Mr M'Cuaig and myself I beg to thank you sincerely for the expression which Mr Cox has made, and for the hearty reception with which you greeted

it. It is with considerable regret that he and I have found it necessary, from increasing professional and social duties, to resign the posts that we have had so much pleasure in holding ; but although we retire from that official connection with the Society, we shall always continue to take a warm interest in its success. (Applause.) I take this opportunity of saying that both he and I have had the greatest pleasure in our dealings with the Committee and the members of the Society, and owe very much to the kindness of those who have assisted us in our work ; but I would remind you again that the best thanks you can give to us and to the Committee is to send as many as possible of your friends to join the Society. (Applause.)

The CHAIRMAN also expressed a hope that the members would keep talking about the Society, and would perhaps present copies of the lectures to friends, and thereby spread a knowledge of its affairs. (Applause.)

A hearty vote of thanks was unanimously passed to the Chairman for his address.

The CHAIRMAN, in acknowledging that compliment, said it had afforded him much pleasure and interest to give them his address, which he hoped had been of more or less interest. (Applause.) He expressed a hope to see a full attendance at the opening meeting of next session, and meanwhile bade all present good-night. (Applause.)

The meeting then separated.

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THE RÔLE OF BACTERIA IN HEALTH AND DISEASE.

BY J. COSSAR EWART, M.D.,

REGIUS PROFESSOR OF NATURAL HISTORY, UNIVERSITY OF EDINBURGH.

SCIENCE during the last twenty years has been invading the realms of nature with so much success that it is now all but impossible for any of her disciples to follow her steps save in one or two directions, and still more impossible is it for the general public to appreciate the enormous strides she has taken, or the remarkable results that have been gained. While progress has been made along nearly all possible lines, perhaps the greatest advance has been in the study of bacteria and other minute organisms. For many reasons our interest in these minute forms has all but kept abreast of the wonderful discoveries which have signalized the advance of the large army of investigators. But though there is no want of real interest in the nature and life-work of bacteria, there is naturally enough a striking absence of real information. In these days everyone discusses bacteria, yet few have any true conception of their place in nature, or in what way they are related to the welfare of the human race. They are usually looked upon as organisms to be dreaded under all circumstances, and while credited with the power of spreading broadcast disease and death, they are deemed utterly incapable of serving any beneficial purpose in the economy of nature. It is probably partly owing to the general interest and importance of these organisms, and partly owing to the misconceptions that generally exist concerning them, that the Health Society has arranged that

you should have to-night an opportunity of hearing something of their structure, life-history, and of their rôle in health and disease. At the outset let us consider what bacteria are. Are they plants or animals? Had we asked this question some years ago, the answer would have been—they are the lowest members of the animal kingdom. Now everyone admits that they belong to the lowest, or one of the lowest divisions of the vegetable kingdom, that in fact they are related to algæ (the seaweed group) on the one hand, and the fungi (the yeast plant and mushroom group) on the other. You are aware that while the higher plants can be easily distinguished from the higher animals, it is extremely difficult often to say whether some of the lower organisms are animals or plants. The best distinguishing test is usually the food on which the lower organisms live. If they are capable of flourishing on the gases of the atmosphere and on the salts of ammonia, &c., found in the soil or in water, they are looked upon as plants. But when they require as nourishment organised substances, such as starch and nitrogenous compounds, they are considered animals. Bacteria, however, though like animals they generally live on organised substances, are placed in the vegetable kingdom, partly because of their structure, and partly because of the plant-like stages they pass through during their development. Bacteria are exceedingly minute organisms. Some of them only measure $\frac{1}{2000}$ of a millimetre in length, whilst the largest are only about 50 micromillimetres. Though so exceedingly small, they seem to have been detected in putrid water by Leuwenhoeck in 1675, soon after the microscope was introduced. Little advance was made in the study of bacteria from the time of Leuwenhoeck until recently. Since 1838, by the investigations of Ehrenberg, Cohn, and others, our knowledge of bacteria has been greatly increased. In 1851 Davaine discovered bacteria in the blood of animals suffering from splenic fever, and at a later period he associated the bacteria with the disease; and in 1876 Koch made out the complete life-history of the splenic fever organism, and proved conclusively that bacteria were directly related to epidemic and contagious diseases. Up to 1876 bacteria had chiefly attracted the attention of naturalists, and they were discussed chiefly in relation to spontaneous generation and fermentation. But the burning question as to whether

microbes could originate spontaneously had scarcely been settled in the negative when bacteria ceased, as it were, to belong specially to biologists, and began to engage the attention of all who take an intelligent interest in the welfare of human beings, and of the lower animals that minister so much to our daily comfort. This universal interest will not be wondered at when it is remembered that bacteria, or other minute organisms, are in all probability associated with the existence of all epidemic and contagious diseases, and that it is in all probability by modified forms of bacteria that we shall be able to protect ourselves in the future against many of the worst diseases flesh is heir to. Bacteria having such possibilities, we can understand the rush made to study them by almost everyone capable of looking through a microscope, and also why scientific and other journals are flooded by papers dealing with their structure and life-history and their relation to specific diseases. Let us now consider the different kinds of bacteria. The classification usually adopted is that given by Cohn, viz. : (1) bacteria proper; (2) micrococci ; (3) bacilli ; and (4) spirilla. All bacteria are capable of multiplying by fission, *i.e.*, by simply dividing, and they are composed of what may be termed protoplasm, which is enclosed by a membrane consisting chiefly of cellulose—a substance almost peculiar to the vegetable kingdom. In many cases they form colonies, the members of which are embedded in a gelatinous substance derived from the investing membrane. While alive, bacteria are usually extremely active, and in many cases the movements are produced by means of one or two delicate thread-like processes known as cilia or flagella. Their activity depends largely on their surroundings, *e.g.*, some are only capable of growing when plentifully supplied with oxygen, while others flourish without free oxygen. In all cases their activity varies with the temperature and with the amount of moisture and nature of the nourishment.

The bacteria proper are small oval or slightly elongated rods with round ends, which multiply by first elongating and then dividing transversely. When multiplying rapidly several remain in contact, and form a short jointed chain. As they separate they usually develop one or two cilia which assist in their darting and spinning movements.

Under certain circumstances these movements cease, and the

resting stage is assumed—the individuals becoming embedded in a sort of gelatinous matrix.

Micrococci are minute oval or spherical bacteria, which though devoid of processes are capable of moving. When multiplying they become dumb-bell shaped, and then divide transversely. Sometimes the new elements remain in contact so as to form chains, which are often curved and of considerable length. In other instances, while the micrococci are increasing, groups of four or short double chains are formed, and, as in bacteria, large nesting colonies are often produced.

Bacilli differ chiefly from bacteria in being longer in proportion to their thickness. Their ends are sometimes square cut, at other times rounded. Some are provided with a cilium at one end, and are capable of rapid movements; others are without cilia, and motionless. They all multiply by fission, giving rise to long or short rods. Often the new rods, by remaining in contact, produce chains of a considerable length, the elements of which ultimately separate.

In addition to increasing by simple division, nearly all the bacilli have the power of elongating to form filaments, which are often interwoven so as to give rise to dense mat-like structure. Soon after the filaments have appeared the protoplasm in their interior breaks up, and gradually condenses to produce spores. When the spores or seeds have been matured, the filaments break up and admit of their escape; and when they reach a suitable medium they rapidly germinate and give rise to a new generation of rod-like bacilli.

Spirilla are corkscrew-shaped bacteria, which vary considerably in size, and follow a spiral course when moving. The largest spirilla measure about $\cdot 03$ millimetres in length, and have a long thread (flagellum) at each end. They are often found in putrid infusions of organic substances. The small spirilla are exceedingly slender, and often of considerable length, owing to continuous fission. Some of them flourish in organic infusions, whilst others are believed to assist in destroying the teeth, and some, when they find their way into the blood of man and monkeys, are capable of setting up relapsing fever.

One well-known spirillum produces a decided rose colour, often easily visible to the naked eye, and other bacteria often

produce pigments. The bacillus of splenic fever, when grown on the cut surface of a potato, produces a yellow pigment. One bacterium gives rise to a yellow colour, another to a brown colour, and a third to a blue colour, when grown in milk. Milk, it may be mentioned, is exceedingly well adapted for growing bacteria; almost every specimen of milk one makes use of has several kinds of organism flourishing in it. Fortunately these organisms are usually harmless. Micrococci also form pigments: one produces a beautiful red, and another an orange colour.

Turning now from this hurried glance at the structure of bacteria, let us say a word about their distribution. Being exceedingly minute and capable of being carried hither and thither by wind and water, you can understand that their distribution is almost universal, that they are found in both earth, air, and water. When bacteria are well provided with food they multiply rapidly; when food diminishes they usually become less active, and produce, when they possibly can, spores; after this the bacilli or filaments usually die. The spores are practically incapable of being killed under ordinary conditions. They are able to survive, it seems, for years, perhaps for centuries, and can be readily carried about both by wind and water, without in any way suffering. In the air there are a considerable number of organisms found even in winter, and this can be readily proved if we take an ordinary glass tube, coated inside with gelatine (gelatine is an excellent medium for cultivating bacteria), and pass air through it; the bacteria which have been in the air get attached to the gelatine, and if the tube is kept at a fairly high temperature for a short time, the bacterium multiply and give rise to little spots, which gradually increase in size. In this way we can determine not only the number of organisms in any given amount of air, but also the nature of the organisms. From many experiments made, it seems that air sometimes contains many organisms, while at others it contains practically none. If we take a specimen from the top of a mountain or out at sea, the probabilities are that we shall find no bacteria; while if we take air from this room or any part of the city—more especially from the crowded parts—the chances are that we should detect them in considerable numbers. They vary in character, but they are chiefly micrococci and bacilli. In specimens of air examined in

Paris eighty bacteria were found on an average in a cubic metre of air, and of these, sixty-six per cent. were micrococci, twenty-one per cent. bacteria, and thirteen per cent. bacilli. Another way of testing the bacteria that exist in the atmosphere is by studying rain water. When rain falls, the drops naturally carry bacteria with them, and we find usually that the rain contains a somewhat different proportion of bacteria from the ordinary air. The micrococci are fewer in number, and the bacilli are much more numerous. Why this difference should exist it is hard to tell. The bacteria found in the air are very often in a dead condition; this seems to result from the dryness of the atmosphere, or from the abundance of oxygen. Where there is an abundance of oxygen, the bacteria get less and less active, and seem ultimately to die off; and even, when there is comparatively little oxygen, if the air is exceedingly dry, ordinary bacteria are killed. But while rods and filaments are killed, it should be remembered the spores retain their vitality.

If, instead of examining air, we examine dust—if, *e.g.*, we take dust collected from a room, and cultivate it in gelatine, we find a certain number of bacteria. But the number is scarcely as large as we might have expected; in fact, the bacteria found in dust are very often the dead filaments and rods of those that have been floating about in the atmosphere.

On the screen you have shown a capsule of gelatine, which was exposed for a quarter of an hour in one of the Edinburgh churches during service. While exposed a certain number of particles were deposited on the gelatine from the air, and in a few days some of those developed into the little patches represented. It is thus evident that in the air there are living organisms which can be, when collected and cultivated in the proper way, easily demonstrated.

From considering air and dust, let us next direct our attention to water. Water can be very readily examined if a given quantity is taken in an ordinary flask containing a small amount of gelatine. If the gelatine and water are kept in a fairly warm room, the organisms in the gelatine begin to multiply, and the result is the formation of a large number of small patches, each often consisting of a particular kind of organisms. By studying water in this way, it is found that spring water—in fact, that all

kinds of water, even distilled water—contain organisms, but organisms which, except in very rare cases indeed, are perfectly harmless. Hitherto we have been in the habit of looking on all these organisms as noxious, and capable of setting up all kinds of disease; but, as a matter of fact, bacteria, like other plants, are generally perfectly harmless. In a litre of vapour 900 bacteria have been found; in a litre of rain-water as many as 48,000 bacteria; and in the same amount of river-water over 12,800,000 bacteria have been detected. In sewage-water there are immense numbers of bacteria. In a single litre nearly 100 millions have been discovered; and when a litre of sewage-water is allowed to stand for a short time in a warm room, it is almost impossible to calculate the number present. Bacteria are also found in sea-water, but there the number varies immensely. Near the entrances of rivers the bacteria are usually abundant; but as we proceed to sea they diminish in number, and at a considerable distance off shore very few are found.

Turning next to earth, it is possible by taking a little earth and sprinkling it on gelatine, to prove that earth contains numerous bacteria. The bacteria exist in earth generally in the form of spores. They are lying in the earth ready to germinate if provided with sufficient moisture and nourishment. In some districts there are comparatively few bacteria, whilst in others, especially in towns and farm-yards, bacteria, especially bacilli, are extremely abundant.

Let us now refer to the conditions under which bacteria flourish. It seems that unless bacteria are provided with a certain amount of moisture, and unless they are kept at a certain temperature, and provided with suitable food, they are incapable of growing. Further, when they are exposed to a very large amount of oxygen, their vitality is diminished, or, as I have already indicated, they are sometimes killed. Of all the three conditions named, perhaps the temperature is the most important, and from an enormous number of investigations made, it seems each bacterium has its own favourite temperature. One bacterium flourishes at a very high temperature, another at a moderate, another at a low. Micrococci are destroyed when the temperature reaches 60° C., bacilli at 100° , and no spores survive 140° C.

As to the food of bacteria,—and this is perhaps the most interesting part of the subject,—bacteria feed, as I have already said, on organised substances; they are in fact incapable, like other plants, of living on the gases in the air and the salts in the soil, or in water. Then the members of the bacteria family have been modified in every possible direction so as to be capable of living on almost every kind of organised substance in nature. Some can live on comparatively simple substances: for example, one well-known bacteria is capable of living on alcohol, and when it lives on that it converts it into acetic acid. Others are capable of living on tartrate of ammonia, which is also a very simple substance; while others are capable of living on milk, blood, gelatine, potatoes, and various infusions; and last of all, there are a few which are capable of flourishing in the tissues of living animals. A great question naturally is, how are bacteria able to feed on highly organised tissue? This we can perhaps best understand by referring for a moment to fermentation. You are all aware that fermentation is caused by the yeast plant. If you take a certain amount of sugar and add to it a certain amount of yeast, the yeast plant feeds on the sugar, and as it feeds on the sugar it breaks up the molecules of the sugar so as to form out of them a certain amount of alcohol and carbonic acid. In the same way bacteria feed on the molecules of which the animal tissues are composed. Suppose you take a dead muscle and expose it to the air, a number of bacteria attack the muscle; and in living and feeding on the muscle, they disintegrate or break up the little molecules of which it is composed, and in doing this they give rise to what we call bye-products, which practically correspond to the carbonic acid and alcohol formed by the yeast plant in feeding on sugar. Now, as these little bacteria feed on muscles and other dead organic substances, they break up the cells bit by bit, and they produce, as they do this, bye-products, which are usually known as ptomaines. These ptomaines are very often poisonous, and to a certain extent correspond to quinine and strychnia, and other substances of that kind. But without bacteria, all dead organic substances would remain practically unaltered. If you take an animal or plant, and destroy all the bacteria which are on and around it, and afterwards place it in pure air containing no organisms, that

animal or plant will practically remain unchanged for an indefinite period. In other words, without bacteria there is no breaking up of the tissues, no disintegration. Think for a moment what the result of the absence of bacteria would be in 100 years, or in one year! All the dead vegetable matter and animal matter would remain practically unchanged. Animals would destroy a certain amount, but only in an imperfect fashion, so that there would be a gradual and great accumulation of organic material which it would be absolutely impossible for man to deal with. Hence we must look on bacteria as the great agents of universal hygiene; they clear away the remains of all that has had life, and they are thus the great protectors of the living against the dead; and what is equally important is that unless bacteria break up the dead tissues of animals and plants, nature would soon be exhausted. Plants and animals constantly require a supply of gases and salts; but unless the dead animals and plants are disintegrated or reduced to the simple elements from which they have been derived, the necessary food for the living plants and animals would not be obtained.

It might be asked—how is it possible for these exceedingly minute organisms to do this great work? In the first place they are extremely active. I have already indicated how rapidly they multiply. In the next place they are capable of breaking up an enormous amount of material to get the nourishment which they require. A man every day is supposed to consume about one-fiftieth of his weight, but the bacteria may break up 100 times their weight in a single day in order to obtain the little nourishment they want; and it is on account of having to break up this enormous amount that they are so useful in the universe. On the other hand bacteria are to a certain extent our enemies, because of this power they have to break up tissues, they tend to destroy our food—they attack our milk—they attack fish, flesh, and vegetable matter, and produce what we call putrefaction; that is to say, they break up the tissues and lead to the formation of bye-products, many of which are exceedingly poisonous. Then they tend, when they multiply rapidly, to pollute our water, and also to vitiate the atmosphere. Again whenever they have an opportunity, they assail our tissues. The ordinary bacteria are incapable of flourishing on living tissues.

There are thousands of bacteria often around us, and numerous bacteria in the mouth and in other parts, and yet these bacteria, if they are ordinary bacteria, do no harm. But as soon as the skin is broken—as soon as we receive an injury of any kind so as to admit of the entrance of bacteria into the tissues, they at once begin to break up the tissues and cause a certain amount of putrefaction. It is not the bacteria that hurt us, but the by-products they form as they live on our disintegrated and dying tissues. We can, however, to a certain extent prevent the evil influences of bacteria. For example, if we dry our food, we arrest the disintegrating processes. If we boil our food, we can destroy the bacteria in that way; and after boiling, if we prevent the entrance of air, we can keep food for an indefinite time; if not desirous of boiling or drying food, we can still, in various ways, arrest the action of organisms. For example, though salt has no influence whatever in killing organisms, it arrests their growth and development. Hence, if we put food into a strong enough solution of salt, it is preserved. There are many other substances which, with or without salt, may be used to prevent the growth of these organisms. Another means which I ought to mention of arresting the progress of these creatures is by freezing. One might suppose that if bacteria were reduced to considerably below freezing point they would be destroyed; but this is not the case, however low you reduce the temperature bacteria are not killed, but they are arrested in their growth. If, however, bacteria are heated considerably, they are utterly destroyed. Then the air we can also purify to a very large extent. As the result of numerous experiments, we have learned that the simplest way of purifying air is to saturate it with a mixture of steam and heat. Sulphurous acid is often used to purify rooms, but it is practically useless. Chlorine is more useful, but it does not penetrate sufficiently to kill all the organisms. If, however, we saturate the atmosphere of any room with a mixture of steam and hot air, almost every organism is destroyed. In the same way it is possible to purify clothing and furniture. If we take a thick roll of blankets, into the centre of which spores have been previously introduced, and treat them with a mixture of hot air and steam, the steam penetrates in a short time through the blankets and kills the bacteria.

Hence the simplest way to purify our furniture and clothing is to treat them sufficiently with a mixture of steam and hot air, or with steam alone.

Time only admits of a few words being said about specific bacteria; the bacteria I have been speaking of have been chiefly ordinary bacteria—that is to say, bacteria that are incapable of feeding on living tissue. But there is another kind of bacteria I have hinted at, namely, bacteria that are capable of flourishing on the tissue of living individuals; and they are what are often called special organisms—pathogenic bacteria—because they are related to special diseases. Now the best example of pathogenic bacteria is the bacteria that sets up splenic fever. This bacterium is, when introduced into certain animals, fatal. If you take a few spores and introduce them into the skin of a mouse, in twelve or twenty hours that mouse is certain to be dead; and when the tissues of that mouse are examined they are found to be saturated with bacilli, and so certain is the relation between this bacilli and this disease that it is universally accepted as the cause of the disease. Now you naturally ask how is it that any particular bacillus or bacterium is capable of thriving, of living, on the human blood and on human tissues? It seems some bacteria have the power of feeding on the living tissue, and of waging war on the cells of the tissues. This has been described by a Russian, who, in studying some of the lower crustacea, observed a battle going on between the blood cells and bacteria. Sometimes the little bacteria attacked the blood corpuscle and defeated it; sometimes the blood corpuscle attacked and defeated the bacteria. This led to the conclusion that living cells are capable sometimes of destroying bacteria, whilst at other times the bacteria flourish, and lead to special diseases.

The relation of organisms to special diseases and the power of attenuated bacteria in preventing disease must be considered on another occasion.

In conclusion, I ought to say I am indebted to Professor Greenfield for the use of the excellent diagrams which have helped me so much in describing the various forms of bacteria.

ON SODA, SOAP, AND OTHER CLEANSING MATERIALS.

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THE employment of cleansing materials for domestic purposes has been more or less adopted since the earliest historical periods. It is true that there was not always at ready command such substances as we now employ, viz., soda, soap, and the like, but apparently there was a desire to make the most of what was available. At first, the juices of plants, as those of hyssop and soapwort, were employed for cleansing cloth, and for personal ablution; thereafter various earthy substances of a clayey and unctuous nature, such as fuller's earth, were used, and which being spread over the cloth, and rubbed or stamped in, absorbed the greasy matters, and were subsequently washed off. These were also employed in baths as cleansing substances in personal ablution. The ashes of plants also yielded, when treated with water, a ley or liquid containing potash, which was useful as a cleanser, and an exudation or efflorescence from the ground in the immediate neighbourhood of certain lakes, which yielded natron (a form of washing soda), was likewise employed in cleansing operations.

In Biblical history we read in Malachi iii. and 2, "For he is like a refiner's fire and like fuller's soap;" and in Jeremiah ii. and 22, "For though thou wash me with nitre [Revised Version, natron] and take thee much soap." It is very questionable, however, if soap at all akin to our soap was known in Old Testament times, for the word "borith," translated "soap," rather refers to wood ash ley or potash. In the Homeric description of a laundry,

written about nine hundred years before the Christian era, there is no reference to any substance resembling our soap. Pliny, however, in the first century, in his famous work on natural history, distinctly refers to the cleansing body obtained from tallow and wood ash ley, and even states that the best materials for its formation are goats' fat and the ley from the ashes of the beech tree; and such would undoubtedly be soap. Further, in the ruins of Pompeii, which was overwhelmed by the eruption of Vesuvius in the year 79, there is found a thorough equipped soap work.

Pliny says the Gauls invented the art, and that the Romans acquired it from the Gauls and introduced it into Italy. Soap factories are known to have existed in Italy and Spain in the eighth century; in France about the thirteenth century; and in Great Britain about the fourteenth century. The first English patent regarding soap was granted in 1622 to Jones & Palmer for "the misterie, arte, way, and means of makinge of hard soape," . . . and "the arte, misterie, way, and means of makinge of softe soape." The strict science of soap-making, however, was not known till 1811, when the subject was wrought out by Chevreul. In modern times the amount of soap per head of a nation may be taken as evidence of its advance in civilisation, and at the same time affords practical proof that cleanliness is next to godliness.

Now, in taking up the subject of cleansing materials, it will be necessary, before entering upon the strict question of soap, to refer to the alkalies which are present in soap, and which are required to be used along with fatty substances in the manufacture of soap. The first of these is the material known in early times as natron. This substance was obtained originally during the evaporation of the water of certain inland lakes in Egypt, Hungary, and elsewhere, and was got during the dry season as an incrustation or efflorescence on the banks and neighbouring soil. That was the original source of the material, and at the present time it is acknowledged to be still a source, though not a very considerable one, of the substance. We have certain lakes in Egypt which yield a considerable proportion of natron. There is one near Cairo, and another near Alexandria, where, during the summer months, the waters evaporate or dry up a good

deal, and the natron is obtained, and forms a regular article of commerce. But the quantity which can thus be obtained was and is comparatively small, and as soda came to be required for cleansing purposes, it was found that recourse must be had to some other source than these inland lakes, and it was found that certain plants growing in and near the sea could yield a considerable proportion of soda in their ashes. First of all we had maritime plants, principally *Salsola Soda*, growing on the shores of the Mediterranean, which were burned for the purpose of yielding an ash that was called *Barilla*, and at one time this was a great source of soda used in the formation of soap, and was exported from Spain in large quantities. Then we had in France a similar substance prepared from the ash of a maritime plant, principally *Salicornia Annuæ*, and called *Salicor*; and in our own country we had prepared on the western islands and coasts of Scotland, and on the northern and western shores of Ireland, from ordinary seaweed, a substance called *kelp*, being the half-burned ashes of seaweed. It yielded a large proportion of soda. Altogether about 25,000 tons of kelp were annually manufactured in Scotland. But taking the maritime plants growing on the shore, and those seaweeds growing in the water itself, and burning them, would now-a-days form a very inconsiderable part of the soda which is required for commercial and cleansing purposes.

Through the conduct of the Provisional Government in France at the time of the Revolution in 1789, when the introduction into France of British or Spanish soda was prohibited, a process had to be invented for the purpose of making common washing soda or natron from something else than the ashes of plants, and it was then discovered by a French chemist, Le Blanc, that if you start with common salt you can convert the salt into a body which is halfway between salt and washing soda, and then you can afterwards take that intermediate substance and by a second stage convert the material into washing soda. That process, invented by Le Blanc in France, spread itself to England in 1814, and became, and has continued to be, one of our most important technical industries. Until quite recently this process was employed in converting enormous quantities of common salt into common washing soda, and by comparatively an inexpensive pro

cess. Recently, however, it has been found that a modification of this process can be adopted, called the ammonia process, which in a cheaper way carries through the operation, so that we do not now follow the exact details of Le Blanc's process in obtaining from common salt the common washing soda which we use so largely for ordinary cleansing purposes.

So much for the first material—the natron or soda, but there is a corresponding substance which is obtained from inland plants which has also been largely used for cleansing purposes, and that is called potash. The plants are burned, and the ashes are taken and simply treated with water, and the alkali potash is extracted, so that the liquid, when evaporated, yields the crude potashes. Then the crude potashes may be purified, and you get a refined potash, or what we call pearl ash. The potashes are very largely prepared in Canada and the northern States of America. In these countries large numbers of trees require to be cut down, and the branches and twigs are piled up and burned so as to get rid of them, and the ashes thus obtained when treated with water yield potashes. But you do not require to depend upon trees for the potashes, because almost any inland plant will do. In Russia they burn up all sorts of rank grass and vegetable refuse, and from the ashes obtain potash; and in France all the clippings of the vine plant are piled together and burned; whilst in Japan they use the cuttings of the indigo plant for the same purpose, so that if you take inland plants generally and burn them, you obtain potashes from the ashes. In fact, so well known is this practice in some districts, that there is rather an amusing anecdote told about some ashes which were come upon when an ancient tomb was being opened last year in Rome. One of the workmen finding the ashes in the tomb, collected them together and sent them home to his wife, so that she might treat them with water and cleanse the family linen; and it came out afterwards that instead of the ashes being from wood, they were the cremated remains of the Emperor Galba, who had been interred there 1800 years ago. I am afraid that the good housewife did not get much cleansing potash out of these ashes.

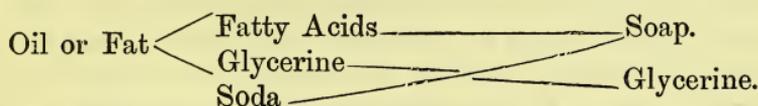
Potash is a corresponding substance to soda, and these are not only useful for cleansing purposes in their own way and by themselves, but are likewise of great use in the compounding of soaps.

Soda is employed in the preparation of the hard soaps, and potash is used in the manufacture of the soft soaps. When you take them by themselves, however, they are rather caustic for application in anything like a considerable quantity. They are rather caustic for cleansing purposes. From their caustic nature they act upon fibre pretty strongly, and also on the hands; and when strong they have also the power of altering colours, which, of course, affects their use for washing what are known as coloured articles. This can be illustrated by taking various colouring matters and adding a little of the natron or washing soda, and the colour becomes altered. The same results can be observed with potashes, so that it is not advisable in such circumstances to use for cleansing operations in anything like quantity such caustic bodies as washing soda and potash.

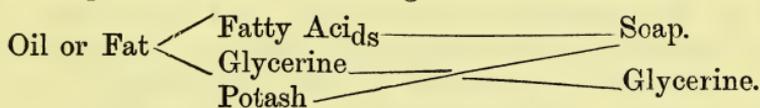
The manner in which these substances, potash and soda, are employed in the preparation of our soaps, may now be referred to. Both are dissolved in water, and are treated with caustic lime to remove carbonic acid, and the resultant liquors are known as caustic soda and caustic potash. In preparing ordinary soaps you require to incorporate these caustic alkalies—soda and potash—with certain fatty substances, and, in fact, any of the oils and fats will do for the purpose. Of course, some of the oils have a much better use than making soap. They are too expensive for that purpose, such as almond oil, which can be used for perfumery purposes, and commands a comparatively high price. Other oils are more suitable for illuminating purposes, as lamp oils. Some of the oils, too, are rather rancid and impure for making the best kinds of soap, so that in soap-making we are limited to certain oils and fats, which are found in actual commerce to be serviceable for the preparation of soap. First of all you have tallow, as obtained from ordinary suet. It is largely used in preparing ordinary soap. Then you have palm oil, which in this country is extensively employed for the purpose; and cocoa-nut oil, which is equally used to a large extent in the preparation of our soaps. Then you have olive oil, likewise used very largely on the Continent, as in France, in the preparation of soaps. So that you have tallow, palm oil, and cocoa-nut oil used in this country, in addition to the olive oil so largely employed on the Continent.

Now, it is a very simple matter to try a preliminary experiment as to the preparation of soaps. If an empty bottle be taken, and some oil be introduced, and thereafter the soda solution, by merely agitating the two, you get a kind of soapy substance produced. You get a thickish mass almost like butter, and have produced in this way an imperfectly formed soap. It is just, in fact, the first stage in the manufacture of soap. The oily substance seems to have disappeared, and an emulsion is produced, due to the combination of the fatty acids of the oily bodies with the soda employed in the experiment. The soapy substance which is thus produced is brought about by a very simple change which takes place in the fatty substances, which contain certain fatty acids in combination with a body called glycerine, and the soda combines with the fatty acids and sets free the glycerine. So that all the difference between the oil and the soap is, that in the oil you have fatty acids and glycerine, and in the soap you separate that glycerine, and get a combination of fatty acids and soda, which go to form the soap you are manufacturing. Do not fancy for a single moment that the manufacture of soap is as simple as described in the small experiment, or that you can in a minute or two prepare soap for family use. The fact is, the manufacture of soap requires prolonged boiling; and when you observe the process, stage by stage, as it goes on, you will find that the first day's operations, when they boil out the fatty substance, yields a material which is a kind of fatty soap, and where only portions of the fatty acids are combined with the soda. But then there is a second day's boiling with more soda, and that gives you a better kind of soap; and altogether you come to a third, fourth, fifth, and sixth day, and even seventh day's boiling with successive quantities of soda before the process is concluded. It requires, therefore, prolonged boiling, and you must add little by little the soda, so as to combine it with the fatty acids, and thus get quit of the glycerine by successive boilings. Now, the object of that great care is that you want a soap which will have as little as possible of the caustic nature of the soda, which, when it is employed as a cleansing material in anything like quantity, affects the fingers, and spoils the skin, and may even render the cloth rotten or tender, so that it cannot endure so much wear and tear. Therefore you see that the process of manufac-

ture of soap requires to be carried on day after day until you are sure that the soda is combined with the fatty acids, and has consequently got its raw and caustic nature very much lessened by its combination with these acids. The change which occurs when an oil or fat is converted into a soap, with soda, may be represented thus—



And when potash is used the change is—



The term soap, therefore, is specially confined to the compounds of the fatty acids of oils and fats with soda or potash. The oils and fats are themselves insoluble in water, but when soaps are formed they are soluble in water, and when used in cleansing operations the soaps assist in the processes of scouring and washing by the removal of the grease and dirt. In other words, soaps possess the power of rendering the greasy exudations of the skin and the oily matters on clothes more soluble in water, so that the grease, oil, dirt, and dust may be readily removed. This cleansing power is said to be detergent, and soaps, therefore, possess the property of detergency. Granting, therefore, that you have proceeded with your process of boiling so as to get the soap you desire to be prepared, then the next question is as to the various kinds of soap which you can thus manufacture, and as to the qualities of these various kinds of soap.

As typical of the soaps, we may take first the kind of soap known as ordinary white soap generally prepared from soda and tallow, occasionally accompanied by a little lard, and likewise palm oil which is now largely used in preparing all our soaps, and thus ultimately you arrive at this white soap. It may be stated that palm oil is a very convenient substance in its way in supplying many departments of our arts and manufactures. In the first instance, when the palm oil is obtained, it has three fatty acids in combination with glycerine, and which are suitable for three different technical

purposes. For instance, it has, like other oils and fats, a body called oleine; then it has a substance called margarine, now often spoken of as palmatine; and then a body called stearine. Our palm oil has all these present in it, and each of these consists of a fatty acid with glycerine. The palm oil can be treated so as to separate the glycerine from the fatty acids, and if the latter be subjected to pressure at an ordinary temperature, the oleic acid commonly called oleine is obtained; and such is used for cloth purposes in woollen factories in connection with the spinning of woollen yarn. If the residue is further pressed at a blood-heat, we obtain what is technically called margarine, and that is used in the preparation of our soaps; and there is left a substance technically called stearine, and which is chemically stearic acid; and such is employed in the preparation of ordinary stearine candles. So that palm oil is useful for three purposes—first, for cloth; second, for soap-making; and third, for making candles.

The materials for white soap, viz., tallow, lard and other fats, and soda, are all blended together and thoroughly boiled up in a cauldron sometimes containing thirty or forty tons, until the soda is thoroughly combined with the fatty acids. Then you require to separate the soap from the water which is still mingled with it, and that is done by throwing in plenty of common salt, and the soap floats on the surface and remains in a fluid state owing to the high temperature. That liquid is allowed to settle for some time, so as to deprive it of impurities, when it is baled out, placed in moulds, and allowed to cool; after which it is cut into large sheets by means of wires, and then these sheets are again cut into the ordinary bars of soap, which are generally about 15 inches long by $2\frac{1}{2}$ inches square.

The composition of an average sample of white soap, as thus prepared, is—

Tallow, palm oil, and lard,	60·0
Soda,	6·4
Water,	33·6
	<hr/>
	100·0

The difference between white soap and yellow soap lies in the

incorporation of a certain amount of resin or rosin with the tallow, palm oil, or other fatty substance. The resin or rosin contains acids which combine also with the soda in the soap, and tend to produce a still further quantity of soapy material. The consequence is, when you examine a sample of good yellow soap, you find incorporated in it for every three parts of true fatty matter about one part of resin. Both the fatty substance and the resin are thoroughly united with the soda so as to form the soap; and that produces the difference between white soap and the yellow soap, the latter containing a certain proportion of resin. The percentage composition of good yellow soap is as follows:—

Tallow, palm oil, and resin,	70·0
Soda,	6·5
Water,	23·5
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	100·0

Now, these may be regarded as the ordinary forms of hard soap—white soap on the one hand, and yellow soap on the other. There is not much difference in their chemistry, for you will find the amount of soda in 100 parts is about 6 in both cases, and you have the fatty and resinous substances running from 60 to 70 per cent., and which with water make up the 100 parts. The water is in larger quantity when the soap is freshly prepared, and in lesser quantity when it is kept for some time.

These constitute the ordinary varieties of hard or soda soaps; but sometimes soap is presented to you with a mottled or marbled aspect. This variety depends for its peculiar appearance, either on colouring being added to the soap afterwards, or on the hot liquid soap being agitated in the large cauldrons so as to keep the impurities from settling, and thus retain them throughout the mass. Sometimes a little oxide of iron or other substance is thrown in so as to increase the colour. The result is that you get a mottled or marbled appearance in the soap. This does not add to its cleansing properties in any way—although it cannot be said to take any away.

Now the whole object of treating oils and fats by means of soda, so as to get these converted into soaps, is to enable a sub-

stance to be formed which shall be soluble in water; which besides being thoroughly soluble in water, which of course ordinary fat is not, has left in it such an amount of soda that if the soap encounters any greasy matter it tends from the presence of the soda to remove the grease by forming a little extra soap with it; and thereafter the ordinary soap which you employ and the soap formed by the soda uniting with the greasy matter easily remove the dust and dirt from the articles they are employed in cleansing, and enable such impurities to be washed away in any water which is used for the purpose.

In alluding to these different kinds of soap, it should be mentioned that in France they prepare a large proportion of soap from olive oil and soda, which is generally known in the market under the name of Marseilles Soap or Castile Soap. This kind of soap, obtained in this way from olive oil, is not unlike our ordinary soap, and has the advantage that it is generally a hard soap. It is often sent out in cakes for toilet soap, and is a good quality of soap.

In regard to the preparation of soft soaps—such as are known under the name sometimes of black soap, and at other times are known in England as Scotch soaps, and are sometimes spoken of as economical soaps—the soft or black soaps are manufactured from fatty substances, treated with potash and not soda. These soft soaps are prepared by boiling up fatty substances, generally fish oil, such as whale, seal, and cod oils; or vegetable oils, such as hemp seed or poppy, with potash, and the whole is ladled out into casks and not into moulds, for the substance never settles or separates from the water. The soft soaps prepared in France and the Continent are generally manufactured from hemp seed oil and potash. Black soap is prepared for coarse purposes, and is practically a combination of potash along with fatty substances. The analysis of the black soap gives:—

Oils and fats,	.	.	.	.	47·0
Potash,	.	.	.	.	8·0
Water,	.	.	.	.	45·0
					<hr/>
					100·0

Nearly one half of the entire weight of the substance consists

of water, and you will observe that it must be more caustic than the other kind, for in white and yellow soaps you have only 6 parts of soda to 60 or 70 of oils and fats, so that you have ten times the amount of fatty matter to the soda; whereas if you take black soap you have 8 parts of potash to 47 parts of oils and fats, so that you have only six times the amount of fatty matter compared with the potash present. Therefore the amount of the corresponding proportion of potash is more in the case of soft soap than of the soda in the ordinary hard soaps.

There are a number of special kinds of soap—for instance, cocoa-nut oil soap. That is prepared from cocoa-nut oil by boiling it up with soda. It is more caustic than ordinary white or yellow soap. It has the advantage that it can be used with sea water; and therefore is often called marine soap; the composition of it is as follows:—

Cocoa-nut oil,	.	.	.	.	22·0
Soda,	.	.	.	.	4·5
Water,	.	.	.	.	73·5
					<hr/>
					100·0

Taking these proportions of soda and cocoa-nut oil, it will be found that the oil is only five times the amount of the soda, so that it is decidedly caustic, and can consequently be used for cleansing purposes with hard waters. There is an enormous quantity of water in cocoa-nut oil soap; it contains 73 per cent., or nearly three-quarters of its entire weight of water. It has great power of holding water, so that when you purchase cocoa-nut oil soap you purchase a good deal of water.

Some soaps are prepared and used principally for medicinal and sanitary purposes. A well-known variety is carbolic acid soap. It is prepared by taking ordinary soap and heating it, and then putting in a small proportion of carbolic acid to the extent of 2 per cent., and the result is that it has the same disinfecting properties as the carbolic acid has, besides having the cleansing properties of ordinary soap. Then, again, there are sulphur soap, tar soap, arsenical soap, and others more specially bearing on the medical department—being special kinds of soap that are not employed for domestic purposes.

In respect to toilet soaps, of which we have a very large number, these are represented very well in what is described as old Brown Windsor soap. The old Brown Windsor soap was at one time highly thought of, and is still, of course, esteemed if you can get the "old brown Windsor soap." But it got its good name and fame because it was really old Brown Windsor soap. It had been made once, and had been kept long so as to be aged, and the result of the ageing was, that any caustic soda that was in it got influenced by the air, and had its caustic properties neutralised to some extent by the carbonic acid in the air, and therefore the caustic property got overcome by age. Then it was re-melted and stirred up again, and sometimes re-melted a third time, so that you had three stages of the manufacture of the same soap, and the ultimate result was that it got soft and tender, so that if used on the most delicate skin or the youngest person, it did not in any way ruffle or harm or otherwise affect the skin. That was the way it got its good name or fame as old Brown Windsor soap.

But now-a-days we get through things so quickly, and our stocks of materials get exhausted; and I am afraid that a considerable portion of what is called Brown Windsor soap has not had much ageing or time to get aged, but is got through as quickly as possible. The colour is obtained, not from age, but from a little umber or annatto, and there is added a little cheap scent, such as nitro-benzine, and then the soap is rushed into the market and sold as Brown Windsor soap.

Then, again, we have transparent soaps. Some of these are very good; some of them are very bad. As an instance of a very good one, you may take Pears' soap, which is really first-class, and is prepared in the right way. It is practically free from causticity, and does not affect the most delicate skin. Good transparent soap is generally prepared from ordinary soap of good quality, which is taken and cut into shavings—dried to a large extent—and then treated with alcohol, which is afterwards evaporated, and in the process of evaporation transparent soap is left. There are two advantages in this treatment. The first is, that when you cut the soap into shavings, the soda, if any has been left, tends to get mild by contact with the air; and further, when you treat the material with alcohol, you still further tend

to leave all the extra soda out of the mixture. You thus get two ways of improving the quality of the substance, and the result is that you obtain a fine quality of soap suitable for the hands and face and general purposes. But just as in the case of the old Brown Windsor, these transparent soaps are not all good. Many of the transparent soaps in the market are prepared hastily from oils and fats and soda, and the transparency is imparted by the addition of sugar, sometimes as much as 25 per cent., and a little petroleum, along with some colour. The material gets a ready sale, but it is not of proper quality, and rather brings the class of transparent soaps into disfavour.

These toilet soaps are no better for cleansing purposes—removing dust and dirt and grease—than a good yellow soap is, and, so far as regards the foundation of most of them, a good yellow soap has a better foundation than most of them have. Some of these toilet soaps, indeed, are prepared quickly from rough materials, which are not of a quality so good as those contained in good common yellow soap. Then there are enormous differences in the prices. If you take the toilet soaps in cakes you will find you pay about 2s. to 4s. a lb. for the article, whereas an ordinary price to pay for the best yellow soap, suitable for all cleansing purposes, is from 3½d. to 4d. per lb.

In speaking of these toilet soaps, there is one which I must particularly direct your attention to as being markedly tender upon the most delicate skins. It was introduced into Edinburgh by my friend, Dr Allan Jamieson. It has a quality not inferior to and in some respects is even superior to the old Brown Windsor or Pears' soap. It is prepared in Germany, and is known as *Unnas ueberfettete seife*, or over-fatted soap. It contains no excess of alkali, and indeed possesses an excess of fatty matter, so that when used for very tender skins it not only cleanses the skin, but, if not rubbed off too much, leaves a fine oily coating on the skin, which prevents it from getting rough or chafed, or otherwise injured. It is of extremely fine quality, but it is too high in price. The cakes cost 8d. each, and weigh about two and a-half ounces, so that the price comes to be about 4s. per lb. For a quarter of that price we should be supplied with as good soap as this. The quality, however, is very good,

and the over-fatted soap would be well worth 1s. per lb., which would be a fair and sufficient price for the article.

Now, a word about adulterations of soap. Soap, like most substances now-a-days, must be sold at various prices, and the demand must be met for an article at low prices, as well as at ordinary prices, and such has stimulated manufacturers to supply soap at the prices at which it is asked for. Of course good pale yellow soap cannot be got under $3\frac{1}{2}$ d. or 4d. per lb. But people want soap cheaper than that, and as the raw materials cost money, something must be done to bring the soap down to the price that may be required. The result is therefore that there are a good many ways of providing for the adulteration of soap. When the soap is taken out of the cauldrons or boilers and placed in the cooling frames there is an opportunity for throwing in a quantity of water, and incorporating such into the soap as it cools, and then you get a soap which can be sold at a low price, but which contains an undue quantity of water. There is another way of pitching in a lot of washing-soda into the frames when the soap is solidifying, and the extra soda amalgamates with the soap, with the result that the soda, which costs less than a penny per lb., is sold with the soap and makes it a little cheaper. Besides that sometimes there are salts thrown in, such as sulphate of soda and chloride of sodium or common salt, so as to produce cheap soaps. Such modes of adulterating soap are not, however, followed by our leading manufacturers. I merely mention these things to indicate to you that these cheaper soaps are not to be always regarded as of the best quality or value for the money, and that when good soap is asked for and purchased, it will be found to be the cheapest in the long run.

Then again take black soap. I had a curious experience on one occasion in the Parliament House where I had to give evidence as to the quality of a particular black soap which was said to be prepared by an improved process and to be capable of being produced at about one half the price of other soaps. I examined it for the purpose of stating what it was, and I found it to consist of fatty matter and potash to a limited extent, but that a considerable proportion of it was boiled rice. So that in point of fact, it was a mixture of soap and pudding; but it spoiled both, for one could not eat the pudding because of the soap, and as for cleans-

ing operations, the pudding was practically useless for that purpose. Taking the cheap soaps, I may mention, looking to the adulterations which are liable to take place, and what must be quite apparent to you—that so far as regards the lessening of the price of the article by a halfpenny a pound, it is no economy to buy a so-called cheap soap if you find that in saving a halfpenny a pound in one shop, compared with what you would pay in another, you get a pennyworth of water or salt which you do not want, in the soap which you are purchasing, and which can be of no use as cleansing agents.

Soap powders are now very often employed for cleansing purposes. They may have their uses; but looking at them from the view of supplying an economical aid in washing clothes—for ordinary washing purposes—I cannot say much in their favour. These soap powders, as a rule, consist partly of washing soda, and partly of soap. Generally they have a larger quantity of washing soda than of soap in them, and they are, therefore, of a very much more caustic nature than soap, and the consequence is that if clothes are treated with any of them, under the impression that it is a soap powder, and, therefore, a substance similar to soap, then the colours are destroyed, and the clothing is liable to suffer from the extra causticity. Soda forms a large proportion of these soap powders, and you pay an enormous sum for them. Taking the ordinary packages of soap powders, I estimate that you pay from 6d. to 8d. per lb. for the mixture of materials. Well, the mixture consists of a large proportion of washing soda at three farthings per lb., and some soap at, say, 3½d. per lb., making for 2 lbs. of the material, provided the soda and soap were equal, about 4½d., and for 1 lb., 2¼d. In buying the soap powders, therefore, the housewife is paying 6d. or 8d. for what, if she chooses to make it up herself, she can get of the best quality at 2¼d. per lb. I do not see any economy in that.

The washing powder most largely sold in the south side of Edinburgh, and which is described on the label in high terms as being the best and cheapest composition ever discovered for washing and bleaching all kinds of linen and woollen goods, without the pernicious effects caused by soda and potash, I find contains nothing but washing soda, and it is charged a 1d. a packet—about 6d. per lb.; and any housewife can buy washing soda, in

any shop she likes, at 2 lbs. for $1\frac{1}{2}$ d., or $\frac{3}{4}$ d. per lb.; and why should she pay 6d. per lb. for the same material when it is sold in packages as washing powder? It would be much more economical to make up your washing powders for yourselves. And always do it with your eyes open. When you are working with these packages, you do not know what you are using—they are strong and caustic, and you may in time ruin the clothes which you are washing. But if you proceed cautiously, with very little soda, and with good yellow soap accompanying it, and are aware of what you are using, you can employ the best mixture made up by yourself which you find suitable for the purpose. I must except from these powders, to a considerable extent, the employment of what is known as borax powders. Borax is rather a milder form of soda than the ordinary washing soda; and when the operation of extra cleansing power is required, and beyond what you can obtain from soap, a little borax may be found beneficial in washing operations.

I have cautioned you about the use or employment of soda and potash. Potash is not so much used in this country, but in regard to soda I think it is too much employed for washing purposes. Soap, on the other hand, being a combination of fatty acids and alkali, principally soda, you have necessarily the caustic nature of the soda mollified by the presence of the fatty acids; and even in black soap, which has more causticity than white or yellow soap, you have that causticity also qualified by the fatty acids. But as sufficient alkali is left behind in soap, there is always enough power to remove grease from cloth and the surface of the person, so that there is little occasion, except where you have very hard water, to use any soda at all for the washing of clothes.

In the employment of these detergent substances for the cleansing of the body or washing of clothes, judgment must be exercised by everyone. It is true that in early times there was little necessity for precautions as to the employment of anything like large quantities of cleansing substances, because they were all expensive. In the times when potash was obtained from the ashes of plants, it was necessarily a somewhat expensive process, for they had first to get the plants, then burn them, and afterwards treat the ashes which were ob-

tained from them. Of course wood was being burned often at any rate for cooking and heating purposes, and the ashes were in limited quantity, but still sufficient to supply material for the family washing. But the quantity made at any time must have been comparatively little, so that there was no necessity for recommending caution in dealing with those substances.

Now-a-days soda, however, can be had so extremely cheap that in regard to the employment of it a caution has to be given, not only in respect to the soda itself, but in regard to the undue use of large quantities of soap. In the washing of clothes the less of the caustic properties used the better, both in soda and potash, alike for the colour of the cloth and the strength of the fabric. Much soda undoubtedly renders cotton and linen very tender, and necessitates undue wear and tear. The action of soda on woollen articles is more decided than even on cotton and linen. When woollen articles are treated with much soda they get hardened, the finer fibres get eaten away, and they become discoloured, and gradually they get extremely tender and break to pieces. Woollen articles that have been treated with large quantities of soda are rendered short in the fibre, so that they are readily broken away. On one occasion I employed this property of soda in a useful way. There was a large quantity of new blankets sent to one of our hospitals, which, when given out, were said by the patients not to be so warm as the old blankets were, and that led to an investigation as to whether the blankets were genuine or not. They looked well, and weighed properly, and I got a blanket sent to me for examination and analysis. We found soon that there was cotton mixed with the wool, and the question was as to separating the two, because they were thoroughly woven throughout, and it was only by detaching the fine fibres from each other that you identified the cotton fibre. I fell on the device of using soda. I took a bit of blanket and put it in a vessel with soda, and boiled it there, and very quickly the wool got eaten away by the soda, and there was left behind the cotton as a kind of skeleton—a sort of ghost—of the original blanket out of which it was taken. I mention this merely to indicate to you the pernicious effects of using caustic materials which, when employed strong, by themselves affect woollen articles in this way, and which even when not very

strong will more slowly, but with equal certainty, tend to destroy the woollen fibre.

I need only speak shortly about the employment of bleaching materials in the washing and cleansing of clothes. If people are lazy, they can easily, by the aid of bleaching powder, clean or bleach clothes without much rubbing and scrubbing in the process; but these bleaching substances as a rule are very pernicious to clothes. The use of bleaching powder, even on a small scale, will destroy colours; and besides that, it attacks the fibre of the cloth and makes it very tender. It affects the cloth in two ways—first in the colour, and then in the fibre.

In concluding my remarks, I should like to sum up the main points in the following observations:—

First, use all ordinary cleansing materials—soda and soap—in moderation, alike to save waste of substance and save injury to hands and articles. Avoid the use of all kinds of washing powders of the composition of which you know nothing, and which are often expensive, as well as caustic and destructive.

Second, for washing kitchen tables, chairs, and floors, and all plain woodwork, use a little soda or black soap, and scrub well. All grease stains and spots will be readily removed, and the dirt and dust will wash away.

Third, for better furniture and painted woodwork employ no soda, but use very sparingly good yellow soap and wash well off, when any oily or greasy film will be removed along with the dirt and dust.

Fourth, for ordinary cotton and linen clothing be very sparing of soda—use little or none—but employ good yellow soap in moderation, and depend upon active exercise of the hands and fingers for the cleansing process.

Fifth, for kitchen cloths and other greasy articles of coarse texture, some soda may be used, but ordinary black soap will be found fully as serviceable, and will be less destructive to the cloth and the fingers.

Sixth, for woollen clothing and blankets use no soda, but employ sparingly good yellow soap in lather with tepid water, and be careful to wash the soapy liquor well out of the wool.

Seventh, for personal washing of hands, face, and body, use good, plain yellow soap, or white curd soap, but be sparing in its

quantity, and depend largely on the friction of the hands for the removal of the grease, scurf, and dust from the skin.

Remember always that an excessive use of soda and soap in ordinary house cleaning work and in family washing operations leads to destruction more or less quickly of paintwork, and to the undue tear and wear of clothing, sheeting, &c. ; and that the immoderate employment of soap in the washing of the person leads to the soap being imperfectly removed, so that the pores of the skin get clogged up, and healthy skin secretion cannot go on.

Accept and use all cleansing materials—soda and soap—as aids to and not substitutes for scrubbing and rubbing. Never shirk what is popularly known as “elbow grease.”

Employ these aids in moderation with plenty of friction, and clothing, sheeting, and towelling will be all the better cleaned, and will be all the longer preserved for family use.

Use soap equally in moderation for personal washing, and exercise the hands freely, so that the skin may retain its natural, healthy, secretive power, which is so conducive to good health.

Such moderate and sensible use of cleansing materials will do much to ensure that we and those dependent upon us are clean in person and in dress, and that our homes are wholesome and healthy abodes.

HEADACHES.

By G. A. GIBSON, M.D.

“I pray God that our hedes never ake.”—CHAUCER.

THESE words, drawn from “the pure well of English undefiled,” may serve as a text for my remarks this evening. They prove that the father of our literature stood in wholesome dread of an aching head, and may be taken as evidence that the author of five hundred years ago was not exempt from the ailments of his followers. The brain-worker, in truth, has at all times been more liable to headache than other men, and we find that one of Chaucer’s successors, Pope, writes feelingly of being

“ at some dear idle time,
Not plagued with headaches or the want of rhyme.”

Headaches have been known since the dawn of history, and although I have mentioned the brain-worker as their greatest victim, he cannot be regarded as being by any means the only sufferer. The young and the old, the rich and the poor, are alike in their liability to them.

“ From the cruel headache
Riches do not preserve,”

says Sidney, and we are forced to recognise the fact that no civilised race escapes—no station is above a headache.

Our subject, however, appears to have a growing importance, inasmuch as headaches and allied nervous troubles are increasing in number. Not that there is any increase in the number of severe nervous diseases—that is not my meaning; but there can

be no doubt that in our day we are of a more nervous type than our forefathers were. Our modern habits of life make us much more sensitive to every impression. Contrast the state of primitive races with that of civilised nations. The dusky savage, spread out at ease with his feet in the sunshine, and his head in the shade of the friendly palm which affords him shelter, clothes, and food, rarely suffers from any nervous symptom until the trader has made him acquainted with the doubtful blessings of rum and tobacco. With the European the whole aspect of life is different. The complex relations of modern society, the restless bustle of the city, the exhausting effects of late hours, the continuous tension caused by new means of communication—these and many attendant circumstances reduce the leisure necessary for the restoration of body and mind after the wear and tear of daily life. Even the division of labour, which is regarded as of such advantage in assisting our modern methods of work, may tend to make men more susceptible to nervous affections, for, by narrowing their lives and lessening their interests, it naturally makes them one-sided, and therefore imperfect.

The art of medicine itself has done something to increase the tendency to such troubles. Modern preventive methods have gently fanned and brought to its full glow the smouldering flame of many a weakly life that in sterner times, after flickering for a brief space, would have gone out before the strong gusts of a ruder atmosphere. As such feeble lives in their turn give rise to other feeble lives, medicine tends to produce individuals of a less robust type.

We are more considerate in our treatment of the weak now than our ancestors were, and possibly we may in this way over-estimate the increased tendency to nervous symptoms. Formerly, many affections were included in a vague group of maladies termed "the vapours." It is somewhat difficult to define this arbitrary class, and to fix with exactitude the meaning of the phrase; but it may be said that several diseases, now carefully treated on rational principles, were regarded as the products of a flighty imagination.

Before plunging into the subject of this lecture I should like to say a few words on pain in general. Pain is a subjective sensation, that is to say, a state of consciousness produced by irritation of some sensory nerve. Sometimes the mind correctly

interprets the message sent by the nerves to the brain, sometimes it does not. You all know the effects of pressure upon the inside of the elbow, that part which is called the "funny bone." The pressure upon the elbow is felt, but besides that there is a tingling in some of the fingers, although they have not been touched. This feeling is caused by the habit of the brain to translate irritation of a nerve as being irritation of the ends of it, and when you irritate the large nerve which lies on the inside of the elbow the brain reads that irritation as if it were applied to the fingers. Whether localised rightly or wrongly these subjective sensations are of importance. There ought to be no subjective sensations, and in health there are none. Their presence shows that something is going wrong. Do not therefore consider pain as altogether an evil. It has important uses. It is to be regarded, in the same way as you regard the red light on the railway, as a signal of danger. But having called attention to the fact that there is danger, the signal has done its duty, and is dropped whenever the line is clear; in the same way, when pain has shown the need for rest and repose it has fulfilled its part, it must be got rid of, as it is after this only an evil. In our times no one ventures to uphold the view that pain is a necessary discipline from whose useful correction it were sinful to seek relief. Not very long ago a chorus of disapprobation, to put it mildly, was raised over the employment of anæsthetics for the relief of suffering womankind, because, forsooth, the beneficent drugs appeared to some superstitious minds as an infringement of an old world curse. Happily such ideas are now only relics of an almost forgotten past; and, although we clearly recognise that men and women are made "perfect through suffering," we do not admit that unnecessary suffering is to be regarded as a means of good.

In taking up our subject, it will be necessary to glance briefly at the structure of the head, in order to form some conception of the parts involved. It will then be our duty to ascertain the cause of the pain, along with the other symptoms which accompany it. And lastly, it will fall to us to consider the means of alleviating the suffering which is caused. With regard to this last aspect of the subject, I conceive that I shall best perform my duty by pointing out how to avoid, rather than how to cure headaches. At the present day the highest aim of the healing

art is to prevent disease by striking at its causes. These are manifold, but we may say with truth that most maladies are direct or indirect results of the neglect or defiance of the Laws of Nature. It cannot be too widely known that life can only be lived well when these laws are followed. "The Reign of Law" must be respected here as well as in every other division of the realm of Nature.

With primitive races an illness, like any other interruption of the regularity of natural phenomena, is, as a rule, attributed to the operations of some malevolent power. The Maories of New Zealand, for instance, have, or had, a special devil named Tonga, whose malign influence was held responsible for any headache that might occur. With such theories on the subject of the causes of disease, it is no wonder that the magician was called in to exorcise the fiend, and drive away the disease.

In the middle ages, when the various saints of the calendar were worshipped as minor deities, the belt of St Guthlac was believed to be a sovereign remedy for headache.

Even in comparatively modern times strange customs, based on superstitious beliefs, have been current. To cure headache, a snuff made by powdering dry moss which had grown on a human skull was at one time employed. The discarded skin of a snake was bound around the head in obstinate cases. But even this strange method of relieving an aching head is a refined mode of attacking the disease compared with the employment, in the same way, of a halter with which some one has been hanged. Binding such objects round the head probably originated in the fact that headache is often temporarily benefited by tying a handkerchief or towel about the head. This has for ages been done; and you will remember that Shakespeare makes Arthur, in the pathetic scene where he is pleading for his eyesight, say to Hubert—

"When your head did but ache,
I knit my handkercher about your brows."

To return to the subject from which I have wandered, I would only add, that headaches may best be avoided by leading, in its widest sense, a healthy life. Regular hours of work and rest, attention to diet and clothing—these, and all the other matters

understood under the term hygiene, must have their due share of attention. Celsus, whom I may call a fashionable physician of the Augustan age, for he flourished in Rome during the first century, remarks that "he who is daily occupied, whether with private or public affairs, should set apart some part of his time for the care of his health." This maxim is applicable to everyone, no matter in what station he may be placed.

The head is beautifully adapted to afford shelter to the central nervous system, and to bring the organs of special sense, to wit, the eye, the ear, the nose, the tongue, into intimate relationship with it. When taking a rapid survey of the anatomy of the head, I shall ask your attention especially to one important subject—the relation of the different structures, seen in Fig. 1, to sensibility and sensation; that is to say, we must distinguish those parts in which pain may be felt from those which are not sensitive.

The skin and the loose textures beneath it are abundantly supplied with nerves of sensation which are prone to every kind of neuralgic pain.

In the few muscles of the scalp nerves of sensation are present, and in rheumatic conditions these muscles can be the seat of pain.

The skull or bony framework contains some nervous filaments, but it is not particularly sensitive except when there is some inflammatory affection.

The membranes, which line the cavity of the skull and provide coverings of exquisite delicacy for the brain, may be spoken of collectively, although strictly they are three in number. Here there are numerous branches of the chief nerve of sensation belonging to the head and face, and it is not to be wondered at that in affections of these membranes there is excruciating pain.

Lastly, we have to consider the brain itself, composed of cells that generate or modify nervous energy, and fibres that conduct it. It is not of course my province to enter upon a description of this organ, but there are two points which I wish to impress upon you. One of these points is that although the brain is the seat of the perception of all sensations, it is throughout most of its extent absolutely devoid of sensibility itself. It certainly seems paradoxical, but it is a fact. That the brain, capable as it

is of translating the irritation of a distant nerve into the sensation of pain, and localizing that sensation in the region irritated, should be incapable of feeling any direct irritation applied to itself is at first sight surprising. The brain can be cut away slice by slice, or torn to pieces almost down to the beginning of the spinal cord, without producing the least symptom of pain in animals. This fact alone would not carry

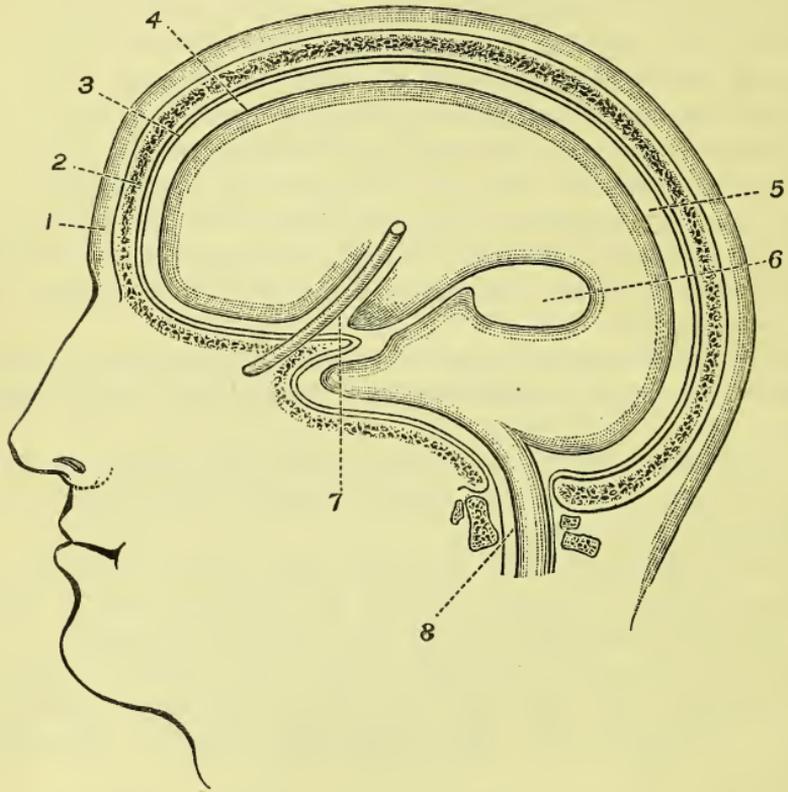


FIG. 1.—Diagram of the relations of the brain and its envelopes. 1. The skin and subcutaneous tissues. 2. The skull. 3. The membranes. 4. The brain. 5. The space surrounding the brain, communicating with—6. That inside the brain; 7. That around a blood-vessel; and 8. That of the spinal canal.

so much weight with us in itself, for, as Dr Ferrier says, "Frog and pigeon physiology has too often been the bane of clinical medicine," but it is supported by the evidence of disease. In man tumours as large as a duck's egg have been found after death in the brain, where there has not been the least symptom of dis-

ease during life. We must therefore conclude that the brain, although registering sensations from other parts, is not capable of feeling. It is, however, quite possible that it may become sensitive when it is diseased. The nerves of the stomach, as a rule, send no messages to the brain, unless food has been too long withheld or is taken in too large a quantity, but in certain conditions they give rise to most agonising sensations. The same may be the case with the brain.

I wish also to call your attention to the conditions of the circulation in the brain. The brain receives a relatively large amount of blood, and for this large blood supply special arrangements are provided. You can easily imagine that the total contents of an unyielding box like the skull cannot vary in amount. Without some special provision there could be no variation in the quantity of the blood. But no mental process occurs without some increase in the stream of blood through the brain. Some years ago I used frequently to see a gentleman who gave in his own person an excellent proof of this statement. When a boy he had received a kick from his pony upon his forehead, which shattered the skull in that region. Under the care of his medical man in the country, aided by the counsel of our own Syme, he recovered, but with a permanent opening in the skull—an opening only filled up by the skin and soft parts beneath it. The opening was shown by a hollow on the brow, and this depression exhibited a rise and fall accompanying the flow and ebb of the blood. When he was at rest the movement was uniform and regular, not very conspicuous, but quite sufficiently distinct to allow the number of pulsations to be counted. When, on the other hand, he was engaged in any mental process, the movement became much more striking. He was a business man, and apt at figures, so as a good test I was in the habit of asking him to work out problems in what schoolboys call mental arithmetic. When he multiplied 79 by 97, or performed any similar piece of arithmetical gymnastics, the depression was instantly replaced by a swelling, which exhibited the same rise and fall as the hollow. Taking advantage of the graphic method of registering movements, I obtained several tracings from the opening by placing a lever over it which marked the vibrations upon a sheet of paper spread upon a revolving cylinder. These tracings are represented here, and

you will be able at a glance to observe how the lever rose on the mental operation, as shown in the upper curve of Fig. 2.

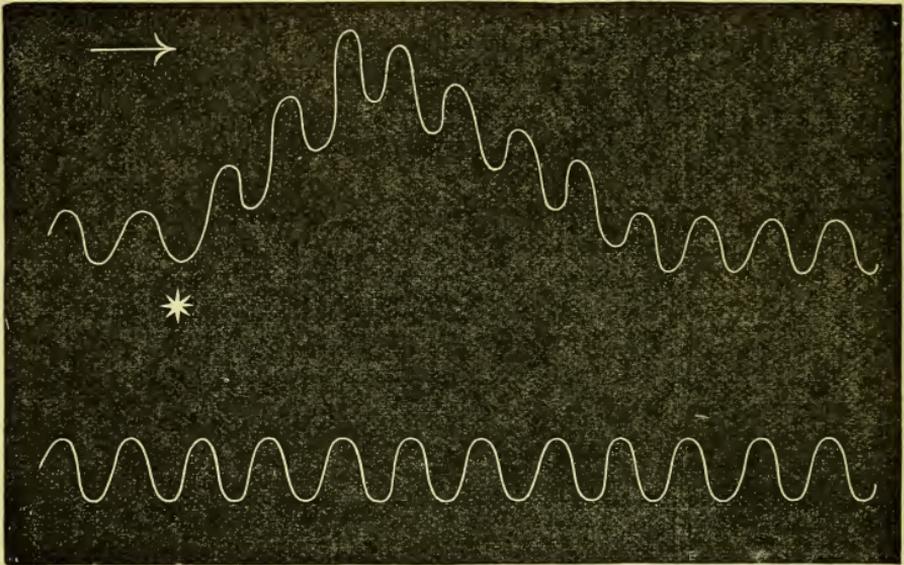


FIG. 2.—Tracings taken from an opening in the skull communicating with the brain. They are to be read from left to right in the direction shown by the arrow. The lower curve gives the movements when the patient was at rest. The upper curve was taken when the mind was occupied,—the asterisk marking the commencement of mental activity.

The alterations in the quantity of the blood are allowed by a beautiful arrangement whereby an increase or decrease is provided for. Around the brain and inside of it are spaces communicating with each other, and with the spinal column. All these are full of fluid, which can freely pass from one to another—not only so, but the blood-vessels of the brain are surrounded by spaces also full of the same fluid in free communication with that already mentioned (see Fig. 1). In this way is permitted the influx of blood which is caused by any excitement of the mental processes, and similarly the diminution which occurs in sleep as a consequence of the exhaustion of the nervous centres. In the one case the fluid which I have mentioned is replaced by blood, in the other it takes the place of the blood.

These introductory observations will enable us, with a fair prospect of mutual understanding, to enter upon the special subject which has brought us together.

Let me mention briefly how headaches may be classified. For

our present purpose the simplest arrangement will be to place them in three main divisions according to their causes. These are—(1) Changes in the blood; (2) Variations of the circulation; and (3) Alterations of the nervous system.

We shall in the first place consider the headaches which have their origin in various modifications of the blood. Such changes in the condition of the blood induce an irritable state of the nervous system. It has been well said by Romberg that "pain is the prayer of the nerve for healthy blood." As the headquarters of the nervous system, you will easily understand how the head is liable to pain, but from what I have told you regarding the relative sensibility of its different structures you will also easily understand how very difficult it is to give a satisfactory explanation of the exact mode of production.

As types of headaches depending on blood changes, I may mention in passing, but cannot dwell on, those which are invariably present in such fevers as typhus, typhoid, and scarlatina. In all such diseases the pain, which is situated over the brow, is due to the specific poison circulating in the blood, and it is usually present before the feverish symptoms show themselves. I need not detain you by saying another word on the subject, but before leaving it I would seize the opportunity to entreat you most earnestly to remember that all these fevers are preventable diseases. Some years ago Mr Chiene brought before you the enormous cost entailed by these unnecessary diseases. Much has been done to stamp them out, but much yet remains to be done.

Two varieties of headache caused by certain constitutional blood taints must be mentioned—I refer to the gouty and rheumatic headaches.

The gouty headache, usually confined to the front of the head, is said by a respectable author to be "due to the same causes that usually give rise to the gout itself—over-feeding and laziness." But this is rather hard on those who inherit a predisposition to the affection in its irregular form, and who are for the most part amongst the most abstemious of men. It is chiefly amongst the sufferers from hereditary gout that the headache over the front of the head is found. This form of headache is very frequently accompanied by a painful sensation of pressure on the eyes, which

is probably caused by over-filling of the blood-vessels, and sometimes also by a darting neuralgic pain on the brow in the situation affected by tic. These troublesome symptoms, which are greatly on the increase, are more or less associated with gouty dyspepsia, or gouty skin affections, or some other manifestation of this most protean disease. I cannot, of course, enter upon the question of treatment—to do so would be to launch out into a treatise on gout itself; but I may suggest that the application of heat locally, in the form of hot water, gives great relief. The treatment, however, is simply that of the constitutional state, and each case will require its own special lines of treatment.

The rheumatic headache, which is vastly common in this country, has its position somewhat widely extended over a large area of the brow, the temples, or the back of the head. It is a muscular pain of a dull aching character, and the painful parts are always tender to pressure and worse at night. It is often induced by a damp atmosphere or a draught of cold air. For its relief is required the treatment of the rheumatic tendency, with careful regulation of the diet and clothing. Cold water in this condition is only to be applied to the head with caution.

We have amongst us a good many every-day causes of headache depending on digestion. One very fertile source is over-eating. The headache which follows indiscretion in eating is partly caused by the changes in the blood, but partly also, as will be mentioned later on, by the nervous influence transmitted from the outraged digestive organs. There is usually severe pain over the front of the head, with a general sense of fulness in it, the eyes are heavy and the sight is often dim, the extremities are cold, and there is usually nausea, with a foul tongue and heavy breath. Vomiting is common, and may be so severe as to produce exhaustion, followed by sleep and recovery. Such a headache may be in part the result of exhaustion. If the system is worn out, the digestive organs are in consequence unable to digest the wonted food. In such a case it is not the fault but the misfortune of the patient, and what is wanted is an improvement in the general condition. But on the other hand it may be due to a culpable want of self-control in the matter of food, and every class and rank of society have examples of this weakness. The remedy naturally lies in the hands of everyone, for it is easy to avoid excess.

Among the innumerable wise utterances of our well-beloved fellow-townsmen, Professor Blackie, are what I may call his maxims on dining. He stated some time ago that he found a dinner party to be a most excellent field for the exercise of the grace of self-denial. I cannot at this moment remember whether he laid down the rule that every second or every third dish ought to be passed, but it was one or other, and probably he may have allowed it to vary with circumstances.

There are many persons, belonging of course to my own selfish sex, who persist in gorging themselves with unvarying regularity, and yet manage by the aid of what are called "dinner pills" to escape retribution for a longer or shorter period; sooner or later, however, the process comes to an end, and, after more or less of penance in one form or another, the sinner has to betake himself to a different life as regards diet. Such men seem to think that after a long course of self-indulgence, the doctor can wipe away all the effects of their past errors, but it cannot be too widely known that there is no such thing as medical absolution.

There is also the headache produced by the abuse of alcohol, which I shall have to make some remarks upon, although I can hardly deem it a necessary subject to bring before the Health Society. Fortunately, while the population of this island is increasing, the consumption of alcohol is diminishing; medical men, nevertheless, are still not infrequently witnesses of the effect of the abuse of strong drinks. A man who has produced the after effects of indulgence of this kind, suffers from a dull headache over the forehead, throbbing over the temples, giddiness, nausea, and, as a rule, vomiting. He is sick in body and mind; he evinces a preference for solitude, and expresses a desire for soda-water, usually with a little brandy in it, "just to take the chill off;" he has very commonly some plausible story about a lobster or a cucumber, to which his doctor, waiting for a more convenient season, and disliking to hit a man when he is down, listens with a grave professional scepticism, and leaves the patient for the nonce to a melancholy chuckle over the supposed success of his inventive powers. As to the prevention of this kind of headache I think I may say nothing.

There is a point to which I may briefly invite your attention before leaving the question of the abuse of alcohol. It has been

stated that different kinds of spirit seem to affect different parts of that region of the nervous system concerned with the upright position. Good wine or beer is said to cause a man to fall on his side, whiskey, and more especially Irish whiskey, on his face, and cider or perry on his back. If this be so it may be possible to tell from the position of the misguided being what he has been drinking. But what I wish to say especially is that if different kinds of spirit affect different parts of the brain, the pain which follows ought perhaps to be found also in different spots. My own observations will not furnish any facts bearing on this question.

One other matter before I leave this part of our subject. There is a custom, very common, I believe, in Edinburgh, of allowing the workmen in the breweries to drink beer rather freely. I find that the men have been served before they go home to breakfast, before they go home to dinner, before they go home to tea, in addition to another quantum in the middle of the forenoon, and sometimes again in the afternoon. The amount given each time is technically called a "horn," and enquiry regarding the equivalent of this in imperial measure elicits the fact that it is "about a pint." The pint is probably like the Highlander's "mile and a bittock;" and when you consider that the beer served out is what brewers call "returns," and, further, that it is taken on an empty stomach, you will not be surprised when I tell you that those of us who have performed the medical duties of the dispensaries of this city, have had frequent and painful opportunities of studying the evil effects of this baneful system. I would say no hard words about anyone who brews good honest beer, but I wish most distinctly to protest against those who give a kind of alcoholic hog's wash to their men. Let them run this refuse into its proper place—the gutter; let them, if they like, give their men a glass of decent beer when their work is over for the day; but let them grant slightly higher wages to those who decline to take it; and they will do much to improve the condition of their workmen.

To return from this digression. There are headaches commonly called bilious, which are more especially found in those who have lived in the east. The situation of this headache is usually over the brows, the tongue is dirty, the breath foul, the skin sallow, and the eyes yellowish; and with these symptoms there is con-

stipation, with pain in the right side and shoulder, which is attributed to the liver. The temper is irritable, the spirits are depressed, the dreams are frightful.

The common cause of this condition is the use of food which is too stimulating, and the habit of taking "pegs." A "peg" is composed of a bottle of potash or soda water with a quantity of brandy in it, varying in amount according to circumstances. The combination is popularly said to receive its name from the fact that each dose of the mixture is likened unto a peg in the coffin of him who takes it; it is not surprising, therefore, that it leads to the use of such compounds as "corpse-revivers," and drinks known under other euphonious terms. Although relatively more common in warmer climates, this condition is frequent in this country, for the "peg" of India has its analogue in the "nip" of Scotland. The means of prevention need not be referred to.

Among the headaches of perfectly innocent indigestion, I may refer to some mentioned by Dr Lauder Brunton, all of which I believe to be produced more through the blood than through the nervous system. He describes the headache of constipation, which is always over the forehead, as being invariably relieved by saline purgatives. He further mentions headaches of indigestion without constipation, pointing out that there is one form, found just above the eyebrows, curable by acids; and another, just below the hairy scalp, curable by alkalis. These facts are simply drawn from experience, and no explanation is offered of them.

Also to be included amongst the headaches caused by noxious substances circulating in the blood, are those due to bad air. The simplest cause of such headaches is imperfect ventilation, by which too much carbonic acid is present in the air. The natural proportion of this gas in the atmosphere varies from three or four to nine or ten parts in ten thousand, but in churches, when a popular preacher is in the pulpit, or theatres, when a "star" occupies the boards, and many other resorts of mankind, the air is so polluted with respiration and gas-light, that the proportion is much higher. Even a small excess above the natural amount produces bad effects on the system by interfering with the purification of the blood in the lungs, about which Dr Graham Brown will speak in this place next week. By this means vitiated

blood is sent to the nervous system, and the result is a dull heavy pain over the brows and forehead, with languor and lassitude, or even prostration of physical and mental powers. These symptoms sometimes persist for some time after an escape has been made from the poisonous atmosphere.

Many of the squalid homes of the very poor in our midst are in the highest degree unhealthy from this cause. It would be a relief to give vent to strong feelings on this subject by saying some bitter things about the owners of such dens, and a pleasure to mention the philanthropic labours of others who are endeavouring to provide better abodes for these poor people. I shall, however, on this occasion forbear, merely remarking that in many instances the very dilapidation itself, into which such houses have fallen, may be the salvation of the inmates, for it provides ventilation of a kind through the cracks and crannies.

Another and more serious source of danger in the air, is the presence of sewer-gas. In old houses the waste and soil pipes are usually combined in one single tube, which commonly runs inside the walls. When such pipes have become corroded and leaky, the gases pass from them into the house. In all modern houses of good construction the waste and soil pipes are kept separate, and they are placed outside the walls, with careful arrangements for trapping and ventilation. But there are houses of another kind, run up, not for the unwary inhabitant to live *in*, but for the "jerry builder" to live *by*. In such houses we often find that the inmates suffer from headaches resembling those caused by defective ventilation, from low forms of sore throat, and from troublesome inflammations of any wounds that may happen to be present.

When the medical man endeavours to discover the cause of these symptoms, he finds many different examples of dishonest invention. There may be, for example, such a piece of perverted ingenuity as a pipe from the house leading to nowhere, and another pipe at the sewer coming from the same indefinite region. Or the fixed basin, which the inhabitant finds to be such a convenience in his bedroom, may be destitute of the bend which should prevent the escape of gases from the pipe, and thus it acts as a most efficient conductor of these gases to the room in which the unconscious sleeper passes a third part of his life. Instances

of such grim practical jokes might be multiplied indefinitely. It is not part of my instructions, however, to dilate on sanitary engineering, but I wish, nevertheless, to remark before leaving this aspect of the subject that the rascally tricksters, who thus imperil the lives of their fellowmen, should be convicted of culpable homicide, if not of murder, in such instances as have led to fatal results.

Lastly, among headaches having their origin in a changed condition of the blood, let me refer to those caused by simple impoverishment. You all know that when a plant is deprived of light and air it loses the healthy green of its leaves. In the same way human beings become blanched under similar circumstances. This occurs chiefly amongst the female workers of our large cities, and they suffer very frequently from headaches in consequence. These are almost invariably situated at the top of the head, and are attended by a beating or hammering sensation, while the patient is pale, with bloodless lips, dark circles round the eyes, palpitation, breathlessness, and swelling of the ankles. The means of cure are the use of iron, with good food, fresh air and sunlight, and such headaches can be prevented by attention to the three latter factors. Workrooms in addition to being carefully ventilated, should have plenty of light from the sun.

The second division of headaches must now occupy our attention. You will remember that it includes those which are caused by changes in the circulation, that is by variations in the amount of the blood flowing through the nervous tissues. That variations are possible, is of course clear to you after my remarks on the arrangements of the circulation in the brain. The fluid to which I referred offers the means of adjusting the quantity of blood, acting as a safety-valve when there is an increase, and supplying the place of the blood when it is lessened in amount.

But notwithstanding this beautiful arrangement, alterations in the quantity of the blood cause pain, probably through the nervous supply to the membranes of the brain.

Let me refer once more to the gentleman with the opening in the skull. I invariably found when I exerted any pressure upon the opening that he suffered from a diffuse pain over the entire head. This may be regarded as analogous to increase of pressure through the circulation.

The blood may be increased in the head in over-filling of the

circulation as a whole—the state known as plethora, which is not nearly so common now as it used to be. In this condition there are frequent headaches attended by fulness of the head, sleeplessness, giddiness, singing in the ears, and mistiness of sight. In those who are below middle age the pain is usually situated over the forehead, and is of a tearing character; while in elderly people the position is at the back of the head, and the feeling is throbbing in its type. The pain is always increased by any stimulus, such as light or sound; even thinking adds to the suffering. Saline aperients, with low diet and abstinence from every kind of excitement, are specially called for if such an attack has come on, while careful regulation of food, drink, work, and rest must be insisted on as means of prevention. Sometimes in this condition there is bleeding from the nose. It is not to be stopped.

Again, from some cause acting locally, such as work or worry, there may be an increase of blood in the head without any general increase throughout the body. The head symptoms in this condition are almost the same as those above mentioned, but the general state of the patient is entirely different. Instead of a hale, hearty man, with ruddy visage and well nourished frame, there is an individual of the Cassius type, and to the medical observer the differences as regards the circulation can be accurately gauged by the pulse. This condition is very nearly allied to that produced by exhaustion, which will be looked into immediately, and the treatment may be summed up in one word—rest.

These conditions are what are called active congestions.

In consequence of diseases of organs elsewhere there are sometimes headaches caused by pressure of the blood upon the nervous organs of the head. I cannot enter upon this subject, as it is a matter for the patient and his physician, but I may mention that headaches sometimes, though not very often, depend on affections of the heart or kidneys.

Very frequently a cough produces headache. The cough, which is simply an exaggerated and modified form of breathing, increases the pressure upon the great veins which bring the blood back to the heart; this increase of pressure prevents the return of the impure blood from the head, while the heart continues to pump blood thereto, and the result is a rise of pressure. With each fit of coughing there is a fulness of the blood-vessels of the

head and neck, with flushing of the face, lividity of the lips, and suffusion of the eyes as symptoms of what is passing inside. With these appearances there is a sharp pain through the head accompanying each attack of the cough.

These conditions are termed passive congestions.

Then, on the other hand, from severe losses of blood there may be a diminution of the quantity of the blood circulating in the body as a whole, for the vessels can contract and accommodate themselves to the smaller amount; in this way less circulates through the nerve centres. The headaches produced in this manner, by want of proper nourishment, are dull, constant, and diffuse, with giddiness and faintness. They can only be relieved by improving the general condition.

The headaches belonging to the third group are the result of changes in the nervous system. No doubt there are often disturbances of the circulation, and sometimes alterations of the blood, along with perversions of the digestive and nutritive processes, the nervous change, however, is the primary cause of the headaches placed in this division.

There are many headaches which are simply caused by exhaustion, and as types of these I may mention that which is left as a symptom of nervous depression after such an acute disease as typhoid fever, or that which follows the fatigue consequent upon long continued cough.

Mental work and business worry, if not relieved by some recreation, are apt to induce, as one of the symptoms of nervous exhaustion, a general headache. The fair sex is not exempt from headaches of this kind, at least those who have household duties to look after, for there is, so far as I am capable of judging, at least as much worry in looking after the details of domestic expenditure as there is in the struggle to provide for it. Even children at school suffer from headaches of this nature. A good deal has been heard during the last two or three years about over-pressure in schools, and a great deal of what has been heard has been absurd; there is nevertheless a germ of truth in it, and Dr Batty Tuke has put the matter in its proper light in a lecture delivered before you. We must never overlook the fact that there is no equality in the matter of mental endowment. Brains, like men, naturally fall into classes. The intellect varies greatly even among the children of the same

parents, and what is mere play to one may be a severe task to another. Even when the brain is in every respect satisfactory in itself, it may be rendered useless by deficiency of physical strength. Herbert Spencer says—"The best brain is found of little service if there be not enough vital energy to work it." Regular work for the brain, even in tender years, is good, provided that there are periods of repose, and that the organism, as a whole, is healthy. If the work be injudiciously arranged, or the system be feeble, headaches and languor, loss of appetite and arrest of nutrition herald a general breakdown. In this way exhaustion, as the result of over work, absolute or relative, may be the cause of headache.

But exhaustion may be induced by misdirected activity. Take the case of the young lady who wastes her energies in a series of fashionable engagements. What a prodigious expenditure of activity there is in a modern ball-room! There is a loss of energy in the form of heat from the exposed bust and arms, in addition to the loss through muscular action. Add to this that every movement is hampered by the arts of the dressmaker and shoemaker. A waist which would be in perfect symmetry at 24 inches, is reduced by misguided ingenuity to 18; while the bootmaker attempts to improve upon a comely foot by placing a high heel below the middle of the instep. Consider also that the whirl of excitement begins when most of us are thinking of going to bed; that our young lady, with the endurance of her sex, will sail onwards through the mazy throng until her partner is ready to drop with fatigue, or giddiness, or both, and you will not wonder that she is tired, and has a headache next morning.

The common feature of all these headaches which result from exhaustion, is that they are not distinctly confined to any special part of the head, but have a diffuse and general situation, that they are attended by sleeplessness, irritability, despondency, languor, and debility.

It cannot be too strongly impressed upon everyone that the true remedy for such headaches is rest,—rest if an attack has come on or is impending, and careful regulation of the habits for the future. There must be for those who are bearing the burden and heat of the day in life's battle a careful and systematic arrangement of work and rest, the repose which is best for most of us being a change of occupation.

Habits are only to be acquired in youth, when the organism is easily moulded, and methodical regulation of work and play must at that age be insisted on. Mental and physical health in maturity can only be attained by careful training in early years, and therefore those who have the care of the young should pay scrupulous attention to the education of the body as well as of the mind. "People are beginning to see," Spencer says, "that the first requisite for success in life is to be a good animal." The capabilities of body and mind must be gauged. By judicious arrangement of work and play and sleep, as well as food and clothes and housing, these should be developed to the utmost. With boys education is now a fairly satisfactory process, and efforts are diligently made to find out the inborn tendencies of each. Even in the "good old days," as they are called, some attempt was made to place each son in that position in life for which he seemed best fitted. The brightest youth, for instance, was sent to study law, and the dullest blockhead was destined for the church. But in the case of girls it is now only beginning to be recognised that an attempt should be made to discover their natural gifts, and to pursue an appropriate training in accordance with such endowments. We are beginning to learn that it is worse than useless to waste time over the attempt to learn what are euphemistically termed accomplishments, when there is not the faintest possibility that they can be learned. Many a conscientious and hard-working girl undergoes untold misery at school, and suffers all her life in consequence of failure in her diligent attempts to achieve the impossible.

In connection with school headaches, I may mention that they may be brought on by a blow on the head. When this is the cause of a headache, the origin of the pain may be simply exhaustion or depression of the nervous energy; but in some cases there may be what is known as concussion of the brain, which would fall under a more serious class. I think you will agree with me that a schoolmaster who administers a shock of this kind to the youthful brain is a ruffian, who should be brought to justice. I believe that for a lazy rascal who can learn his lessons and will not do so there is an absolute necessity for corporal punishment of some sort, but it should be applied to some region of the body as far from the head as possible. My own preference is in favour of the old-fashioned "taws" as at once

an effective and safe means of punishment, and from abundant personal experience I can testify that no permanent damage is likely to result from the use of this instrument.

We have further to consider those headaches which are caused by irritation of more or less distant nerves.

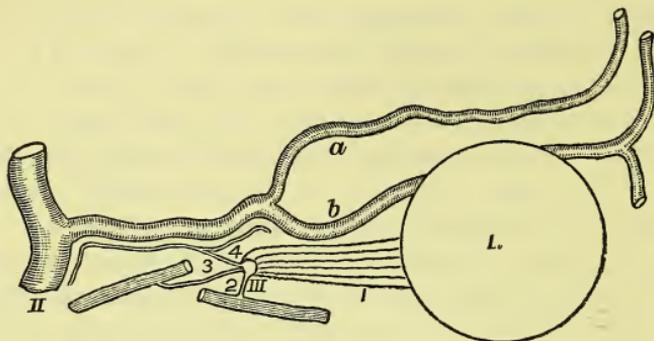


FIG. 3.—Diagram to show the connection between the nerves regulating the accommodation of vision, and the nerves controlling the blood-vessels of the forehead. I. The eyeball. II. The main artery, giving off the branch to the eye, which sub-divides into *a* and *b*, supplying the forehead. The special branches entering the eyeball are omitted to simplify the diagram. III. The nervous nucleus, with—1, branches to the muscle adjusting vision; 2, root from a motive nerve; 3, root from a sensory nerve; and 4, root from the nerve regulating the blood-vessels to the eye, nose, and forehead. When the nerves to the apparatus of accommodation (1) are exhausted, and therefore irritable, the irritation spreads to the other nerves, and by involving those of the blood-vessels (4), it causes a spasm of these vessels. This lessens the supply of blood to the nerves of the forehead, and induces pain in consequence.

Disorders of vision induce headaches which are usually situated over the brows. The cause of these headaches is straining of the mechanism by which the sight is adjusted to different distances. The straining acts in part directly by inducing exhaustion of the nervous arrangements, in part indirectly through local changes of the circulation which widen the area of nervous disturbance, by interfering with the nutrition of sensory nerves, as is shown diagrammatically in Fig. 3. This is a common cause of school headache. If a child is in good health and has average intelligence, any headache which comes on at school is probably caused by some defect of sight, if the sanitary arrangements are perfect. The pain, as I have said, is localised about the forehead, and does not appear until the sight has been used for some time. In such a case the ophthalmic surgeon must be visited, and spectacles provided to correct the errors in vision.

As I shall not have any occasion to refer to headaches in children again this evening, let me say to you never neglect a head-

ache in any child. It may only be caused by indigestion, or it may be induced by the growth of the second teeth; but, on the other hand, it may herald one of the specific fevers, or be the precursor of some disastrous disease of the brain itself. Whenever a headache in a child does not disappear after a brief rest, let me impress upon you the necessity of sending at once for your doctor.

Diseases of the ear frequently cause headache distinctly confined to the temple and top of the head, accompanied by pain in the ear and disturbances of hearing. Affections of the tonsils often produce headaches in precisely the same situation. Besides this headache there is sometimes also in chronic disease of the middle ear, a feeling of fulness of the head, as if its contents had not sufficient accommodation. Such cases require, of course, treatment of the affections of the ear or throat.

Bad teeth are a fertile source of headaches, as they are also of indigestion; and I am glad to see that Dr Smith is going to teach you something about them. Diseased teeth absorb putrefactive substances, which cause irritation of the nervous supply of the teeth, and this leads to pain in the head in much the same way as in the case of the eyesight. The pain is usually felt over the temples or towards the back of the head. It is generally relieved by a purgative followed by a tonic, but I need hardly say that the radical cure is the best.

In some cases of indigestion headaches seem to be caused in a similar way instead of by blood-changes. No doubt you all know that palpitation of the heart is caused in dyspepsia through irritation of the nervous system, and it is probable that some headaches are caused in an analogous manner.

These nervous headaches would not be induced if the system were in good condition, but when it is feeble or disturbed by any nutritive disorder, the nerves are liable to pain, in accordance with the statement which I made to you that a nerve when ill-nourished is irritable.

Among nervous headaches we have also to consider some which are due to inherent defect in the nervous system itself; but as the disorder is not such as we can by means of our present methods of investigation clearly make out, we are compelled to call them functional as a cloak for our ignorance.

The first class of sufferers which I shall mention is that of

hysterical people. I enter upon this subject with some natural hesitation for it requires as much circumspection to approach it as to walk on thin ice. The sufferers from this affection, whether of the male or female sex, hate the term I have used, but we cannot allow a false delicacy to prevent our looking fairly at the facts. Typical cases of hysteria, with their interesting pallor, the lustre of their dilated pupils, the pretty flightiness of their manners, are well known to every one. They usually belong to the well-to-do classes, but not invariably so, and very often regard themselves as endowed with gifts of extra sensibility. Their greatest curse is self. They have too little to do, and for sheer lack of employment they frivolve their time away in various fashionable forms of dissipation, or cry their eyes out half the night over the misfortunes of fictitious heroes and heroines whose fates are at least as good as their deserts. Dr Clifford Allbutt, of Leeds, thus sums up the characteristics of an hysterical person—"A person of feeble purpose, of limited reason, of foolish impulse, of wanton humours, of irregular or depraved appetites, of indefinite and inconsistent complaints, seeing things as they are not, often fat and lazy, always selfish; or, to take it in a less degree, one capricious, listless, wilful, attractive perhaps, yet having always the chief notes of hysteria—selfishness and feebleness of purpose."

The special features of the headache are that it is confined to the top of the head, and of an intensely acute character, resembling the sensation which might be supposed to be caused by a sharp instrument being driven through the head, whence the name *clavus*, from the Latin word for a nail. Along with this there is the feeling of a ball rolling up the throat, fulness in the region of the stomach, palpitation of the heart without any apparent cause for it, complaints of sleeplessness which cannot be corroborated by the attendants, of want of appetite, "which does not lessen the labours of the cook," and of all kinds of inconsistent sensations.

Now hysteria is a real and most formidable disease, and there is nothing more erroneous than to put down a person suffering from it as a humbug. I find that there is a great tendency, especially among ladies, to utter the expressive word "fiddlesticks" whenever hysteria is mentioned. This, however, is a cruel injustice, and I take this opportunity of protesting against it.

The treatment of such headaches is the treatment of the malady itself—by moral, hygienic, and medicinal remedies. The encouragement of a better frame of mind and a better habit of body by every means at our command. Incidentally, I may observe in passing that the shower bath and electricity do a world of good amongst the methods to be used in cases of this kind.

A totally different class of headaches falling under this division is that affecting nervous people. We may call this the nervous headache, and many persons of both sexes with highly-strung nerves are subject to it. The bulk of the sufferers are, no doubt, women, but there are many feminine men—I use the word in no offensive sense, but simply as an analogous expression to the commonly employed term “masculine women”—there are many feminine men who are also similarly afflicted. There is a very general dislike to the word nervous, but there is no reason for this antipathy, as nervous people are, in many instances, the very salt of the earth. Used in a medical sense, the term simply means that the individual to whom it is applied is delicately adjusted in every way. Frequently endowed with brilliant imagination, subtle penetration, and quick sympathy, they are the master spirits of art and literature. They are capable of self-denial, and, willing to spend and be spent in the performance of their duties, they have endurance enough to struggle on until a task is done, when complete prostration follows.

Let me quote again from Dr Clifford Allbutt, in order to point out for you the difference between this and the hysterical class of affections:—“The neurotic woman”—that is, put in common language, the nervous woman—“is sensitive, zealous, managing, self-forgetful, wearing herself for others; the hysteric, whether languid or impulsive, is purposeless, introspective, and selfish. In the one is defect of endurance, but in the other defect of the higher gifts and dominion of mind.”

The nervous person may go on comfortably for a long time if no special strain occurs, but a very slight cause is sometimes sufficient to upset the equilibrium. Even a change in the weather may be enough to do so; and this is not so much to be wondered at, when you think that a fall or rise of one inch of mercury (that is, from about “fair” to “rain”) means a great difference in the atmospheric pressure on an average sized man

Headaches, which we may truly call nervous, are characterised by their sudden onset, their indefinite position, the profound depression and sinking feeling attending them, which often lead to retching or vomiting. They are often called "sick headaches," but this is a misnomer, and the term should be disused altogether.

It is not easy to suggest, in a general way, how such attacks may be avoided or averted. Everything that can increase the tone of the system should be adopted. Regular hours, exercise in the fresh air, and cold bathing should be practised; and those who cannot take a cold bath without shivering after it, will often be able to do so, if after a rapid plunge they step into a basin of hot water.

Lastly, amongst these functional headaches of nervous origin must be mentioned migraine, often called "brow-ague" and "sick headache." These terms are apt to lead to confusion, and should be discarded. Migraine is a distressing affection. The pain is always accurately confined to one side of the head, always associated with temporary disturbances of sight, and usually followed by sickness and prostration. Its causes are little understood, but there is always some spasmodic change in the blood-vessels of the affected side of the head, which probably induces the pain in the nerves. This condition of the vessels probably results from some primary nervous change elsewhere, and the effects all follow each other in a circle.

The treatment of this affection is not very satisfactory, but some drugs, such as the active principle of tea and coffee, appear to control the attacks, while others, such as arsenic, are of use in warding them off. Here, as in the two last classes of headache, the whole system must be improved.

Before leaving the subject I would like to express my conviction that the application of cold water to the head is of very great utility in preventing headaches. The excellent Celsus, whom I have already quoted, says that "nothing is so beneficial to the head as cold water," and I am perfectly sure that the cold douche every morning will be found of great service by bracing up the nervous structures of the head.

Headaches, finally, may be the result of organic disease of the brain itself; but into these, which do not fall under any of the three divisions mentioned above, I cannot enter.

HEALTHY LUNGS AND THEIR CARE.*

By J. GRAHAM BROWN, M.D., F.R.C.P.E.

LADIES AND GENTLEMEN,—All diseases to which the human frame is liable are the result, more or less directly, of the action of some deleterious agent foreign to the body. Thus, an attack of indigestion may be caused by the eating of some irritating article of food: inflammation of the eyes may be brought on by the hurtful action of dust: the skin is inflamed by the application of mustard: the coats of the stomach corroded by the action of vitriol. These are common and evident, but there are many conditions which are not so apparently caused by such irritants, and yet which do actually so arise. These I cannot explain to you just now, and this is of the less importance, seeing that the foreign and extraneous agents which affect the lungs are, for the most part, of the more obvious kind. Now, if we accept the view which I have just indicated (and there is not a man of experience who will doubt it), we are driven to the conclusion that a condition of health depends much upon our outside surroundings, and to a very great degree upon the care which we individually take of our bodies. This is the reason, Sir, that I am here to-night. Were it not that it is in the power of everyone to ward off many of the insidious attacks of disease by attending to certain well-defined rules, such a course of lectures as this would not command interest. I am not here to talk about disease or its treatment. These are subjects wholly

* This lecture is reproduced *verbatim* as it was delivered. It is not altered either in style or matter.

unfitted for a popular audience. But I think I shall interest you as much (and I know the subject is of far more importance to you) if I point out what are the dangers to which a healthy man is exposed in regard to his lungs, and how these can be met. We need not walk blindly. Nature herself steps in to show us the way. She points the path; nay, more, she leads; and we have but to stand aside and let her move onwards. But do we know how to stand aside? Can we follow her in her leading? It is this which is the true and scientific basis of health, and the wisdom of the human race.

And now, turning more particularly to our present subject, we shall find, as I shall endeavour to explain more fully presently, that Nature preserves the health of the lungs by means of a system of most elaborate safeguards. These fall naturally into two groups. There are first of all those arrangements by which the respiratory organs are protected from injury. These are very intricate, and I shall only be able to explain certain of them to you,—indeed, science does not at present grasp the whole of that elaborate mechanism. But beyond these there are other arrangements which are designed for the purpose of enabling the lungs to throw off disease when they have become so attacked. The object of the present lecture, then, is to consider these various safeguards with which Nature has environed the organs of respiration, so that we may be able to assist her in her attempts to preserve health, and not oppose to her efforts a blind and fatal resistance. In this I shall presuppose a certain knowledge of the general arrangement of the organs in question, such as may have been derived from a lecture on that subject, delivered by Dr Andrew Wilson, in a corresponding course of "Health Lectures," some time ago.

(The lecturer here gave a brief description of the arrangement of the respiratory organs.)

It is hardly necessary, at this time of day, to insist upon the great importance of preserving the health of the lungs. He, who in his rude health, laughs at precautions, and jests at danger, yet knows the risks to which the race is exposed from this quarter, would fain learn how these are to be avoided.

To take the simplest case, where the lung-surface is diminished

from overstrain, as in a "broken-winded" horse, all active exercise is interfered with. Muscular activity throws more work upon the lungs, and must therefore be curtailed. Life is a burden. This is, however, the least of the evils which lung disease entails. Disorders which have their starting-point in the lungs, do not, unfortunately, limit themselves or their effects to these organs. The whole body suffers, the whole economy is overturned, and too often life itself is the forfeit. Now, we are not here to discuss such severe disorders as these, and I only mention them in order to impress upon you the necessity of guarding the lungs from the small beginnings of disease. A common cold, let us say for example, has not been thoroughly got rid of, and has left some traces of weakness behind it. Experience tells us that it is just at these weak points that such a disease as consumption will most readily commence. To many persons, indeed, such a neglected cold may prove to be of no consequence, but there is a certain proportion of individuals who inherit, or are specially liable to the disorder, who will thereby fall victims, and who might have escaped had their lungs been in a perfectly sound condition. It is indeed very important that those who unhappily inherit from their parents a tendency to consumption, may to a great degree guard themselves from its attack, by attending to the rules of health as applied to the lungs. I wish to impress this fact very strongly upon you, for it is grievous to see how often such rules are neglected with fatal consequence. If the lungs are in a thoroughly sound state they will almost certainly throw off the germs of disease which are present in the air, and are being constantly drawn in with the breath. They reach the lungs, indeed, but they find no lodgement there; but if the lung tissues are weakened by the action of some slight disorder, disease germs are apt to find a suitable resting-place there, where they may grow and lead to serious mischief. You will understand me better if I give you another example of what I mean. We will, if you please, take another disease and another set of organs—those of digestion. It is pretty certain that the germs of Asiatic cholera—that terrible disease which seems to devastate new provinces and countries each year—enter the body by the mouth. Many and many a

man living in the infected districts receives into his stomach the germs of cholera without taking the disease. He escapes because his stomach is healthy. Had he had any disorder of that organ he would very probably have fallen a victim. There is, I believe, little doubt that these germs of cholera cannot live in a healthy stomach, but they can and do grow when the stomach is not in a healthy state. And so, just as the man who walks amongst cholera must keep his digestive organs sound, he who inherits consumption, or is exposed to infection therefrom, must maintain his lungs in a healthy condition. To explain how this may be done is the aim of the present lecture.

A subject of this kind is, of course, far too wide to be fully treated of in one lecture. I can only indicate some of the more important points,—those which, without any special knowledge, you may be able to make use of in the preservation of the health of your lungs. Although such a division is wholly arbitrary, I shall, for convenience of description, consider the subject under the following headings:—first, the muscles of respiration; second, the elasticity of the lungs; third, the mucous membrane, or lining membrane, of the air passages.

The Respiratory Muscles.—It is self-evident that the activity, and therefore the health of the lungs depends much upon the state of the muscles which act upon the chest, and by means of which the air is drawn inwards. In a man of ordinary health they are usually found to be fairly fit for their work. How they may be improved in tone, and with what benefit, I shall presently show you. In the meantime, I wish to point out that whatever be their condition it is essential that they should have fair play, and that they should not meet with obstructions in carrying out their work. That the chest may expand properly it is obvious that there should not be such clothing round the chest as will offer any serious impediment to the free movement of the parts in question. It is scarcely necessary for me to enumerate these. For men, ill-devised braces and tight-fitting waistcoats are objectionable in this way. Much more serious in this regard is, however, the corset worn by women. That the wearing of stays is hurtful in many ways, you must have frequently heard in this place. Not the least objectionable of their effects is the com-

pression of the chest which they produce. They curtail very materially the movements of the lower ribs, and thereby throw an unequal amount of work upon the upper parts of the lung. Let us then see to it that the clothing we wear is so arranged that it does not press unduly upon the chest, and that we are able to draw a deep breath with freedom.

But it is not merely by improper clothing that the chest may be prevented from free movement. More important than that is the posture of the body. It is a well-known fact that much fuller breaths are taken when standing than when sitting. More air enters the chest with each respiration, the lungs are better ventilated, and therefore under more healthy conditions. You will readily understand that the difference is still greater when the standing posture is compared with the cramped position assumed by the workers at such a trade as the making of shoes, which requires stooping forward, or with that of the student poring over his books. The reason for this you will at once understand if you will look at this diagram. (Diagram shown.) You will perceive that the compression of the abdomen tends to force the liver upwards, and so to encroach upon the lung-space. Because of this resistance the work done in expanding the chest must be correspondingly increased. Such cramped positions ought to be avoided as much as possible, and particularly in the case of children great care should be taken that while engaged in reading or writing the chest is free to expand.

Elasticity. The elasticity of the lungs is one of their most important properties. You know what elasticity means. It does not mean, as many people who ought to know better seem to think, the power a substance has of being stretched out like a piece of india-rubber. That is not the meaning of the term at all. What elasticity really means is the power which some bodies possess of returning to their original position after having been stretched out. This property is found more or less perfectly in many solids. It exists to a considerable degree in india-rubber, but not perfectly. Probably it is in no solid more perfect than in the tissue of the lung. And it is well for us that it is so, for think what the lungs have to go through in this way. Think what it is for the million of air cells to distend and collapse

uniformly and regularly, while from one year's end to another the volume of the lungs must not appreciably change. If you take a strip of the purest india-rubber, stretch it out, and allow it to rebound, you will find, if you measure it very accurately, that it has gained slightly in length. It has not returned to its former size. If the stretching be repeated again and again the difference increases, until at length the strip becomes quite drawn out and flaccid. Now compare this with the elasticity of the lungs. If the lungs remain healthy throughout life there is probably very little of this permanent stretching, although the tissue of these organs is put on the stretch and relaxed some eighteen times a minute, day after day, and year after year. This is no doubt in part due to a process of repair which is at all times going on, but still it shews how very perfect the elasticity of the lungs is.

Under certain circumstances this perfect uniformity in the distention and collapse of these millions of air cells is not preserved. Some of them may not allow the air to enter properly, and, from the conditions under which the lungs are placed, the neighbouring cells suffer and get over-distended to make up. This over-pressure breaks the delicate walls which lie between the cells, and when such breaking takes place to any great extent, the lung surface is seriously impaired, that is to say, the surface upon which the blood is spread out to meet the air in order to absorb oxygen and give off carbonic acid. That this is a very serious matter must be at once apparent.

Before considering how such a result as this can be prevented, let us look for a moment at the beautiful arrangements by which Nature has provided for this nearly perfect elasticity. Remember that not only must the lungs distend and collapse uniformly and regularly, but provision must be made for the numerous strains to which they are exposed. What a sudden and violent stress a severe cough must occasion to the lungs. To see, and still more to feel, such straining is sufficient to impress this upon the mind. Loud speaking and singing involve considerable strain, and in children, long fits of crying produce similar results. From all such effects the lung tissue must be protected, and this is done in various ways, the more important of which I shall now describe.

Look first at the wind-pipe. It is a tube kept permanently

open by means of a series of rings of cartilage or gristle. You can see them in this diagram. (Diagram shown.) They are hard but extremely elastic, and are separated from each other by layers of tissue. These rings, however, do not go the whole way round. They are shaped somewhat like the letter C, and are so arranged as to leave a long narrow space at the back not occupied with gristle. This next diagram shows the arrangement. (Diagram shown.) Filling up this vacant space then, and binding together the two extremities or horns of each cartilaginous ring, is a firm layer of muscle. This muscle is not of the ordinary kind. It is known as involuntarily, that is, it is not under the control of the Will, and only acts, like the heart, stomach, and other internal organs, when there is a local necessity. I put this matter roughly, for I have not time to explain it in full, but all that you need to think of at present is that this strong muscular layer is there, and can break the shock of any sudden strain, and prevent it coming too violently upon the lungs. There is, in addition, a considerable amount of what is called "elastic tissue" in the wind-pipe, which helps in this matter. Then as we go down to the bronchial tubes, we find the rings of gristle getting less distinct, and the muscle increasing in quantity, until at last the gristle quite disappears, and a circular ring or sheath of muscular fibre takes the most prominent place, ready no doubt to give, under such a strain as severe coughing, and so to save the lung. Pass on to the air-cells themselves, and you will find that the chief guard against overstrain consists in a net-work of elastic fibres, such as this diagram shows. (Diagram shown.)

Now you will admit that this is a wonderfully complete system of protection (and I wish there had been time to go more fully into the matter), and yet we frequently find that the elasticity of the lungs is more or less lost. The most common cause of this is disease of the bronchial tubes, and with this we have nothing here to do. But there are other causes under our control which often produce it, and these we must attend to, so that we may know how to avoid them. I have mentioned already that, when some of these air-cells do not expand properly, the others have to stretch too much so as to take their place, and so their walls get torn and they lose their elasticity. Now this state of things

takes place whenever one part of the chest is not allowed to expand as much as the rest, as for example when tight-lacing is allowed. And so I have to protest again against that pernicious habit. The same remark applies to any cramped posture, and in general to anything which prevents the full and free expansion of the chest.

Another cause which leads to over-stretching and consequent loss of elasticity in the lungs, is the violent blowing of wind instruments. Now I do not believe that all such blowing is harmful. Far be it from me to breathe anything against so charming an employment as bag-pipe playing. Properly conducted, and allowing of sufficient rest between the efforts, I think such blowing may, in sufficiently strong persons, be conducted without such risk. But you must remember that the bow must be often unbent if it is to keep its strength. No prudent archer in the olden time but would slip the string off the notch, when the fight was over, and allow the bow to relax. This he did to keep unimpaired the elasticity of the wood. And so must we do as regards the lungs. They can stand a very considerable strain, as I have endeavoured to show you, but that strain must not be kept up too long. The lung tissue must be allowed to relax. This is where the fault lies in blowing wind instruments. The strain is kept up too long.

This now leads me to the subject of the rational exercise of the lungs—the rational lung gymnastics. It is an observation which many of you must have made that in highly trained singers there is a wonderful development of the chest. The capacity of the lungs is largely increased, and the chest correspondingly full and deep. In such persons the elasticity of the lungs is much tried, and yet we seldom or never find in them any ill results from the strain—a strain which is very considerably higher than that to which most of us are exposed. The true reason for this is, I believe, that a well-trained singer is taught not only to expand his lungs fully, but also to empty them as thoroughly as possible at frequent intervals. In other words, the bow is carefully unbent. This is the real secret of efficient lung gymnastics, not only to expand the chest well, but to empty it thoroughly after each full breath.

Certainly, singing when well managed is the very best means of strengthening the chest, and to all who can do so I recommend its careful practice. But, unfortunately, there are some of us who cannot so indulge, and whose vocal attempts would be a pain to ourselves and a source of constant strife with our neighbours. Yes, I fear that we should not be popular. Do you remember how Ayton in one of his charming ballads describes the fate of some one of this kind, who *would* exercise his lungs by vocal efforts. Ayton is describing a great and royal banquet at Windsor. At a certain stage in the proceedings it is thought that a little vocal music would be suitable.

“ . . . Then rose the cry, ‘ a song, a song from Brougham ! ’
He sang, and straightway found himself alone within the room.”

For such unfortunate persons some other form of exercise must be devised, and what probably suits best is to proceed as follows : You stand upright, with the face looking rather upwards, and extend the arms straight in front of you, with the palms together. The arms are then to be slowly carried backwards horizontally, on a level with the shoulders, as far as is possible. While this movement is being made, a deep breath is to be drawn. The arms are then to be brought rapidly back and crossed upon the breast, so that the right hand lies on the left shoulder, and *vice versa*, a full expiration being then made. These movements ought to be repeated regularly for some minutes.

High mountain air is very conducive to lung exercise, because the air being rarified, more must be taken into the chest to satisfy the requirements of the blood, in the matter of oxygen.

The Mucous or Lining Membrane of the Air-Passages.—The mucous membrane of the air-passages is a very complicated structure. Without attempting to describe it in full, I shall only mention to you those points which are of importance to our present subject. The surface, then, of the membrane is formed of a layer of cells of varying shape. Of these, two are important to us, one of which is seen in this diagram. (Diagram shown.) These are of an elongated shape, are placed upright on the surface of the membrane, and are furnished at their free end with a number of the thread-like processes which project upwards. The

drawing has been made from dead cells, for in life these whip-like threads—cilia they are called—are in constant and very rapid movement. They do not move at random, but the cilia of all neighbouring cells sweep in the same direction at the same moment. If you scrape away a morsel of such a membrane as we are speaking of, and place it under the microscope, you may see these cells, but they will then be alive, and the movement of the cilia will be so rapid that you will not be able to see them distinctly. You will nevertheless see evidence of their presence, for you will perceive that the fluid in which you are examining them is in motion. Such small particles as happen to be lying in it will be rapidly whirled past, impelled by the sweeping of these little threads. I have told you about this, which is after all rather a technical matter, because that sweeping away of small floating bodies is the duty and function of these cells with those little hairs or cilia. I shall presently have to impress on you that one of the chief things against which the lungs have to be protected is the dust which floats in the air. This dust is to a considerable extent removed by these ciliated cells. Such is one of Nature's most important ways of protecting the lungs. Now these delicate cilia can only sweep about freely if they are surrounded with moisture, and this is in great measure provided by the other form of cell of which we have to speak. These are what are called goblet-cells. They lie embedded amongst the others, and have a cup shape with the open mouth projecting outwards. Their function is to secrete mucus, that slimy fluid which keeps the air passages moist. The same moistening function is performed by various glands, which are found in the substance of the membrane. Now, the moistness of the air passages has many purposes besides that of allowing the cilia to move freely. Another of its functions is to catch dust. You know that if there be a drop of water on a table over which dust is blown, the dust will pass over the dry parts and stick where there is moisture. So it is with the air-passages. If the inner surface were dry the dust of the air would all pass into the lungs, but the moist walls catch a considerable proportion of what dust is passing, and these myriad cilia which are all sweeping upwards towards the throat, get rid of them. Now here is another indication for us. It is

clear that we must not allow the air we breathe to get too dry, for then the moisture on the air-passages will get dried up, it will no longer allow of the action of these cilia, and we shall have our lungs invaded with dust. This great dryness of the air you may often feel in places which are heated with badly arranged stoves.

But there is another reason why it is important that we should keep the air-passages moist. It is that they may remain sensitive. Take the tongue for example. If any of you have had a fever of some severity, you may, perhaps, remember that the hard dry tongue which then lay in the mouth was very dull to sensations of touch or taste. This was very much due to the hard dry layer on its surface. Just so is it with the air passages. If their surface becomes dry it loses the power of fine perception, as a gloved hand does. But you will ask me what sensation is this membrane fitted to receive? We are not in any way reminded of its presence any more than we are of many other of the internal organs. Yes, that is so, and yet there are many sensations which are being constantly perceived by the nerve-ends in the walls of these air-passages which are of the greatest importance to our well-being, although they are not perceived by our brains. With some of these sensations we are however familiar. Take the nose for example. The nerves which lie embedded in the lining membrane of the nose warn our senses of the presence of hurtful gases. But they do more than that, for if some particles of an irritating nature get into the nose, these nerves set in motion a very singular mechanism, by which they are expelled by sneezing, so that they may not find their way downwards into the air-passages and do harm. Snuff, for example, has this effect, and there are other things which so act, which will readily occur to you.

Another point, at which it is perhaps still more important that the nerve sensations should be acute, is the larynx—the vocal apparatus at the top of the windpipe. That may be looked upon as a sort of gate-way to the lungs, and it is provided with a muscular arrangement by which it can be firmly closed. Have you ever noticed that when you try to drink a glass of briskly effervescing soda water you often feel a sudden choking sensation, and are obliged to stop inhaling, and breathe out the air from the

lungs? This is but the automatic way that Nature adopts to protect the lungs from harm, for that gas which is bubbling off from the soda water is carbonic acid, and the glottis, or gate to the larynx, has closed firmly against it. Many other things have the same effect, such as dust, smoke, and the fumes of burning sulphur. Against such, the trachea and bronchi also act, for those involuntary muscular fibres of which I have already spoken as breaking the shock of sudden strain, also act in protecting the lungs by narrowing the air passages. It is only necessary for them to contract to bring about this result, and they are caused to contract by means of a mechanism which includes the nerves in the walls of the air-passages, and for the vitality of which it is essential that these walls should be moist.

Every one knows what it is to have particles of food pass into the windpipe, or "go down the wrong way" as it is called. Well this is very bad for the air passages and lungs, and Nature steps in to remedy it. We have already seen that small dust particles are greatly got rid of by means of the little hair-like cilia which are always sweeping upwards. Small particles of food are, however, far too large to be got rid of in this way, and therefore another means is provided. That means is *cough*. The act of coughing is a very complicated one, and I can only give you its outline. Something, let us say, is lying in the windpipe and causing irritation there. This sensation is conveyed from the nerves of the lining membrane up to the upper end of the spinal cord. The nervous sensation there enters what is called a centre, informing that centre, as it were, that there is something that needs expulsion. Accordingly an impulse is sent downwards which first closes the glottis, or gateway of the larynx, after a deep breath has been taken, and then causes a violent expiratory effort. Under the pressure of the air the glottis is suddenly forced open and the breath rushes out, carrying with it the irritating particle. You see how very complicated the process is, although I have only sketched it very roughly to you, and you can imagine how important it is that there should be nothing to dull the perception of the lining membrane of the air-passages.

Now a good deal has been said to-night about the evil of dust in the air we breathe. Let us consider it for a moment. These

particles are for the most part very minute. They show themselves to us floating in the sunbeam, and they are universally present, save at high altitudes or far out at sea. For the most part such particles appear to do little harm. They are caught on the moist walls of the air-passages, and swept back by means of the cilia, in the way I have sought to describe. But if in large quantity, even the ordinary dust of rooms is hurtful, particularly to the lungs of sick persons. All dwelling rooms, and more especially sick rooms, should be swept out with care, in such a way that the dust does not rise; that is, sufficient dampness should be used in the process. But while this ordinary dust is not of great importance, there are, unfortunately, some kinds that are most hurtful. Coal-miners, masons, and persons who work in materials which give rise to dust, are all subject to serious lung disease from the penetration of these particles into the air-cells. The various safeguards I have mentioned are not sufficient to give protection when large quantities of dust are flying, and so these diseases arise. There are two ways in which this may be avoided, first by wearing some form of respirator, and second, having a thorough draught of fresh air sufficiently strong to carry the hurtful particles away from the mouth.

There is, however, a more insidious form of dust which is liable to attack our lungs, that, namely, which consists of infectious material, the low forms of growth which were described to you here a week or two ago. The germs of several diseases are believed to reach the body by being inhaled. Among these I may mention measles, whooping-cough, and especially consumption. Against such we can only guard ourselves by avoiding the near neighbourhood of infection, and by keeping the lungs in as perfect health as possible.

Pure air is to the lungs the most important tonic, and we should see to it that we have sufficient of it in the rooms in which we live and work. Not only must the air-space be sufficient, but that air must be constantly renewed, if we are to live healthy lives. Nor can the importance of open air exercise be exaggerated. We should accustom ourselves and our children to be out in all weathers, and at all temperatures, unless there be some special reason to the contrary. Keep the skin healthy with regular cold bathing, and always wear wool next to it.

Ladies and gentlemen, I can detain you no longer. The subject I have endeavoured to bring to your notice has been but touched here and there. I have not attempted to deal exhaustively with it, and great blanks are left. I have said little or nothing, for example, about the evil effects of carbonic acid in the air. In this as in many other cases I have left out such portions of the subject as have been treated of in other lectures, delivered under the auspices of this Society. For all such omissions I now beg you to excuse me.

THE PHYSIOLOGY AND FUNCTIONS OF THE TEETH.

THE lecture which I have this evening to deliver may not assume the dimensions, in a scientific point of view, nor the importance in its bearings on our bills of mortality, presented by some of those to which you have already listened. In many of its aspects, however, the subject touches upon matters exercising a considerable influence on the comfort or discomfort of human life, while in others it becomes interesting as a curious scrap of natural history.

As is the case in treating of all other vitalised structures, any knowledge of the teeth, in their healthy and diseased conditions, will be easiest imparted and best understood by a previous acquaintance with the development, organisation, and general characters of these bodies. In offering, then, a sketch or outline of such matters, let me, upon the principle of beginning with that which is best known and most familiar, commence with the adult teeth of the human subject.

The full complement of the adult or permanent set of teeth in man amounts to thirty-two in number—sixteen in the upper and sixteen in the lower jaw. Anatomists have generally considered forty-four instead of thirty-two to be the typical or normal number of teeth to be found in animals belonging to the mammalian class, among which is man. They therefore consider that certain teeth in man, and many other animals, are suppressed, and thus never make their appearance. A knowledge of this diminution in the number of the teeth in man is interesting, as it explains to some extent the occurrence of what is sometimes set down as a third dentition, as well as the occasional appear-

ance of extra or supernumerary teeth in the mouth,—such additional members in both cases merely indicating a tendency to return to the normal or typical number which had been departed from. These thirty-two teeth, again, are divided into four different kinds of teeth, each one of which divisions is held to present a certain typical shape or character of tooth, to which all teeth in the same divisions throughout the animal kingdom are referred. These divisions consist of Incisor, Canine, Bicuspid, and Molar teeth.

As in the typical number of the teeth, however, so in regard to their typical form, great deviations take place throughout the animal kingdom; but such deviations are not to be considered as deformities arising from a departure from an orthodox pattern, but rather as due to adaptive modifications, to natural selection, as it has been called, or “survival of the fittest.” It is only an illustration of the fact that organs not needed tend to be suppressed, while those most used are retained and improved in their development; while evidence is also shown that, so far as a “fixity” of organisation is concerned, there is always a proclivity to return to the typical number and forms of these teeth, according to circumstances.

These thirty-two teeth in man are preceded by a less numerous set, which fall out in virtue of another rule which prevails in that class of animals to which he belongs, and which is, that in the great majority of them there are two generations of teeth—namely, one, consisting of the temporary or milk teeth, which are destined to be shed; and another, the permanent or adult set, which succeeds them.

In reference to all these peculiarities, animals which possess teeth of various forms are called Heterodont, and those which possess teeth of only one uniform shape are called Homodont. Animals again which have only one generation of teeth are called Monophyodont; those having a first and second set being called Diphyodont.

The thirty-two teeth, constituting the permanent set in man, are arranged and classified in the same way in both the upper and lower jaw—sixteen in each—as follows:

In front, above and below, are four sectorial or cutting teeth, flat or chisel-shaped at their edges, and termed the incisors.

Bounding these, on each side, is a conical, spear-shaped, piercing tooth, termed the canine or eye-tooth.

Behind the eye-tooth again, we have two small, tuberculated, double-pointed teeth, termed the bicuspid, premolars, or small grinders ; two on each side, above and below.

Behind these again we have the large crushing or grinding teeth—the true molar teeth; three on each side above and below, or twelve in all.

These true molar teeth appear only once in a lifetime, and only among the permanent teeth. They are not preceded in the temporary or milk set by any representatives, so that the temporary or milk set differs from the permanent in number, to the extent of six above and six below ; the number of the milk teeth being twenty instead of thirty-two, and the difference consisting in the absence of any predecessors to the true molar teeth, the temporary molars being succeeded by the bicuspid.

The typical form distinguishing each of the different kinds of tooth included in the four divisions which have been alluded to, depends not less upon the fang or root than it does upon the crown of the tooth.

The natural form of root in all the incisor teeth above and below, is a single straight conical fang.

In the canine or eye-tooth, the same form is observed.

In the bicuspid of the lower jaw, the same style of root prevails, but in the upper bicuspid the root inclines to be double, or to divide into two fangs.

In all the lower molars, the natural number of fangs is two—one behind the other.

In all the upper molars, the natural number of fangs is three—one towards the palate, and two towards the outer side of the tooth.

A knowledge of these facts—of the exact form, number, and position of the fangs of any tooth—is essential not only towards distinguishing it with certainty, but is absolutely necessary for the skilful, or even the safe performance of a very common little operation, namely, extraction.

Man differs from all the other mammalia in the arrangement of his teeth. In him they are all of one uniform length, being all, generally speaking, on the same level at the crowns. And

again, no interspaces exist among them, every tooth being close to the one next it. In the lower animals, on the other hand, empty spaces exist at certain parts along the jaw ; the series of teeth being interrupted by gaps or vacancies, generally occurring near the eye-teeth. And the teeth themselves are not of a uniform length, the eye-teeth in particular being almost always much longer than their neighbours, and overtopping them considerably.

The existence of these unoccupied spaces—these gaps among the teeth of the lower animals—is interesting, as possibly being calculated to account for their not suffering so much as man does from irregularity or overcrowding of the teeth ; and probably the extra room thus afforded may be one factor in explaining why the lower animals seem to suffer so much less during dentition or teething, than is supposed and asserted to be the case in man, in whom the jaw is barely, if it is actually sufficient, to contain the mass of teeth in all stages of growth, with which it is at that time encumbered. The healthy growth of the jaw itself is, of course, an important element in the regularity of the permanent teeth, by affording space for their accommodation, and its full, or even large development, is generally indicative, not only of bodily health and strength, but even of mental vigour and force of character.

We have next to consider, very shortly, the development and structure of these organs ; how they first make their appearance, and where they come from ; how they grow ; and what is their intimate construction.

Teeth, like some other structures common to the animal creation, such as nails, hair, or horns, are dermal organs—that is, they are associated with the integuments—with the skin covering the body or the mucous membrane lining its interior.

At an extremely early period of life—at the mere dawn of existence, indeed—the mucous membrane covering in the rudimentary jaw takes on an action by which it here and there produces the future tooth. This mucous membrane may be said to consist of a layer of exceedingly small microscopic particles termed cells, packed upon the surface of an underlying or basement tissue—the whole structure covering in, like a carpet, what is to become the jaw, in the same manner as the gum does at an

after period. The process of development commences by this mucous membrane sending inwards certain inflexions, which look like finger-like processes, of itself, at each point where a tooth is to be produced. The point or extremity of each of these processes expands after a time, till, when viewed in certain directions, they assume somewhat of the appearance of a wine-glass with a narrow stalk, the globular portion lying deepest. Into this globular or goblet-shaped end of the process a small projection of the subjacent tissue protrudes, and which is the germ or papilla of the future tooth. The stalk portion of the goblet now becomes obliterated, while the goblet itself develops from the cells with which it is provided, the enamel of the tooth; and the germ or papilla, goes on increasing until it forms the substance known as dentine, and which constitutes the body of the tooth itself. A portion of the remains of the papilla undergoes less change than the rest, and forms the central pulp or what is termed the "nerve" of the tooth, while a covering for the root is also produced, which closely resembles ordinary bone, and is called the "cement." This very sketchy description may convey some idea of the original development of these organs as it goes on, previous to their appearance in the mouth.

As soon as the crown of the tooth is completed, and long before the root is perfect, the process takes place by which the tooth is "cut," as it is termed. This occurs, not by the tooth forcing or tearing a way or passage for itself through the gum and other tissues, but by these tissues themselves making a way for the tooth's escape. The protrusion of the tooth through the opening thus provided, is not very easily accounted for, as the idea of a reactionary force being exerted in the advance of the crown by the downward growth and elongation of the root, will not apply to the case of teeth with fully developed roots never being cut, or to others which are cut rapidly, but which are so stunted in their root-growth, as to have scarcely any fang at all.

Such, then, is an outline of the number, arrangement, and development of the teeth in man, and a rough explanation of that strictly natural and healthy process going on in infant life termed "teething," not a step in which ought to be regarded as a disease. Yet, there is no doubt, that there are persons who on any illness, no matter what, occurring in an infant at the age

of teething, evince a strong inclination to blame this process, and are prone to cut open the gums and lay bare those delicate tooth germs just described, sometimes when but half made up, fondly believing that only their escape would cure the child. Little surely can such know the beautiful and carefully protected structures with which they interfere ; little surely can they know the wondrous provision made for effecting those ends they endeavour to promote. It needs no interference on our part to open the closed daisy to the morning sun.

I might here describe the various steps by which the second dentition is effected, but they, with some obvious and slight modifications, so closely resemble those exhibited in the first dentition, that it would be tedious to do more than merely mention that the shedding of the first set proceeds from a rapid and spontaneous absorption of their fangs at this period ; and that the development of the two last molar teeth of the second set on each side above and below, takes place by the processes of cell tissue not being provided by the mucous membrane above, but by the structures developing the tooth in front.

Passing on to consider the nature and structure of the dental tissues themselves, they may be stated in general terms to be three in number—dentine, enamel, and cement ; substances which in their healthy state are all but indestructible, and in this way have not only served as evidence in the identification of bodies, and the detection of crime, but have guided the hand of the great paleontologists in imaging forth those stupendous creatures revealed in the geology of an epoch long previous to the existence of man.

By researches and observations, thus facilitated, in the economy of the teeth, there has, as many of you know, been traced and demonstrated the nature and habits, not only of numerous existing species, but the nature and habits and even the form and appearance of animals which belonged to an altogether different epoch of this world's history ; and not only that, but the aspect and condition of the face of the earth, at such former periods, have through this means been almost incontestably proved.

It was greatly by observation of the anatomical peculiarities of the teeth of extinct animals, that Baron Cuvier made those discoveries which tended to throw so much light upon the subject of

paleontology. By the form and appearance of any tooth found imbedded in the Montmartre quarries, near Paris, he was thus enabled to tell the form of jaw and head proper to the animal to which such tooth belonged: that being ascertained, the construction of the spinal column, and other bones consistent with such a character of skull, was indicated and made out. The extremities were, in like manner, prefigured in accordance with the habits and necessities implied in the conformation of those parts already known; and more strange than all, it was found that the animal thus prophetically framed and put together in the mind of the naturalist—merely from the indications afforded by a tooth—was confirmed as exactly representing the configuration of the creature to which such tooth belonged, by the subsequent discovery of the rest of its skeleton.

The tissues of which these organs are composed are of much the same general nature in all animals, although in certain cases one or other of them may not be present.

Dentine, or the body of the tooth, is composed of an infinite number of excessively minute tubes embedded in a matrix of calcareous or lime salts, so that it consists of something like bone. These tubes are arranged so as to lie with one end opening towards the pulp at the centre of the tooth, the other terminating at its external surface, each of them measuring in the diameter of its bore about $\frac{1}{100000}$ of an inch. Their use seems to be the maintenance of the life of the tooth by securing its nutrition from the central cavity found running along each tooth, and which cavity contains the blood-vessels and nerves necessary so far for keeping it alive.

Enamel consists of a collection of dense, almost flinty, fibres or columns closely packed together, and standing upon the surface of the dentine, where the tooth is exposed in the mouth, and for which it constitutes merely a mechanically protective covering.

Cement, or that substance covering the root, closely resembles true bone, and acts in the double capacity of assisting the central canal in affording nourishment to the dentine, and as a bond of union between the root of the tooth and its socket in the jaw.

Wherever any of these three substances is weak or defective, they are, owing to the small amount of vitality at best possessed by them, exceedingly prone to disease and destruction. In their

healthy condition, nature has provided well against the trying circumstances they are exposed to by a residence in so changeable a climate and damp a locality as the mouth, not to speak of the toil and heavy work they are sometimes doomed to undergo. But if disease, or only delicate health, or a flaw in its tissues, particularly in that of the enamel, should overtake a tooth, the combined effects of this, and all the evils to which it is exposed, speedily result in the death of some circumscribed portion of its substance, followed by its subsequent decomposition and decay, constituting what is called dental caries, and the central canal, with its exquisitely sensitive contents, being thus in time encroached upon, acute pain is the result—toothache, in fact, is produced.

The cement frequently becomes the seat of hypertrophy, or an overgrowth of its substance, owing to irritation and inflammation, and leads, by pressure on the nerve supply within the socket, to considerable pain, generally assuming a neuralgic character. The same may be said of the effect of certain small bony excrescences found growing from the sides of the central canal of a tooth, and leading to pressure upon the sensitive contents of that cavity. Again, the tissues outside and distinct from a tooth, but connecting it with its bony socket, may become the seat of inflammatory action and intense pain—as, for example, in what is known as alveolar abscess or gumboil. These and many other dental diseases, it may be added, are greatly dependent upon and influenced by the general health of the patient, as well as by local and more immediate circumstances. The treatment called for in these and other affections, it need not be said, is a matter of far too wide and comprehensive a nature to be here entered upon.

We have thus rapidly gone over the external characters, development, and structural peculiarities of the teeth in man, a system of organs regarded in general with too much indifference. "The mouth," says Sahadi, in his Persian philosophy,—“the mouth is a grotto where pearls are priceless.” Grottoes of the kind, however, being somewhat numerous, familiarity seems to have bred contempt for their pearls, if not forgetfulness of their existence.

In conclusion, a glance may be taken at the varieties these

organs present in some of their better marked examples among the lower animals.

The teeth of the human subject, in external appearance at least, afford but a very limited idea of what these organs are throughout the animal kingdom. Among the lower animals the number, the position, the form, the uses and functions of the teeth vary to an endless degree.

In number we have them ranging from the innumerable teeth in some fishes to the solitary tooth of the monodon or narwhal—the tooth well-known for its resemblance to the unicorn's horn of heraldic notoriety.

In position and relations we have them not confined to the jaws as in man, but, as in fishes and reptiles, scattered over all the bones of the mouth, the tongue, and the gullet; and if we include some still lower animals, such as the echinus or sea urchin, we find the jaws themselves performing the functions of teeth; while in crabs, beetles, and various insects we find teeth situated even in the stomach.

In form and size, again, they are infinitely diversified, from simple flat plates, as in some of the ray and skate tribe, till we have them assuming the form of the tusk of the walrus, or of the extinct mastodon, or of the baleen plates of the whalebone whale; while in size they are met with from the most minute points to the gigantic weapons of the mammoth—tusks which have been known to measure eleven feet long and weigh two hundred pounds.

In their functions and uses we find them serving as weapons of attack and combat in the lion and its congeners; as implements of building in the beaver; as a means of digging in the extinct *dinotherium*; of climbing in the walrus; of securing their slippery prey in the extinct sharp-toothed birds—the *ichthyornis* and the diving *hesperornis* of Professor Marsh; of prehension and seizing in fishes; of poisoning in serpents; as well as constituting accessories of speech and appearance in man.

We have thus glanced discursively and very rapidly at the development and structure of the teeth in man and the lower animals, and as a practical *resumé* of what has been advanced let me finish by saying a few words on its application in daily life.

In reference to the masticating functions of the human teeth, their form and character indicate that man is a mixed feeder,

not possessing the tearing powers of the carnivora, nor the grinding and crushing powers of the vegetable feeding animals, to any marked or special extent.

The perfect development of the teeth and the soundness of their component structures correspond in all probability with what was the health of the individual from the very earliest period of infancy up to that of cutting the first and the second sets of teeth.

The number of diseases alleged to be connected with teething or cutting the milk teeth is probably exaggerated; and again irregularity of the second set appears to be due in some measure to the absence of any reserve spaces in the dental series as occurs in the lower animals as well as to occasional arrest in the growth of the upper and lower jaws.

Dental caries or decay of the teeth seems to be a process involving both vital and chemical action, some defective or morbid condition of the dental tissues leading to their being devitalised, and subsequently acted on by destructive and decomposing agencies of various kinds.

The prevention of decay is to be sought in maintaining the general health, and, as a local measure, in cleanliness of the teeth by removing from them decomposing agencies of a destructive nature.

The remedy for dental decay is its early removal, and the employment of such measures as can only be properly turned to account in the hands of a trained professional man, and which it would here be waste of time to describe.

Affections of the root and socket of the teeth lead to pain, and generally to loosening and extrusion of the tooth—mechanical violence, certain constitutional ailments, such as a gouty-rheumatic tendency, and old age, conducing to such a result; and are all difficult to treat without professional skill and experience.

The wearing of artificial teeth has not been alluded to in this lecture, as little more could have been said about it, except that considerable patience and perseverance is required, in order to become accustomed to their use and presence; and that when the time, trouble, and expense unavoidably entailed in properly and artistically providing such substitutes, cannot be incurred, it is more prudent to do without them.

THE CHILDREN OF THE CITY: WHAT CAN WE DO FOR THEM?

By JAMES B. RUSSELL, M.D., LL.D.

LADIES AND GENTLEMEN,—It is now more than a century since a distinguished citizen of this city wrote a book entitled, "Sketches of the History of Man," in which there is a chapter, "A Great City considered in Physical, Moral, and Political Views." He began the chapter with this sentence:—"In all ages an opinion has been prevalent, that a great city is a great evil; and that a capital may be too great for the state, as a head may be for the body." The latter part of this sentence suggests that probably "political" more than either "physical" or "moral views" were at the bottom of the alarm and anxiety inspired into the hearts of kings by the growth of cities. Despots naturally must regard it with jealousy. Cities have in all ages been the birth-places of movements in favour of popular rights and nurseries of political freedom. Still the physical necessities begotten by the aggregation of men have always formed the chief element in the difficulties of their government. The cry for bread was heard as often as the strains of the *Marsellaise*, in the opening scenes of the French Revolution.

In the case of Paris and of London, attempts were made, at a very early date, by the sovereigns of France and England, to check their growth by direct prohibition. I cannot open up the main purpose of my lecture better than by giving you the reasons assigned for this mistaken and futile endeavour. I need not tell you that Paris and London paid as little heed to those imperial edicts as the advancing waves to the behests of Canute. But the most important of the features of city life which troubled the minds of kings still exist, and nowhere more strongly marked and clamant for reform than in this country and in our day. Now the

responsibility has passed with political power from the throne to the people. The difficulties and national dangers inherent in the physical circumstances of cities cannot be better expressed than they were in the language of kings centuries ago, but the centuries have passed and the difficulties and dangers remain. It rests with the sovereign people, in the first place, to grasp as clearly, but in the next place to attempt with more success to solve the problem. The object of my humble endeavour to-night is to help you to the accomplishment of both objects.

The attempt to limit the growth of Paris by prohibiting the erection of new buildings beyond certain bounds was begun in 1549, and renewed from time to time down to 1672, when Louis XIV. justified his edict by the following reasons :—“(1.) That by enlarging the city, the air would be rendered unwholesome. (2.) That cleaning the streets would prove a great additional labour. (3.) That adding to the number of inhabitants would raise the price of provisions, of labour, and of manufactures. (4.) That ground would be covered with buildings instead of corn, which might hazard a scarcity. (5.) *That the country would be depopulated by the desire that people have to resort to the capital.* (6.) That the difficulty of governing such numbers would be an encouragement to robbery and murder.”

Queen Elizabeth prefaced her proclamation issued in 1602, prohibiting the erection of new buildings within three miles of London, with the following preamble :—“That foreseeing the great and manifold inconveniences and mischiefs which daily grow, and are likely to increase, in the city and suburbs of London, by confluence of people to inhabit the same ; not only by reason that such multitudes can hardly be governed, to serve God and obey Her Majesty, without constituting an addition of new officers, and enlarging their authority ; but also can hardly be provided of food and other necessaries at a reasonable price ; and finally, that as such multitudes of people, many of them poor, who must live by begging or worse means, *are heaped up together, and in a sort smothered with many children and servants in one house or small tenement ;* it must needs follow, if any plague or other universal sickness come among them, that it would presently spread through the whole city and confines, and also into all parts of the realm.”

Such were the dangers and disadvantages of large cities as they appeared to the rulers of those distant centuries. Some of them, and notably those of government and food supply, have in the interval been fairly met or even overcome by improved local administration and the repeal of the corn-laws. The standard of health of cities has also been enormously advanced, but it is still true that the rural districts are being depopulated to maintain the towns, that the inhabitants of towns are, in the words of Queen Elizabeth, "heaped up together, and in a sort smothered with many children" in small tenements, and that towns are, though much improved, "unwholesome" as compared with the rural districts from which their active, reproductive population is drafted.

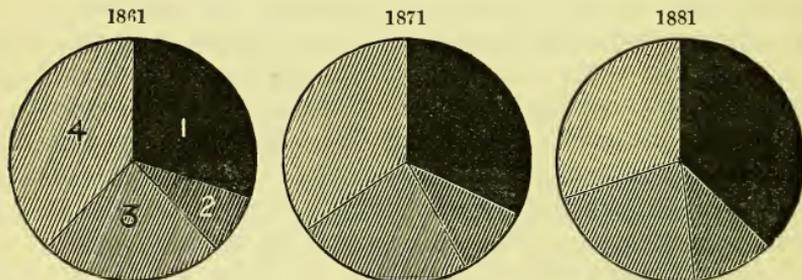
Let me now try to put before you as concisely and simply as may be some information as to the growth of towns in Great Britain, as to the manner of this growth and the vital characteristics of a town as compared with a country population. In doing so I shall state nothing which is not capable of proof by actual statistics, but remembering how difficult it is to make figures popular, I shall use them as sparingly as possible.

In this country, Government, to use a commercial phrase, takes stock every ten years. In England the whole country is divided into Sanitary Districts, which are classified as Urban or Rural according as, from the density of the inhabitants, they require more or less stringent sanitary provisions. In 1861 it was found that 63 per cent. of the entire population of England lived under Urban conditions, in 1871 this proportion had risen to 66 per cent., and in 1881 to 68 per cent. In other words "in 1861 there were 172 dwellers in towns to 100 dwellers in rural districts; but in 1871 the number had risen to 192, and in 1881 had reached 212." The growth of London has been so extraordinary, we may say portentous, that it deserves a special reference. In 1801 it was found that out of every 100 of the entire population of England eleven were inhabitants of London, and this proportion has advanced steadily with every census until in 1881 it had reached fifteen.

In Scotland we have no such sub-division of the country into districts on the basis of their sanitary requirements; but the Registrar-General classifies the population according as they live

in principal, large or small towns, or in mainland-rural or insular-rural districts. This will equally well serve our purpose. In 1861 we find that 61 per cent. of the entire population of Scotland lived in towns; in 1871 the proportion had risen to 65 per cent., and in 1881 to 69 per cent. You will observe that the absorption of the rural population into towns is advancing more rapidly in Scotland than in England; and the fact assumes more importance than is at first apparent, when we remark that it is into the eight principal towns that the population is flowing. While the proportion of the people found at each census in the smaller towns and villages was falling off, the proportion found in the chief towns was rising from 29 per cent. in 1861 to 32 per cent. in 1871, and 38 per cent. in 1881. Glasgow is devouring the population of Scotland even more rapidly than London that of England. At the census of 1871 we find in Glasgow and its suburbs no less than 17 per cent. of the inhabitants of all Scotland, and in 1881 this proportion had risen to 18 per cent.

DISTRIBUTION OF POPULATION OF SCOTLAND IN TOWN AND RURAL DISTRICTS.



(1) *Principal*, (2) *Large*, (3) *Small*, *Towns*. (4) *Rural Districts*.

If we look more closely at a town as compared with a rural population, we discover various characteristic features which it is of interest and importance for us to note. There is always in towns a much greater proportion of adults of both sexes, persons at the prime of life. The marriageable females are greatly in excess of the males of the same age. As a natural consequence, early marriages are much more frequent in the towns than in the rural districts, the birth rate is higher, and the proportion of children under five years of age is in excess. But between five and fifteen years of age the proportion is reversed. Though the

town population is more productive, it is less conservative of child-life than the rural population. Another equally sinister characteristic of a town population is that, while above forty-five in country districts, the proportion of persons still living in the married state is maintained, even to extreme old age ; in the towns it falls off in comparison, and is replaced by a large excess of widows and widowers.

If we enquire where towns-people were born, we discover that a very large number, amounting in the larger towns to one-half, are not natives of the town. They hail from agricultural districts and villages. Their speech shows every variety of provincial dialect. In manufacturing towns, and among the unskilled labourers everywhere, we recognize a strong Irish element. If we single out the adults, the persons who are engaged in the workshops, factories, warehouses, who are bustling about the streets in the full vigour of life, we find that a very small proportion, perhaps a third only, belongs to the town, while among the children and the adolescents the relation is reversed, a third being strangers, which still, however, indicates a large admixture of outlandish blood.

Such is a general statement of the comparative composition of a town and a country population, if we contrast them at any one period of time. These differences are the final outcome of all the vital movements which are progressing from day to day and from year to year—migrations of families and individuals, guided by every variety of motive, from town to country and from country to town, over the face of the land, and of the balance of births and deaths within the towns and rural districts. It will both interest you, and expose more clearly to your apprehension the nature and extent of those vital movements, if we take a rapid glance over broad Scotland in the interval of ten years, between 1871 and 1881, and endeavour to illustrate the process which throughout the kingdom is resulting in the gradual absorption of the population within the limits of towns.

There are only two ways of exit from the ranks of the inhabitants of a district, whether it be urban or rural—by death or by *e*-migration. There are only two ways of entrance—by birth or by *im*-migration. If, therefore, we find that the population living within any fixed boundary has *increased* by more than

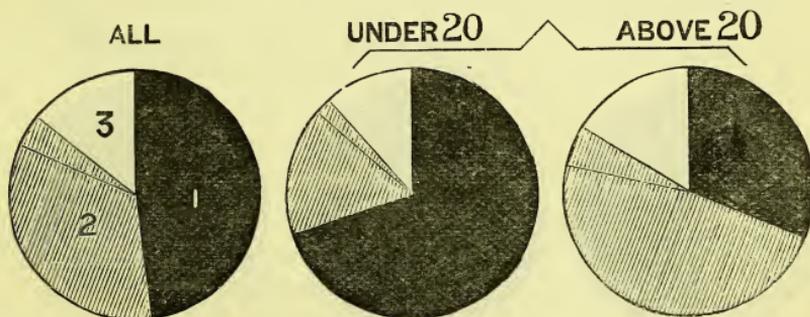
the surplus of births over deaths, or in spite of an excess of deaths over births, then there must have been *im*-migration within that boundary from the outside. If, on the other hand, we find that the population has *diminished* by more than the excess of deaths over births, or in spite of a surplus of births, then there must have been *e*-migration outside the boundary from within. The universal experience is, that towns are growing in excess of their surplus births, and that rural districts are diminishing in spite of an enormous surplus of births. Therefore, we are shut up to the conclusion that there is a continual migration from the latter to the former. Take further into consideration this fact—that both the death-rate and the birth-rate of towns are much higher than the death-rate and birth-rate of the rural districts, and I ask you, is it pronouncing a harsh judgment upon the towns to say that they devour their own children and fill their empty places with the children of the rural districts?

But I am departing from my proposed illustration from the case of Scotland. I shall take the average results of the ten years, 1871 to 1881. The eight *principal towns*, all having above 25,000 inhabitants, had an annual excess of births over deaths of 13,340, but they increased by 21,760 souls every year, so that they absorbed every year 8420 *im*-migrants. Their average birth-rate was 33 and their death-rate 23 per 1000 inhabitants. The *large towns*, all having from 10,000 to 25,000 inhabitants, had an annual excess of births over deaths of 5560, but they increased by 6106 souls every year, so that they absorbed every year 546 *im*-migrants. Their average birth-rate was 42 and their death-rate $26\frac{1}{2}$ per 1000 inhabitants. The *small towns*, all having from 2000 to 10,000 inhabitants, had an annual excess of births over deaths of 12,174, but they only increased by 9384 souls, so that they sent out an annual surplus of 2790 persons. Their average birth-rate was $32\frac{1}{2}$, and their death-rate only 18 per 1000 inhabitants. The *rural districts* had an annual excess of births over deaths of no less than 15,815, but they only increased by 305 souls, so that they sent out a surplus population of 15,510 persons every year. Their average birth-rate was 32 and their death-rate less than 18 per 1000 inhabitants.

Although these figures seem very simple, they, in reality,

represent the final result of very complex social movements, which, if followed out, would lead us into nothing less than a statistical analysis of the population of the habitable globe, including even the Scotchman, who is said to be sitting on the top of the North Pole! When we strike the balance of births and deaths over all Scotland, and compare the absolute increase of the population of all Scotland in those ten years, we find that over 93,000 persons must have left the country altogether; joined the great army of Scotch invaders of England, or emigrated to the Colonies or elsewhere. Then we have also to remember the steady influx from Ireland. Nor are the movements between town and country all one way. There are counter-currents from the town to the country, which become specially active in times of commercial depression. But we need not complicate our thoughts with these phenomena. They are all subordinate to the general law, which is the transference of an increasing proportion of the whole population, from the conditions of life in the country to the vastly different conditions of life in the town. I wish you to have a clear understanding of the final result of all this interchange of people, of birth and death and migration, upon what may be called the statical condition of a town. This gives us the practical result, which will form the text of the remainder of my

PROPORTION OF NATIVES AND IMMIGRANTS IN EDINBURGH—1881.



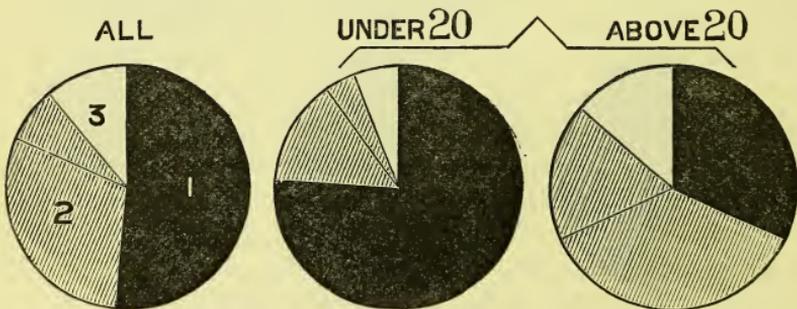
- (1) *Natives.* (2) *Rural Districts, the Irish element indicated by small segment.*
 (3) *Born in seven towns and elsewhere.*

lecture; and, for this purpose, if I may venture to trouble you with a few more figures, we may take Edinburgh and Glasgow. What was the composition as to birth-place of the inhabitants of

those cities as they were in 1881, after all the complex movements of the past centuries had passed over them ?

The growth of Edinburgh during the ten years preceding last census was supplemented by an annual draft from external sources of 578 persons, over and above her own birth-product. In 1881, out of every 100 of her inhabitants, only 48 were natives ; 34 had been born in the counties of Scotland, exclusive of the seven principal towns ; 7 had migrated from their birth-place in those towns ; 5 had come from across the Border ; and only 4 were of Irish origin ; leaving a balance of 2 contributed from outlandish sources. If we divide the inhabitants of Edinburgh into two classes, one consisting of persons under twenty years of age, and the other of persons aged twenty years and upwards, and then contrast the birth origin of these two classes, we get the following interesting and instructive result. We shall call the younger class the *adolescents* and the older the *adults*. Of the adolescents 71 out of every 100 were natives of Edinburgh, of the adults only 31 ; of the adolescents only 16 hailed from the counties of Scotland outside the seven principal towns, of the adults 48 ; of the adolescents 6 had migrated from those towns, 4 were of English origin, and only 1 of Irish, as compared with 8, 6, and 5 respectively among the adults, leaving in each case a balance of 2 derived from outlandish sources.

PROPORTION OF NATIVES AND IMMIGRANTS IN GLASGOW—1881.



- (1) Natives. (2) Rural Districts, the Irish element indicated by small segment.
(3) Born in seven towns and elsewhere.

In the case of Glasgow it is necessary to include the suburbs to get a true measure of the indebtedness of the entire community to external sources for the increase of its population. We then

find that her own birth-product was supplemented by an annual draft of 2340 persons. The materials for an analysis of the inhabitants of Glasgow and suburbs as to their place of birth are not accessible to me. I must therefore take the artificial Glasgow of the Registrar-General. In 1881, out of every 100 of the population of this "Glasgow," only 51 were natives, 26 came from the counties of Scotland outside the seven principal towns, 13 were natives of Ireland, 5 came from the other chief towns, 3 were of southern origin, leaving 1 to represent the foreign element. As in the case of Edinburgh, if we separate the inhabitants of "Glasgow" into "adolescents" and "adults," we find that out of every 100 of each class among the adolescents there were 76 Glasgowerians, among the adults only 31; among the adolescents only 14 hailed from the Scotch counties, exclusive of the principal towns, among the adults 37; among the adolescents only 4 were of Irish origin, among the adults 20; while of the former class 3 were natives of the chief towns, and 2 were from over the Border, as compared with 7 and 4 respectively of the latter class, leaving in each case a balance of 1 foreigner to complete the 100.

These are fair samples of the results of the family management of towns. If we turn up their register of births from year to year, we find them overflowing; but when we call upon them at the census we find that half of the family are changelings. In that chapter of his quoted at the outset of this lecture, Lord Kames remarks, contemplating the comparatively modest requirements of London a century ago:—"The annual supply amounts probably to a greater number than were needed annually for recruiting our armies and navies in the late war with France. If so, London is a greater enemy to population than a bloody war would be, supposing it even to be perpetual. What an enormous tax is Great Britain thus subjected to for supporting her capital! The rearing and educating yearly for London 7000 or 8000 persons requires an immense sum." In 1865 Dr Morgan, in a paper on "The Deterioration of Race in Large Cities," estimated that in order to maintain the growth of London "the whole available resources of a vast country nursery, peopled by nearly two millions, must be called into requisition."

Observe I do not find fault with the towns for attracting

“young rusticity,” or young rusticity for being attracted. There are natural and insuperable limits to the number of people who can live upon the soil which they cultivate. In all ages a time has come sooner or later when, those limits having been reached, the surplus population has, in the search for subsistence, forced its way into “fresh fields and pastures new.” The boy,

“When first he leaves his father’s field,
And at night along the dusky highway near and nearer drawn,
Sees in heaven the light of London flaring like a dreary dawn,
And his spirit leaps within him to be gone before him then,
Underneath the light he looks at, in among the throngs of men ;”

this boy is but a drop in the great tide of men, which flows peacefully to many shores under the same impulse which hurled the surplus hordes of the crowded north in a raging sea down upon the Roman Empire and overwhelmed it. I do not complain of the continued operation of this natural law. It is futile to oppose it, as those sovereigns tried to do by edicts and ordinances. What I do protest against as a great national injury is that the towns do not rear their own children into healthy and vigorous citizens, competent to supply some larger proportion of their wants. They receive those selected lives, reared by the parental care of rural districts, aided by favouring physical conditions, and they subject them to physical conditions which are fatal to child-life, and slowly sap the vigorous rustic constitutions of the parents. Look at those circles exhibiting at each successive census the proportions of the whole population of Scotland living under the conditions of town and country life, where black in three shades represents the towns in their three grades of size, and green stands appropriately for the country.* Observe how the black is steadily spreading and the green retiring before the inroads of the black. Remember that the birth-rate is much higher in the towns than in the rural districts, and that consequently the proportion of the total birth-crop of the nation, which is exposed to the adverse influences of towns, is larger than the black represents, and the proportion springing up under the benign conditions of rural districts less than the green repre-

* See page 84, where the diagram referred to is reproduced, with shading instead of colouring.

sents. Now endeavour to estimate the gravity of this ever-advancing revolution in the vital constitution of the nation by its results on child-life. Speaking of Scotland as represented in those diagrams, as the black extends you have a condition of things extending, in which, of every 1000 children born, 137 die before they have reached their first birth-day. As the green diminishes, you have a condition of things diminishing, under which only 90 are thus prematurely cut off. But the deepest shade of black, the largest towns, is steadily absorbing a larger proportion of the dark area, and this means the extension of conditions under which 150 out of every 1000 children born perish within a year of birth. Glasgow is extending most rapidly of all, and she makes away with 153 per 1000 of her children before she has had them a year in her fatal arms. Scotland is but a small item in the United Kingdom. Her whole population is less than that of London, and only constitutes between one-ninth and one-tenth of the United Kingdom. A much larger proportion of the English than of the Scotch people live in large towns, and the large towns of England are much more deadly to child-life than those of Scotland. Within a year of birth they destroy on an average 185 of every 1000 born. If we take individual towns, the sacrifice is still more dreadful. For example, in Liverpool it is 219 out of every 1000 born, and in Leicester it sometimes rises as high as 245, that is to say, one out of every four of the unhappy babies of Leicester is buried within twelve months of its birth.

You know that in war when you read that so many were killed, you always read further that so many were wounded. You do not need to be told that of the wounded many more will die, and that the majority of those who ultimately survive will be more or less maimed and crippled, and a large proportion will be invalided and found unfit for further service. So it is with those troops of children. If 137, or 153, or 185, or 245, in four several troops of 1000 each, have died within one year of their entrance upon the campaign of life, then a proportion keeping pace with the rising fatality will be wounded. Of these many more will die as the campaign progresses, and the survivors will be invalided and found unfit for further service. Still further, if only 90 have died in another troop, you need not be told that the

physique of those who survive must on the whole be more vigorous and serviceable than the physique of the survivors of those other thousands. I reason thus to lead you to the conviction, without appealing to the comparative statistics of stature, rate of growth, weight, chest-girth, and all those facts of anthropometry or man-measurement, that it cannot but be that the physique of town born and bred men and women is inferior to that of men and women born and bred in the country. This being admitted, if the proportion of all the children of a nation who are town born is increasing from year to year, then the physique of the whole country must be deteriorating in quality. The rural districts furnish the only resistance to our progress down the inclined plane, and just as the towns absorb the inhabitants of the rural districts, this resistance will become less, and the national descent more rapid.

Now, you know what I mean by "The Children of the City," and you can estimate the importance of my question:—"What can we do for them?"

I must endeavour to work out for my remarks some limiting lines derived from the characteristics of the child as contrasted with the man, otherwise I shall be led into a general disquisition upon health and the whole round of sanitation. I confine myself mainly to the physical aspects of childhood. The child has to grow the machine which as an adult it will use. In the first year of life, the child adds more to its bulk than in any subsequent year. It trebles its weight, and adds $7\frac{3}{4}$ inches or 41 per cent. to its height. In the second year it gains nearly 4 inches more, and so by gradually diminishing increments attains "the full stature of the perfect man." It follows from these facts that every element of health which influences the adult tells much more upon the child either for good or ill. The adult is in a position of stability, and has mainly to strive to keep what he has got, to resist deterioration. The child has not merely to resist but to store up. It must progress or it will die. The child is physically, even more than morally, the father of the man. It may change morally, but it cannot get rid of rickety bones, or impaired organs, or a tainted constitution. If it gets insufficient or improper food to eat, foul air to breathe, impure water to drink; if it is cramped in space and cradled in dirt, it

cannot help itself. It must succumb or grow up through sickly and unhappy adolescence into weak and stunted manhood. This helplessness is one of the pathetic features of childhood, which should touch the heart of society on its behalf. No moral blame attaches to it for the circumstances and surroundings into which it is born. The child's sufferings are vicarious—if for sins and shortcomings, they are not its own. The element of discipline which enters so largely into the physical conditions of the adult life, and makes the thoughtful philanthropist hesitate in his work of relief and amelioration, has no place in our dealings with childhood. As regards pure air, pure water, cleanliness in all its details, nothing more need be said than that the child enjoys the largest share of the blessings which descend upon the community which is well cared for in these respects. The general sanitary improvement of our towns tells first and chiefly upon the children. So also with everything affecting the morals of the adult population. Vice and drunkenness strike at the child through the physical deterioration of the home, and the destruction of that self-denying and scrupulously conscientious discharge of parental responsibility upon which the weak and helpless child is so utterly dependent. The city quickens every element, the bad as well as the good, in human nature. So if we find there more culture, more moral earnestness and elevation, more intense religious life, more philanthropy, more political fervour than in the country, we also find there more vice, more crime, more self-indulgence, more modern heathenism, more political and social quackery. At the root of a high infantile death-rate, there are always elements of moral delinquency in the parents, and drunkenness is unquestionably the most potent for evil of all the moral factors. It devours the material necessities of child-life by diverting the money which should provide food, clothing, education, air-space in the house, to the tills of the publican. It transforms the kindly, self-denying father into a selfish, heartless brute. It impairs the constitution of the child before it has entered the world. It taints the mother's milk after the child is born, and deprives it of all the tender nurture which instinct secures for the offspring of even the inferior animals. This is all I intend to say of the morals of this complicated question of child-life in cities. I feel bound to say so much simply to show that I am alive to their

existence and importance. It is a favourite method of landlords and others, whose material interests are affected by the arguments of those who advocate the improvement of the physical conditions of life in cities, to divert attention from one of the many causes at work which happens specially to touch their pockets, to another cause which somehow or other always has this feature to commend it—that it shifts the burden from their shoulders. It is also a failing of one-eyed though zealous social reformers to magnify their particular fad, and so aid and abet, it may be unwittingly, the numerous class of interested obstructives. They join heartily in any cry of “lo! here,” “lo! there,” as the most likely way to secure that nothing at all will be done, and so their interest will be conserved.

Let us assume, then, that a city child has parents who are sober, industrious, honestly desirous to do their best in the circumstances in which they are placed, to rear it. Let us also assume that it has been born in a city which has a good water-supply, which is well-drained and sewered, and, on the whole, as cities now-a-days are, fairly well looked after as to general sanitation. If I were asked to express in one word what it is that the city child still lacks which the country child possesses, and what it is that the child as a child, wherever it may live, most requires, I should reply, “Space,” or the Anglo-Saxon equivalent, “Room.” So soon as men cease to use that portion of the surface of the earth on which they reside for the production of their food, they are relieved from the necessity of distributing themselves over the surface. Instead of farms and crofts and cottars’ houses, with intervening fields and roads, we have villages, towns, and cities with only so much bare space left in them as is necessary for inter-communication by narrow lanes and streets. The relation of space to people is regulated not by agricultural necessities, but by competition for living and working-room upon it. The larger the city the hotter grows this competition. It is hottest in the heart of it, where house is piled upon house, and tenement crushed in upon tenement, and ever the less becomes the proportion of space per inhabitant, and the scantier the access of the air and the sunlight. The fields fly further and further away from the advancing Medusa of the city, whose look turns them into stone.

This element of space comprehends all the physical conditions of health so completely that, under the name "density," it is recognised by vital statisticians as the best standard of measurement of those conditions in different districts for comparative purposes. It may be variously expressed. The population divided by the superficial area in acres upon which they live, gives the number of persons per acre—which is 84 in Glasgow, and may be only the twelfth part of a person in a rural district. The opposite calculation gives the fraction of space per person—which is the eighty-fourth part of an acre, or about 58 square yards in Glasgow, and may be 12 acres in a rural district. Another interesting expression of the same facts is got by supposing each man, woman, and child to stand in the middle of his or her own plot. How near would they be to one another? This is called the "proximity," and in Glasgow the distance would be 8 yards, while in the rural district it would be 147. But it is the house-space which is of most importance to the child, and most of all in a city where the space outside the house is so restricted. It does not matter much to the country child whether it resides in a mansion or in a sheiling with a "but and a ben," or even in a "but" without the "ben." Outside there is boundless space. The cottar's wife can carry her baby over the threshold with the certainty of seeing the sun, and giving it a bath of pure air. The cottar's three-year-old can toddle over the grass and fill its hands with daisies, and the school-boy can run and leap for miles. But the town child finds no such compensation outside the one-room house. Therefore this aspect of density is the most serious of all from our present point of view. Again turning to Glasgow for illustration, we find that the average size of the Glasgow house is only between two and three rooms, and that every room is occupied by an average of more than two people. Of every four persons living in Glasgow, one resides in a one-room house. There it is found that the smaller the house, reckoning size by rooms, the more people occupy it in proportion to the cubic air-space within. In large houses, therefore, space is a luxury. It is in excess of the requirements of health. In the small houses, on the other hand, it is pinched and reduced below those requirements. It is like insufficient food or clothing, a manifestation of straitened circumstances, or of thoughtlessly distributed expenditure.

It is necessary for scientific purposes to be able to express the facts of density, so far as measureable, by such figures ; but while I feel that it is not necessary to tell you that there is only one-twelfth part of a person per acre in a rural district to enable you to understand the healthy conditions which there prevail, I am painfully aware that to tell you of the average eighty-four persons per acre in a city makes you little the wiser. Even when I add that one out of every four of these persons lives in a one-room house, there is still something wanted to give you some conception of the disadvantages of child-life in such conditions. Let me try to help you to fill in a few corners of the picture, for I make no reference to the disease, the moral contamination which spring from these conditions, but only to some special uses of space which are indispensable to childhood.

Some of you may have read a clever little book called "Ginx's Baby, his birth, and his other misfortunes," and if so, you cannot have forgot the circumstances of space in which this baby, the twelfth of its name, found itself. "The dimensions of the bed were 4 feet 6 inches by 6 feet. When Ginx, who was a stout navy, and Mrs Ginx, who was, you may conceive, a matronly woman, were in it, there was little vacant space about them. Yet as they were forced to find resting-places for all the children, it not seldom happened that at least one infant was perilously wedged between the parental bodies ; and latterly they had been so pressed for room in the household that two younglings were nestled at the foot of the bed. . . . The family sleeping-room measured 13 feet 6 inches by 14 feet. Opening out of this was their kitchen and sitting-room ; it was not quite so large as the other. This room contained a press, an old chest of drawers, a wooden box once used for navy's tools, three chairs, a stool, and some cooking utensils. When, therefore, one little Ginx had curled himself up under a blanket on the box, and three more had slipped beneath a tattered piece of carpet under the table, there still remained five little bodies to be bedded. For them an old straw mattress, limp enough to be rolled up and thrust under the bed, was at night extended on the floor. With this and a patchwork quilt, the five were left to pack themselves together as best they could. So that, if Ginx, in some vision of the night, happened to be angered, and struck out his legs in navy fashion,

it sometimes came to pass that a couple of children tumbled upon the mass of infantile humanity below."

The only detail of this graphic picture which is not true to nature is that all those twelve children survived. In real life, at least half of them would have been laid to rest in the churchyard, for there is nothing more striking in one's experiences of visiting such localities than the uniform tale of large families and high mortality—ten, twelve, fourteen, or more children, and only two or three alive. Mr Ginx was a labourer, earning 18s. to 20s. per week, and living in London. In Glasgow he would have occupied a one or two apartment house in a back land, up several flights of stairs, at the end of a dark lobby. There young Ginx would lie, his first breath, like every subsequent one, filling his lungs with the foul air of a crowded and not very clean house. By and bye he would get an airing, in the shape of a promenade in the arms of his little sister, through the back court, a sunless pit, full of the smoke of washing-houses and the smells of ashpits. As soon as she got tired or felt anxious for a little independent diversion she would deposit him on the steps of some convenient stair, or on the shivery asphalt. At other times Mrs Ginx would take him out shopping, having first carefully locked the others in, generally on the Saturday nights, in all weathers, and perhaps from certain difficulties in the way of getting Mr Ginx home, returning very late. The nearest place where she could find a sunlit space with trees and grass and some approach to fresh air is a public park a mile or two off, but Mrs Ginx cannot leave the others, and she is unable to carry or pilot them through crowded streets so far, even if she has not lost all notion of the use of such a trouble, which is very likely. The outcome of the whole situation is that baby is scarcely ever out of that stuffy room. When he begins to creep about, he is constantly in the way, and is either put up on the bed to keep him out of the risk of being scalded or burned or trodden upon, or is sent out with his little nursemaid sister to look at the shop windows, or be planted down in his familiar back court, where he may be seen, like that other child seen by Aurora Leigh on the "uneven pavement" of St Margaret's Court—

"Whose wasted right hand gambled 'gainst his left,
With an old brass button in a blot of sun."

Those restless movements of the tiny hands and feet which are so troublesome in the small house and must be restrained, are the first manifestations of that instinctive craving for exercise which characterizes all young animals. They are essential for the proper development of the body, and ought to be encouraged. As intelligence grows and as the child obtains more and more command over its body, this instinct expands into the desire to play. Then begin for all the tribe of Ginx troubles, which thicken the further they advance into boyhood and girlhood. If you wish to understand the position of play in the physical, mental, and moral development of the child, you must read a little book, admirable alike for its wisdom and gentleness—"What is Play," by Dr Strachan, published in this city some years ago. Play he defines as "All voluntary exercise in the young, prompted by natural inclination and producing pleasure." He points out that the desire to play is an instinct implanted in the child as in other young animals, "to secure in the young the exercise required for development, just as the appetite for food is intended to secure proper nourishment." In short, play is essential for the health and duly proportioned growth of the child. It is that which makes the man and woman, who no longer desire to play, but are impelled by the exigencies of life to maintain by useful work the physique of which the foundations were laid in play.

In this aspect of play consider the position of our city children. They are impelled by a restless, ceaseless instinct, and not by the Devil, as the landlords and the police seem to think. Pent up in common stairs and in back courts, without a bit of space which they can call their own, their play inevitably becomes in great part mischief. What can a poor boy do but pull bricks out of the walls of the ashpit to build houses with, or climb upon its roof and tear the slates off to make traps for the city sparrows? If they fly kites the policeman cuts the string: if they dig holes in the court to play at marbles, the factor denounces them to the police: if they play ball against the wall, the policeman grabs the ball: if they make slides on the pavement, he puts salt upon them: if they try to swim in the river, they are almost poisoned by the sewage, and when they come out it is to find the man in blue waiting for them beside their clothes: if they pitch a wicket on an empty building site, the birl of the well-known whistle stops

the game before they have completed their innings. The girls are no better off. As you feel your way along the dark lobbies, blinded by the light you have just left behind you, you stumble over them playing at houses. As you ascend the stairs you have to pick your way through their assortment of broken dishes and odds and ends with which they are reproducing their meagre experiences of house-keeping and shopping.

A philosophic induction made by Dr Strachan is well illustrated in the city child. He says :—"In all cases the prevailing characteristics of play correspond with the peculiarities of manners, habits, occupations, and pursuits which characterize the adult population." How often do we see the city child playing at being drunk, or at policemen and thieves, or fighting as their elders do. In short, I know of nothing more pitiful among all the pitiful results of want of space upon city life than this compulsory perversion of a natural instinct into unwholesome ways. It has a positive and a negative aspect. In so far as the instinct is gratified it results in the acquisition of destructive habits, and in moral and physical contamination. In so far as it is repressed it robs the child of the proper fruits of a God-given instinct—the development of healthy bodies, predisposed for useful work ; a sprightly, manly disposition and an active mind. As the child passes into the youth, what can we expect from such a childhood but a breed of "loafers" and "muffs" ! When the child becomes the half-timer and the apprentice, and play assumes the higher form of recreation or renewal and restoration of body and mind by the substitution of sport for daily toil, the city affords no more facility. Their poor pence cannot afford the lease of a field for cricket or football. What can a poor lad do but stand at the close mouth, with his hands in his pockets, smoking or chewing tobacco, talking obscenity, and ready for the dram-shop and the singing-saloon ? Need we be surprised that when they become men, they think the best way to enjoy a holiday is to start for a sail or a run by train to some seaside resort or country place, each with a bottle of whiskey in his pocket ; or that the arrival of an "excursion" is looked upon with alarm by the inhabitants of our villas and marine palaces ?

"What can we do for them ?" First, let me say, you can do much for yourselves. Every facility for locomotion—the tram,

the suburban train—makes it less a sacrifice of personal convenience for the toiling fathers to choose a house as far afield as possible. I advise working-men to live as far from the heart of the city as they can, but I wish specially to speak of what can be done by public effort after you have done your best to help yourselves. Here the philanthropist is met by his familiar bewildering difficulty. Life is fleeting. There are human beings *now* undergoing hardships, suffering from abuses. Can nothing be done to ameliorate on the one hand, while on the other the radical cure is being patiently worked out? This question must be put with peculiar urgency in reference to everything which affects the welfare of children. Their childhood is passing rapidly away. Every year it ends for some of them. But there are some things which can be done at once. We can in various ways bring the children to the country, and do some little bits of good work in the town. The larger task of bringing the country in such measure as is possible into the town involves the revolutionizing of the prevailing principles of laying out and building cities, and the carrying out of improvements in the course of years.

In suggesting ways of bettering the physical conditions of the children of the city, I shall trust very much to that quick perception of the practical necessities of the case which a good cause never fails to secure in a Christian community. I believe that the best way to promote the cure of a social disease is to take pains to convince the public that the disease exists, and to exhibit its precise nature, rather than to attempt to elaborate a detailed plan of treatment. There are already many good souls in all large cities who are in various ways doing their best to bring a little of the sunshine and beauty of God's earth into contact with the lives of the children of the city. I shall not, therefore, pretend to exhaust the resources of benevolence.

I first warmly commend a system of "Holiday Colonies," which, originating in Switzerland ten years ago, has since spread over many of the towns of Germany, Austria, Italy, and has reached even Russia. Those desirous of fuller information will find it in a paper contained in the eleventh volume of the "Literature of the London Health Exhibition of 1884." A local committee is formed, and funds are collected during the winter and spring. The head teachers of the primary schools are

requested to furnish lists of the deserving, really poor, weakly but not actually sick children, between seven and fourteen years of age. These are medically examined, and as many selected as the funds admit. They are then assorted, sometimes in large colonies of thirty or forty each under two or three teachers, but more usually in small bands of ten to fifteen under single teachers. Their clothing is supervised by the ladies, and supplemented by gifts where necessary, but only after getting as much out of the parents as possible. Then farm-houses, school-houses, or even small inns are chosen in the open country. The month which constitutes the school holiday is thus spent. Careful observation by weighing and measuring has shown that the improvement in health effected by these outings is not temporary. The selected children continue to gain in height and weight beyond their fellows. Increased quickness of intellect and great moral improvement are also conspicuous. As to the cost, including a honorarium to the teachers in charge, it only amounts to an average of scarcely two shillings per day for each child. I need not remark that anybody who can afford it may engage unostentatiously in this good work, by giving a holiday to one or two city children.

In America, there are in every city numerous organizations under various names, such as the "St John's Guild" and "Tribune Fresh-Air Fund" in New York, "The Poor Children's Excursions" in Boston, "The Children's Country Week" in Philadelphia, all of which take the children out for longer or shorter periods to the country. In many Transatlantic towns, arrangements exist for giving young children sails on sea or lake during those hot months of summer which blast the infant lives of their population like the hot breath of the Sirocco. Tickets for these sails are usually distributed through the Health Department or the Police, and the mothers accompany the children.

I mention also the "National Physical Recreation Society," established last year in London under the Presidency of Mr Herbert Gladstone, "for the promotion of Physical Recreation among the Working Classes." Its scope is very wide, embracing facilities for physical exercise both in winter and summer. This society has started a magazine—"The Gymnasium News," in which you will find an ample explanation of its machinery and method of work. I commend it as deserving of hearty support.

I merely refer to the establishment of "Day-nurseries" for the care of infants whose mothers must work for a livelihood, to Kyrle societies, to the utilization of board-school play-grounds, to the throwing open in summer of private gardens and parks, as has been done by the Inns of Court in London, where, under supervision, children are admitted in the evenings; to the hiring of play-rooms in poor districts, with toys and material for games, where shelter and amusement may be found in the dreary winter. These notes will serve as hints to the philanthropic, anxious for the opportunity of doing an immediate and lasting bit of good in their day and generation. Every large city should have a society such as the "Metropolitan Public Gardens Association," over which Lord Brabazon presides, to promote and systematise this work in the locality.

The second part of my answer to the question:—"What can we do?" refers to the making of cities more like places where children form part of the population, and are intended to be reared. At present they seem to have been laid out by some Board of Bachelors, or Malthusians, or Herods. "It is a pity," says Mr Kellogg, of New York, "that in the administration of great cities the interests of half their population are so little accounted of. They are managed for adults, for trade, for property-holders. Why should provision not be made for the sports of childhood? Let spaces for fresh air be reclaimed by throwing down the walls of abandoned graveyards and legally obnoxious tenement houses; let them be preserved from the rapacity of commerce and landlords; let them be reserved until they exist in every ward of the town. In them should be malls for children's games, over which policemen should keep guard, not to repress the children's sport, but to warn off querulous and sordid age. Let the children know that they are a recognised constituent of civic life. Respect them that they may respect themselves." It is not easy to reconcile this feature of cities, either with our reason or our humanity. Just think of the pains expended by breeders of stock of every description, from fowls to race-horses, upon special arrangements for the young. The city notion is to pack the adults as closely as possible, and then shake the children down into the chinks. There are paddocks for the young horses and court-yards to the dog-kennels, but the children

must run among the feet of the passengers on the pavement or the horses on the street. There is no space they can call their own. They are in the way both inside the house and outside. One cannot but agree with Herbert Spencer when he says :—" Had Gulliver narrated of the Laputans that the men vied with each other in learning how best to rear the offspring of other creatures, and were careless of learning how best to rear their own offspring, he would have paralleled any of the other absurdities he ascribes to them." How is this ? Have we not all been children ? Are our Members of Parliament and Town Councillors some strange order of beings who sprang like Minerva, full-grown, into life, and had no experience of nurseries, or play-grounds, or cricket fields ? It is often argued by the ladies that the unfairness to their sex, which they allege marks many laws passed or tolerated by Parliament, exists because women have no vote, and cannot influence the representation. I am disposed to believe that if women had had a voice in legislation and administration, children would not have been forgotten. But why do the fathers not look to their interests ? Did any of you ever ask a municipal candidate, " Will you support a proposal to provide play-grounds for children in this ward ? " Have you ever heard the smoke question raised on such an occasion ? Do any of your political associations, after scrutinising the votes of your member on the Irish question or Dis-establishment, ever think of enquiring why, in Committee on some Police Bill, he voted for the reduction of the free space to be left behind tenements, or of the breadth of new streets ? I am in the habit of carefully scanning reports of the " heckling " of candidates at ward meetings and in Parliamentary elections, and I have found questions on every imaginable and unimaginable subject, but not one touching the health of the people. Yet those questions which I have suggested go to the roots of the improvement of cities as nurseries. Wherever the element of space is involved in any proposal for local or national legislation, support that which will give you the most space about your houses. You will always find the landlords and land-owners and speculative builders on the other side. The opposition does not come from the general body of well-to-do ratepayers who have space enough for themselves and their families. Don't allow your-

selves to be frightened by the cry of increased taxation. Those who have *pro indiviso* pleasure-grounds and pay enormous feu-duties for them are quite ready to share with you every expense attendant upon the provision of open spaces for your children. Why should you object to contribute your pence or shillings along with their pounds? You will save it in doctors' bills. The cost of burying one child would pay the tax for years. Many who live in large houses and have private grounds would not do so but for the sake of their families. They believe that the best legacy they can leave to their children is not money saved at the expense of house-room, but money invested in their ruddy cheeks, firmly knit limbs, and sound constitution.

One word of warning I venture to utter as to the situation and use of open spaces for city populations. Speaking of a working-man's wife in New York, the writer I have quoted says :—“Had she time she might carry the little one to the open squares of the city; but these are gradually disappearing, and the taxes for public pleasure-grounds and health-giving spaces are consumed upon the vast, distant Park accessible chiefly to those who have leisure or wealth.” My warning is that you working men should remember that for you the most useful open spaces are those which are close to your dwellings. Observe I do not object to those distant parks in themselves, but solely as substitutes for the occasional simple playground in the heart of the city. Both together form a complete provision for your young children whenever they can venture out during a sunny hour, as well as for yourselves on Saturday afternoons and holidays when you can go to the park with your families. I fear corporations have hitherto as a rule spent all their rates for open spaces upon these parks, and have chiefly benefited suburban communities of wealthy people who have congregated around them beyond the area of taxation. I praise and commend for imitation by other cities the wisdom of the Corporation of Edinburgh in not only providing parks, but also clearing and paving small areas here and there in the dense portions of the city. There your youngest children can sprawl about in the sunshine, and your older ones enjoy their games. See to it also that even in the distant pleasure-grounds the flower-beds do not usurp all the space, but that vacant areas are left for cricket and football. There your lads,

who cannot afford to lease fields like the golden youth of the wealthy, will have the same scope for wholesome recreation. Parks should not be places for merely dawdling along looking at flowers or admiring grass through iron railings.

I suppose many of you have read "Oceana, or England and her Colonies," by James Anthony Froude. You will remember how Mr Froude uses the facts regarding the progressive absorption of our home population in large cities, and the physical degeneracy consequent upon city life, upon which I have based this lecture. He makes them the foundation of his eloquent denunciation of a policy of separation from, and advocacy of a corporate union with our colonies. He says:—"It is simply impossible that the English men and women of the future generations can equal or approach the famous race that has overspread the globe, if they are to be bred in towns such as Birmingham and Glasgow now are, and to rear their families under the conditions which now prevail in those places. Morally and physically they must and will decline." In the first and last chapters of this book Mr Froude repeats again and again, with all the vigour and variety of expression of which he is a master, his opinion that our cities can no longer rear men, that our only hope as a nation is in our colonies. "England would pour out among them, year after year, those poor children of hers, now choking in fetid alleys, and relieved of the strain, breathe again fresh air into her own smoke-encrusted lungs." Again he uses a metaphor which, though not true to nature, yet clearly expresses his notion of the function of the colonies in the future life of the nation:—"By and bye, like the spreading branches of the forest tree, they would return the sap which they were gathering into the heart." To avert national extinction, and secure the colonies as the nurseries of the men who are to fight our battles, and preserve our supremacy among the nations, he appeals to the democracy. He says:—"If the colonies are to remain integral parts of Oceana, it will be through the will of the people. To the question, What value are they? the answer is that they enable the British people to increase and multiply." Thus, and thus only, says Mr Froude, England will remain "Queen among the nations, from without invulnerable, and at peace, and *at health within.*"

Ladies and gentlemen, I also appeal to the democracy, but my appeal is to this effect:—Do not abandon our cities to this black future. How can England ever be “Queen among the nations, from without invulnerable, and at peace and at health within,” if the old heart of the nation beats slower from year to year in an island which is being gradually petrified into cities in which children die or grow up into “Dead-sea apes”? By all means incorporate the colonies, but not as healthy limbs to a decaying body. That will not preserve to us our sovereignty. Never will it be truer that the voice of the people is the voice of God than when that voice says—“Let there be light” in those “fetid alleys,” where Mr Froude says, and says truly, “with no sight of a green field, with no knowledge of flowers or forest, the blue heavens themselves dirtied with soot,—amid objects all mean and hideous, with no entertainment but the music hall, no pleasure but in the drink shop,—hundreds of thousands of English children are now growing up into men and women.” Only say the word, and the light will come. Long before the advent of household suffrage Carlyle told you so. Let his words, repeated now, wake you up to a sense of your power. “Every toiling Manchester, its smoke and soot all burned, ought it not, among so many world-wide conquests, to have a hundred acres or so of free greenfield, with trees on it, conquered, for its little children to disport in; for its all-conquering workers to take a breath of twilight air in? *You* would say so! A willing Legislature *could* say so with effect. A willing Legislature could say very many things! And to whatever ‘vested interest,’ or such like, stood up, gain-saying merely, ‘I shall lose profits,’ the willing Legislature would answer, ‘Yes, but my sons and daughters will gain health, and life, and a soul.’”

F I S H.

IN a country like ours, surrounded by seas and traversed by rivers teeming with fish, it may naturally be expected that so important a source of wealth and of food supply should receive a large share of public attention. That this is the case, we have every evidence. We have Fisheries' Exhibitions, Commissions on Fisheries, Annual Reports on the Fisheries of the three kingdoms; we have the aid of science to promote the increase of fish, and to utilise its waste products; we have laws for the protection and preservation of fish, for the purification of rivers, for the general encouragement and protection of the fishing industry; we have an increased application of capital to provide boats, factories, and markets; some of you may have noticed in the late Exhibition the beautifully simple machinery for the improvement of fishing boats. And, lastly, great facilities have been given for the rapid carriage of fish, and for its sale in a fresh state, and at moderate prices. No one can look back on the last ten or twenty years without recognising the steady development of this great national resource, and we have special reason to congratulate ourselves on it at a time when work is scarce and wages are low. We read, however, with some anxiety, in the last Report of the Scottish Fishery Board, that "the Board have to confirm the belief that fish are not appreciated amongst the working-classes as much as they ought to be. The prejudice against fish has arisen, it seems, because a fish diet is not supposed to be capable of supporting sustained manual labour. The muscles of fish undoubtedly differ in structure and chemical composition from the muscles of the higher vertebrates. With a view of pointing out these differences, and indicating how a fish diet may be prepared to meet the wants of those

engaged in outdoor as well as indoor work, the Board hope to have several enquiries instituted."¹

The results of enquiries—more or less scientific—are not sufficiently widely known among the working-classes whom they most immediately concern, and we propose to-night to offer you some simple information on the subject.

It has been stated more than once in the course of these Health Lectures—but a fact so important stands repetition—that Foods may be divided into three classes—1st, those that replace the waste that constantly goes on in every living body; 2nd, those that produce and keep up warmth; and 3rd, those that specially give energy or working power.

In the first, or tissue-forming foods, are included all those which contain nitrogen, viz., animal food (including fish) and animal products (milk, eggs, cheese, &c.); also certain vegetable foods, chiefly the pulses and the cereals. The second or warmth-producing group includes sugars, starchy foods, and fats. And the chief food in the third or energy-giving class is fats, which, as you see, do double duty. When a man has to go through heavy physical work he requires and can digest a much larger amount of fat than when engaged in sedentary work. A healthy diet should contain foods of all these classes, the proportion being affected by many considerations, such as climate, age, occupation, and state of health. It is needless at present to consider the exact proportions recommended by scientific men; it is sufficient for our purpose to say that variety of food is of the utmost importance, not only to represent these different groups, but to ring the changes on the various foods included in them. It has been ascertained that a man may starve upon almost any single food—the balance of nutrition being destroyed—though some foods, chiefly milk, eggs, and oatmeal, are, from their mixed composition, better able to sustain life than others.

To a certain extent nature guides us in our selection of food. In tropical regions whole races subsist chiefly on vegetable foods, with a small addition of animal produce; in our temperate regions we are mixed eaters, and towards the poles flesh and fat are almost exclusively eaten. That eminent authority, Sir

¹ "Fourth Annual Report of the Fishery Board for Scotland," being for the year 1885.

Henry Thompson, asserts that in our islands we consume too much animal food, particularly the flesh of cattle ; that the cost of our food is greater than it need be ; and that our numerous forms of indigestion, and much resulting chronic disease, are further necessary consequences of the same error. He goes on to say :—" For all who are occupied with severe and continuous mechanical labour, a mixed diet, of which cereals and legumes form a large proportion, and meat, fish, eggs, and milk form a moderate but constant proportion, is more nutritious and wholesome than almost entirely animal food. For those whose labour is chiefly mental, and whose muscular exercise is inconsiderable, still less of concentrated nitrogenous food is desirable. A liberal supply of cereals and legumes, with fish and flesh in its lighter forms, will better sustain such activity than large portions of butcher's meat." *

Now, you may say, as a comment upon this, that the average working man is not likely to be able to obtain so much butcher's meat as to bring on the indigestion and other evils spoken of by Sir Henry Thompson. True ; but there is certainly a widespread idea that such a diet, if not obtainable, is at least very desirable ; and it falls within the duty of a Health Lecturer to explain that this is not the case, and that economy and healthy diet may and do go hand in hand.

What is the bearing of these remarks on Fish, the immediate subject of our lecture ? This—that fish is one of the foods specially calculated to repair the waste of the body and to build up new tissue ; and that, while the general principle applies to fish as to other foods—that living too exclusively on it produces various disorders—its qualities as a food certainly entitle it to rank higher than it seems to do at present in popular estimation.

Fish may be broadly divided into two classes,—those which have fat distributed throughout the body, and those which have the fat gathered into one part—the liver. In the first class we find salmon, herring, eels, and mackerel, and these are undoubtedly the more nutritious. The remaining white fish are included in the second class, and are, as a whole, the more easily digested. To a robust working man the fact of being easily digested is, however, no special recommendation ; his object is

* " Food and Feeding," by Sir Henry Thompson, F.R.C.S., &c.

to obtain a food or mixture of foods suited to the various wants of the body already mentioned, and that will prevent a too speedy craving for the next meal. To fulfil such objects we recommend a local dish called

CORNWALL AND DEVON FISH PIE.—Required, 1 lb. white fish, $\frac{1}{4}$ lb. fat pork or bacon, 1 lb. of cooked potatoes, one teaspoonful of finely chopped parsley, two tablespoonfuls of cold water, pepper and salt. *For the Crust*—6 oz. flour, 3 oz. suet, a pinch of salt, cold water.

Put the water in the dish; cut the fish into small pieces, mince the fat pork, mash or slice the potatoes; put alternate layers of fat, fish, and potato; season gradually with pepper, salt, and minced parsley, and take care that a layer of potato is at the top.

For the crust, mince the suet very finely, removing all fibres and pieces of skin, rub it thoroughly in a basin with the flour and salt, until it is like fine bread crumbs; add enough water to make it a stiff paste, work together with the right hand, and turn out of the basin neatly in one lump on to a floured board. Flour the rolling pin, roll out the paste once, to about half an inch of thickness, wet the edges of the dish, cover the pie with this crust, trim the edges, brush the pie over with a little milk, and bake for about three quarters of an hour.

We have added potatoes to the ordinary Devonshire dish, because in suet crust the suet always runs to a certain extent, and the pie is apt to be too fat and greasy. Boiled rice or macaroni might be used instead of potatoes. If preferred, dripping crust may be used (*i.e.*, dripping instead of suet), and if you wish a still lighter preparation you can use the potatoes mixed with a little milk as a covering for the pie instead of the crust.

This Devonshire pie is certainly a somewhat substantial and rich preparation, but it is withal a good scientific mixture. The fish represents the nitrogenous or tissue-forming element, which is also found to some extent in the flour; the fat, the bacon, and suet represent the warmth and energy-giving foods; the flour and potatoes, another and also necessary class of warmth-giving foods; and the potatoes and parsley further represent the important element of fresh vegetables.

White fish does not contain fat, and is wanting also, to some extent, in flavour, which should always be present in some at least of our foods ; although it is noteworthy that some of the foods which are most essential to us, and of which we do not tire, have but little flavour—bread and potatoes, for example.

BAKED FISH.—Required, a flat fish, about $1\frac{1}{2}$ oz. of dripping or butter, one dessertspoonful of stale bread crumbs, one teaspoonful of chopped parsley, one small onion, boiled and chopped, one tablespoonful of vinegar, one tablespoonful of water, one pinch of salt, half a pinch of pepper.

Melt half of the dripping in a tin baking dish ; cut off the fins, clean the fish, place it in the dish, and pour the vinegar and water over it. Mix the chopped parsley, onion, salt, pepper, and bread crumbs, sprinkle them over the fish ; place the dripping in small pieces over the fish ; bake in an oven for from ten to twenty minutes, according to the thickness of the fish. This dish is more delicate if lemon juice is used instead of vinegar.

The following dish has both fat and flavour provided in sufficient proportion :—

FISH AND CHEESE.—Required, 1 lb. cooked white fish, $\frac{1}{4}$ lb. well dried bread crumbs, 2 oz. old grated cheese, half a pint of the liquor the fish was boiled in, about $\frac{1}{2}$ an oz. of dripping or clarified fat, a little pepper and salt.

Grease a shallow oven tin ; put in it a layer of fish and of bread crumbs, sprinkle some of the cheese over it ; repeat this till all is in, then pour over it the fish liquor, break or scrape the dripping into small morsels, and place them on the top. Brown it in the oven or before the fire. As all the ingredients in this dish are already cooked, they only require to be warmed through and browned.

While white fish should be found more frequently in the dietary of the outdoor worker and of the robust, it is of special value to those engaged in sedentary employments, to the delicate, the young, and the aged, inasmuch as in it nitrogen or tissue-forming food is found in a sufficient and more easily digested form than in either butcher's meat, the pulses, or cereals. A theory was brought forward at one time that fish contains elements which directly nourish the brain, and so conduce to mental work. This view is now seldom brought forward, and the true

theory seems to be that fish sufficiently represents the nitrogenous element of food for the mental worker, and does not so much tax the digestion as to cloud the brain for a lengthened period. You are all doubtless aware that no greater digestive error can be committed than to engage in brain work immediately after a heavy meal. It is as injurious as to do heavy manual work; both courses tending to draw the blood away from the stomach, where a larger than ordinary supply is required to assist digestion. When brain or physical work has to be done during the day, a light and easily digested meal alone should be taken, and the chief meal left till after the work is done. But if the brain or body is chiefly taxed late in the day or at night, the chief meal should be taken in the middle of the day.

For invalids, young children, and old people, white fish is of great value. The whiting is the most delicate, and least likely to disagree; it is sometimes called "the chicken of the sea." The haddock, flounder, sole, and plaice are all easy of digestion. Turbot has more flavour, but is less digestible. We may say in passing that several eminent authorities—Pavy, Sir Risdon Bennett, and others—state that cod is much less digestible than other white fish. This opinion the late Sir Robert Christison repeatedly and emphatically told us was incorrect, and that it is only when cod is tough and woolly that it should be avoided.

Those whose state of digestion, occupation, or age oblige them to select these lighter fish, should also confine themselves chiefly to the less heavy modes of cooking, viz., boiling, steaming, and broiling. For all kinds of cooking, fresh fish must be very thoroughly cleaned and washed, but not left to soak in water, as this would draw out much of the nutritious part. For boiling, use if you have it sea water; if not, put some salt into fresh water. When the water boils, place the fish gently in the pan, taking care that there is sufficient water thoroughly to cover it, but do not have more than is necessary, as a weight of water is apt to break the fish. Many people have a special fish pan and fish drainer, but to those who have not, we would give the hint that in order not to break the fish when lifting it out, they may tie it in a clean cloth like a roly poly, and lift it out by the ends. Fish should have about ten minutes boiling to the lb., but very thin or small fish do not

need so much, and large thick fish may need more. If from any reason you cannot serve boiled fish immediately, do not let it lie soaking in the hot water; lift it out and lay it on a drainer or hot dish on the top of the pan. We shall now show you

STEAMED FISH.—Have a pan half full of boiling water; on it, instead of a lid place a slightly greased soup plate; as soon as it is thoroughly heated, place on it the small fish or piece of fish; cover with a basin or saucepan lid. Let the fish cook thus for about ten minutes; then lift the cover, and turn the fish to allow the other side to cook thus for ten minutes; it is then ready.

Broiling is another very digestible mode of cooking fish. The gridiron must be very clean, well heated, and rubbed with a piece of suet or dripping to prevent the fish from sticking. It is also important that the fire should be very clear. White fish may, of course, be prepared in various other simple ways, cooked with milk and bread crumbs, with rice or potatoes, &c., but these we can only speak of generally, as this lecture does not profess to be an exhaustive treatise on the cooking of fish.

The water in which fish is boiled, should be carefully preserved, and strengthened by boiling in it the skin and bones, and the head if not otherwise used. This makes the foundation of many excellent nutritious and digestible soups, for which you will find recipes in cookery books. One of the simplest is to thicken slightly with flour, boil thoroughly for ten minutes, and then add some milk, boiled rice, and chopped parsley.

CURRY SOUP, which we have already prepared for you to taste, from want of time to cook it here, is a cheap form of a soup highly recommended by the great French cook, Soyer. For this is required, $\frac{1}{4}$ lb. rice, two small onions and one large apple, half teaspoonful of curry powder, half teaspoonsful of sugar, 1 oz. dripping, three pints of fish stock, quarter teaspoonful of salt.

Skin, scald, and chop the onions; pare, quarter, core, and chop the apple; wash the rice, melt the dripping in a stewpan; brown the onions and apple in it. Draw the pan to the side of the fire, mix the curry powder with a little cold water; add it, the rice and fish stock, to the pan, stir well. Place on the fire and boil gently with the lid on for about three quarters of an hour, until the rice and onion are thoroughly cooked, stirring occasionally.

The curry of this recipe does not add to the nutritive quality

of the soup. Taken in large quantities it is apt to injure the digestion, as all strong spices used in excess do, but a small quantity is valuable, as it is enough to give a pleasant and warm flavour to an insipid food, and acts as a gentle stimulant to the digestion.

Frying is a very popular mode of cooking fish, and one which when well done is excellent, but when badly done is detestable, and will sooner or later produce indigestion. You will find in the Appendix directions for preparing clarified or rendered down fat, which we recommend as the cheapest and one of the best preparations to fry in.

FRIED HADDOCK.—Wash and dry the fish well. Scrape off the scales from the tail towards the head. Cut off the head and the fins. Cut the skin along the backbone, and remove it, drawing it off from the tail towards the head. Then pass the knife into the flesh along the backbone, and cut away the flesh from the bones. Cut into neat pieces; dip these into flour, then into milk, and toss them in a piece of clean kitchen paper containing flour, breadcrumbs, or oatmeal. Fry in clarified fat, hot enough to have a slight blue steam rising from it. Do not put too many pieces in at a time, as it cools the fat; and allow the fat to boil again before putting more pieces in. You will find it a good plan to have a few holes made in an iron spoon, in order to lift out what you have fried, without taking fat also. Lay the pieces on a piece of kitchen paper for a few seconds, to take off all greasiness.

You will remember that we mentioned that there is a class of fat or oily fish. The chief of these is salmon, a fish too expensive to come under much consideration in this lecture. From its great richness few people can eat it much or often. It is said that the Scotch apprentices of old, when salmon was plentiful and cheap, made it a condition in their indentures that they were not to dine off salmon more than twice a week. Mattieu Williams* mentions that in Norway, where salmon is still abundant and cheap, it is a frequent custom to soak it in cold water to draw out the richness and special flavour.

Eels are not very popular in Scotland. They are a rich food, and chiefly used for soup, or stewed, or made into pies.

* "The Chemistry of Cookery," by W. Mattieu Williams.

To us in Scotland by far the most important of all fish is the herring.

FRIED HERRING.—Scrape, wash, and cut the fins off; have a couple of tablespoonfuls of oatmeal in a clean piece of kitchen paper, dip each herring into a little milk, or if eggs are cheap and plenty, into a well beaten egg; toss them in the oatmeal, and fry in a frying-pan with a piece of fat the size of a large egg, melted and heated. As herring is itself an oily fish, it is not necessary to use so much fat as for the haddock we showed you.

A fresh Loch Fyne herring is said to supply the largest amount of nutritious animal food that can be obtained at the smallest cost. A dinner of fresh herring and potatoes supplies all the essentials of food:—nitrogen to repair the tissues of the body, starch and fat to keep the body warm and able to work, and potash or salts, found as well as starch in the fresh vegetable the potato, to keep the blood pure and healthy. Fresh herrings may be either boiled or fried, or split open and broiled; the custom on the Clyde is to split two herrings up, clean, bone, rub with fat, and skewer them together, the skins outside, and grill above or before the fire, turning frequently. Among the more tasty, though less nutritious, preparations of herring, are kippers, salt, red, and pickled, all good in their way, but none so fit to keep up health and strength as a good “caller herrin’,” well worthy of being celebrated in song as “bonny fish and halesome farin’.”

In some parts of the country the people are very dependent upon salt fish. This is by far the least digestible and nutritious form in which we can take fish. It is important not only to soak the fish to draw out part of the salt, but also to make a special effort to obtain vegetables as part of the diet. A very substantial pie may be made of layers of salt fish (well soaked and parboiled), onions boiled and chopped, and either boiled rice, potatoes, or macaroni,—the whole being covered with suet or dripping crust. Some fish stock water or a little dripping should be put in the bottom of the pie dish. It need hardly be said that this is a dish only suited for the active and robust worker.

Oysters stand at the head of the group of shell fish, but from their high price can only be considered as a luxury. It is

sufficient to say that they lose much of their specially digestible qualities if cooked.

Crabs are a favourite shell fish, but disagree with many people.

Mussels also are doubtful. Cockles, as a letter in the *Scotsman* informed us lately, have become in times of severity a source of support, and cooked with milk and bread crumbs should be really valuable. Shrimps are rather a pleasant flavouring than a food.

As regards all fish special care must be taken that they are really fresh, in good condition, and well cooked. Stale, unseasonable, and underdone fish are specially injurious to health. The careful and intelligent housewife must always keep in mind that her object is not only to satisfy the hunger of those for whom she provides, but to do it in such a manner as will conduce to their health and strength. In the Appendix you will find a table stating when our chief fish are in and out of season. It is greatly to our own interest to support the wise and well-considered regulations which discourage the supply and sale of fish when out of season.

If the new system of preserving fish by boracic acid proves safe and satisfactory in its results, we may expect a greatly increased supply of cheap fish all over the country. This will have the further advantage of giving occupation to many in remote districts, where difficulty of speedy transit has hitherto prevented the establishment of fisheries, and of factories for using the waste products.

We are told that the too *exclusive* use of fish as an article of food, leads to a low and scorbutic state of health. But to prove the wholesomeness of a diet *largely* consisting of fish, we have only to look at our stalwart fisher men and women. We may assume, however, that they certainly supplement fish with wholesome porridge, and with good Scotch broth.

Were all our Scotch housewives able to cook porridge, barley broth, and fish to perfection, we venture to assert that the temptations to immoderate tea and whisky drinking would be greatly lessened.

C. E. G. W.

APPENDIX.

I.

TO RENDER DOWN FAT.—*Required*: chopped fat; enough cold water to cover it.

Take beef or mutton fat (cooked or uncooked), bacon fat, fat skimmings from soups or stews. Remove any skin or lean meat (which may be put into the stock pot). Cut any or all of these fats into small pieces, place them in an iron pan and cover with cold water. Bring to the boil, removing carefully any scum that rises; then boil quickly with the lid off, till the liquid is a clear oil, which shows that the water has passed away in steam. This generally takes from one to two hours. Then draw the pan aside to let the fat go on melting at a lower heat, as it would brown if kept boiling quickly; stir frequently. When the pieces of fat become shrivelled, crisp and brown, and the liquid spurts, it is ready. Remove the pan from the fire to let the melted fat cool a little, then strain it through a cloth into a basin or pie dish, keeping back the dried pieces. If the fat were poured in when quite hot, the basin would crack. When cold it should be quite white. It keeps fresh in winter for many weeks. The dried pieces may be used in peas soup, potato soup, or haggis. Fat thus rendered down is generally called *clarified fat* or *dripping*, and may be used for pastry, cakes, and puddings, for frying, and for greasing dishes.

TO CLARIFY DRIPPING.—The same dripping or clarified fat may be used for a very long time for frying. When it becomes brown and mixed with sediment, place it in an iron pan, let it heat till a steam rises. Have ready a deep basin containing hot water; pour the hot dripping into this, very little at a time, to prevent it flying up; stir well. When quite cold the purified dripping will form a solid cake on the top, which must be taken off and wiped dry, and is then ready for use again. A *quicker*

way is to put the dripping and cold water together in a pan and bring to the boil; pour into a basin and cool. When cold remove and wipe the cake of clarified dripping.

SAUCE.—Required 1 dessert spoonful of flour, a piece of dripping the size of a small egg, a breakfast cup of the liquor fish is boiled in, a pinch of salt.

Put the dripping into a small saucepan, let it melt but not get hot. Add the flour and mix all with the back of a spoon. Then add the liquor very slowly, a little at a time, stirring continually to prevent the mixture going into lumps. Stir over the fire till the sauce boils, boil well up for about three minutes, when it is ready for use.

This is the way all melted butter sauces are made, from this very cheap substitute up to the richest preparations. The sauce may be made richer by using butter instead of dripping, and milk instead of the fish liquor, and chopped parsley, or various flavourings may be added, but for this sauce, in whatever form you make it, you may be sure (1st) that the fat and flour are well mixed together; (2nd) that the cold water is added very gradually and well stirred; and (3rd) it must be thoroughly boiled.

II.

Periods during which fish is in season.

BRILL, PLAICE, FLOUNDERS, and TURBOT are in season all months except May.

WHITING and HADDOCK are in season all months except April.

HERRING are in season all months except April and May.

MACKEREL and SOLE are in season all the year round.

COD is in season from the beginning of September to the beginning of February, and from the beginning of March to the beginning of June.

SALMON is in season from January 10th to October 15th.

SPRATS are in season from November to February.

Note.—It must be kept in mind that these fish are not in season at every fishing station during the *whole* periods named, but can be obtained, throughout the period, from one or other of the many fishing stations in the United Kingdom.

TEAR AND WEAR.

By W. STIRLING, M.D., D.Sc.,

PROFESSOR OF PHYSIOLOGY IN THE OWENS COLLEGE, MANCHESTER.

EVERY organism, be it animal or vegetable, be it simple or be it complex in its structure, as long as it is a living organism is continually undergoing tear and wear; there is a continual dissolution of its tissues, and as a matter of fact, the manifestation of vital phenomena is quite impossible unless there be a certain amount of tear and wear. This is my text this evening. It will be my duty, in the comparatively short space of time allowed to me, to show you by demonstration and experiment the proof or proofs of this thesis. I shall begin by showing you a very simple experiment. Here, in one scale-pan of a balance, is a guinea pig, and in the other, weights to equipoise it. Before the end of the hour, you will observe that the index of the balance will have travelled a certain distance, indicating that the guinea pig has lost weight; and loss of weight or loss of matter is in this case the expression of a certain amount of tear and wear in the body of the guinea pig. But we must inquire more carefully into the nature and amount of the loss which the animal undergoes as long as it is a living animal. I next show you an experiment known as Black's experiment, a comparatively simple one, but yet a fundamental one. I have here a quantity of clear pellucid lime-water, and you observe that when I breathe through it, after a short time it becomes milky and turbid, and if I allow it to stand, a white deposit will be precipitated in the fluid. This precipitate is carbonate of lime, or ordinary chalk. You say, however, and quite rightly, that this experiment is not a thoroughly satis-

factory one ; so far I have deduced no proof that the air which I inspired did not contain the carbonic acid. I must therefore institute what physiologists call a "control experiment" to show you that the air of this hall practically contains so small an amount of carbonic acid, that it will not suffice to render lime-water turbid. Now, I pump a certain quantity of the air of this hall through another similar vessel containing lime-water, and you observe that the lime-water does not become turbid. The carbonic acid therefore which I expired and which whitened the lime-water in the first glass, must have been formed within my own body, because it was not present in the air which I inspired.

But there is a somewhat more elegant way of showing the same experiment, by means of what are known as Müller's valves. This consists of two flasks with tubes so arranged that the air which I inspire must pass through the lime-water in the first flask, while the air which I expire passes out through the second flask. The inspired air, therefore, is robbed of every trace of its carbonic acid by being made to pass through lime-water ; while the expired air containing a large percentage of carbonic acid—four to five per cent.—very rapidly makes the lime-water turbid. You will observe that I continued to expire as long as I possibly could, and for this reason that the latter half of the air expired always contains a very much larger percentage of carbonic acid than the first half. Suppose, however, instead of operating on myself I select a rabbit or other animal, and place it under certain conditions, it is possible to show that the same change occurs in the rabbit. But it is also possible by a special arrangement to measure the amount of carbonic acid given off by it, and thus to estimate the loss per hour, or per day, or during the time that the experiment may be carried on. For this purpose I have placed a rabbit under a bell jar. This bell jar is placed over mercury, and I have an arrangement, called an aspirator, by which the air which the rabbit has to breathe shall be first robbed of its watery vapour, and then of any carbonic acid which it may contain. The rabbit therefore will be breathing absolutely pure air, a purer air by far than it would have done under natural conditions, living as it does in holes of the earth, and a purer air by far than any of us

is breathing in this hall at the present moment. To insure this result the air is first of all passed through a flask containing caustic soda. The caustic soda removes from it any watery vapour it contains. The air is sucked through a flask containing lime-water, and only then does it reach the rabbit in the bell jar. You will now observe that the air after passing through the caustic soda and lime-water and through the bell jar in which the rabbit is placed, enters another flask connected with the bell jar in which the rabbit is breathing. The lime-water contained in the second flask very rapidly becomes milky, while the lime-water contained in the first flask remains perfectly clear. This, then, is a convincing experiment that the same conditions obtain in the body of the rabbit as obtain in my own person, so far as the excretion of carbonic acid and water is concerned, for you will observe that the sides of the vessel in which the animal has been placed have rapidly become bedewed with moisture.

The quantity of carbonic acid given off may be ascertained by measuring the increase in weight which the flask of lime-water has undergone in a given time. Carbonic acid, therefore, is one great source of loss in a living animal; and when I tell you that twelve to sixteen cubic feet of carbonic acid are given off by each of us in twenty-four hours, you will see that this is a very material loss in the body. But I take it that the expression, twelve to sixteen cubic feet, does not appeal to you in any very definite manner, because most people have no very precise idea of size, and, therefore, instead of showing you this I show you here a bottle containing eight ounces of carbon, a very large quantity indeed, as you will see, and this eight ounces of carbon represents the amount of carbon contained in the carbonic acid excreted by an average man in twenty-four hours. Each of us, therefore, returns to the air a quantity of carbonic acid equal to that which would be obtained through the burning of eight ounces of carbon. This large quantity of carbon on the face of it might seem to some of you to be very large indeed, and you may have doubts whether such a large quantity is obtainable from the foods which we usually take,—that the beautiful white starches or sugars which constitute so large a part of our food should be capable of holding so large an amount of carbon. This,

however, I can easily show you is so by the following experiment. If to this clear solution of syrup I add something which will rob it of its water of combination, I shall have a large quantity of carbon formed. Sugar consists of carbon, hydrogen, and oxygen, the hydrogen and oxygen being in the same proportion in which they occur in water. The sulphuric acid which I add to it rapidly removes this water, and then there remains a black mass of carbon; and observe that when I add the sulphuric acid—a considerable amount—the temperature rises. You observe a black mass froths and foams up in the vessel, indicating the very large quantity of carbon which is present in many of our foods. The carbonic acid which we breathe out is one of the chief forms by which the carbon of the starchy foods is got rid of.

But carbonic acid is not by any means the only loss occurring during respiration, for on a cold day one is familiar with the fact that a stream of watery vapour may be seen proceeding from one's nostrils. This watery vapour is condensed upon small particles which are floating in the air. I show you now a simple experiment to prove that watery vapour is given off by my own lungs. I have here a perfectly clear cold bell jar, and you observe, that when I breathe into it, it is instantly bedewed with moisture, indicating the presence of watery vapour; and the amount of water given off by the lungs in twenty-four hours is very considerable indeed, amounting to the volume—nine to ten ounces—that I now show you in this flask. Thus carbonic acid and watery vapour represent the chief losses from the animal by the lungs. It is to be noted, however, that the amount of both varies with many conditions, such as exercise, age, sex, food, number and depth of respirations, and many other conditions.

I wish you now to look for a moment at another experiment, and to compare the products of respiration with the products of combustion. I burn a taper in a glass cylinder, and you will observe that the sides of this cylinder rapidly become bedewed with moisture, while the taper, after burning brightly for a time, gradually ceases to burn so brightly, and by-and-bye is extinguished in the products of its own combustion. The taper, in the process of combustion, has formed the water and carbonic acid. The water, you see for yourselves, but the presence of the carbonic acid I must prove to you,

in the usual way, by adding a quantity of lime-water, which you will observe is immediately rendered milky. It is plain, therefore, that as far as the combustion of a candle is concerned, the products are precisely the same as are given off from a living animal by its lungs. In order, however, to make the formation of water during combustion more apparent to you, I have here another experiment, whereby I can burn a very small jet of gas, and any water which is formed by it will be rapidly condensed, and in a few minutes you will observe drops of water trickling from this tube—evidence that water is formed by combustion.

It is interesting to compare the products of combustion with the products of respiration; when a man is suffocated by having his wind-pipe rapidly closed, or be it by breathing in too small a space, or be it without a sufficient access of free air, he is as certainly extinguished by the products of combustion of his tissues, as the candle in this jar was extinguished by the product of its combustion. In the candle, therefore, there is a rapid oxidation of its constituents, carbon and hydrogen, to form carbonic acid and water, while at the same time this is accompanied by the evolution of a large amount of heat and light.

I now show you an experiment, with a moral attached to it. I have a bell jar placed in a quantity of fluid, the latter being coloured so that you can see it. The bell jar is only partially filled with fluid, so that a considerable quantity of air stands above the fluid. This air I now inhale into my lungs, having previously closed my nostrils. As I do so, you observe that the fluid rises in the bell jar, and the air has obviously been sucked into my lungs. I now expire; the fluid descends, so that the air which was in the bell jar must have been taken into my lungs. Before taking this air into my lungs, I showed you that it supported combustion, that the taper introduced into it burned quite brilliantly. Suppose now I introduce the taper into the expired air which has been in my lungs. As you see, the taper is immediately extinguished. This is a very striking experiment, and one, to my mind, more pregnant with instruction than any statistical tables of percentages of carbonic acid that I might show you; because, you may take it as certain that where a candle will not burn, a human being cannot live. The expired air, therefore, is absolutely incapable of supporting combustion,

and therefore of supporting life, and you see to what extent air is vitiated by the process of respiration. Hence the absolute necessity for free ventilation. When we compare now the processes of combustion with respiration, we find that they are practically identical, at least as regards their products. But the carbonic acid and water which are given off by a man are not formed in the lungs, as was originally supposed by Lavoisier. The lungs are merely the medium whereby those products are given off from the blood. The carbonic acid is formed in the tissues, in the muscles, in the brain, in the glands, and other organs. But there is this peculiarity, that in the candle while it burns you have a large quantity of heat and light formed, in an animal you have heat formed but no light, with this peculiarity, that the combustion of our own bodies, or the oxidation or burning of our own bodies, takes place in moist tissues. The body, therefore, as it lives is undergoing oxidation, and one of the leading products of this oxidation is carbonic acid.

The human body, however, is far more complex than a candle or a taper. While a candle or taper contains carbon, hydrogen, and a small quantity of oxygen, the human body contains substances infinitely more complex; and nitrogen is an element which is present in combination to a large extent in the human body. The products, therefore, of the oxidation and changes in the human body will necessarily be somewhat different, when carefully examined, from those of a candle. In the human body another great source of loss is urea, which is given off by the kidneys, urea being a nitrogenous body; and in the form of urea nearly all the nitrogen taken in with the food is given off, the quantity of urea given off being something like 500 grains in the twenty-four hours.

Let us review a little more carefully the loss from the human body, which any one can very easily study for himself. From the skin there is given off a large quantity of water. Some of it is given off insensibly, and the remainder of it may be seen as so-called sensible perspiration or sweat trickling from a person's forehead when he does severe muscular work. But even under ordinary conditions twenty ounces of water, a small quantity of gases, and very minute traces of salt are given off in the twenty-four hours, while from the kidneys 50 ounces of water and 500

grains of urea and other allied bodies, and a considerable quantity of salts are given off. I show you the respective quantities because you can judge very much better of the amount in this way, than if I merely made the assertion that such and such quantities are given off. From the bowel about four ounces of water and other solids are given off. I show you here a table indicating the loss by the skin, lungs, bowel, and kidneys during twenty-four hours.

EXPENDITURE OF MATTER BY AN AVERAGE ADULT IN
TWENTY-FOUR HOURS.

<i>By Lungs—</i>	Grains.
Carbonic acid,	15,000
Water,	5,000
Organic matter,	Traces
 <i>By Skin—</i>	
Water,	11,500
Solids and gases	250
 <i>By Kidneys—</i>	
Water,	23,000
Organic matter,	680
Mineral matter,	420
 <i>By Bowel—</i>	
Water,	2,000
Organic matter, }	800
Mineral matter, }	

Take this statement in another way. The loss is represented by about 6 lbs. of water and $2\frac{1}{3}$ lbs. of solids in the twenty-four hours. Of these solids the chief is carbon, amounting to about 4000 grains, and nitrogen to about 300 grains. It is quite evident, therefore, that in the case of a human being, if no food or water were supplied to him, and he lost $8\frac{1}{3}$ lbs. in twenty-four hours, he would very soon reach a vanishing point, and that his body would very quickly waste and disappear. He would at the same time suffer from thirst and from hunger. But in the

process of starvation, we know that the whole of a person's body does not disappear. There must be some mechanism, therefore, by which the combustion of our tissues is so far restrained during starvation. The effect of complete withdrawal of food, or starvation, has been studied on animals, and, unfortunately, exhibited in man himself. Chossat made numerous experiments on starved and starving animals.

Chossat found that when an animal loses two-fifths of its weight, or 40 per cent. of its body weight, death took place, always accompanied or preceded by a great lowering of temperature. In his table, you will observe the striking facts are that of the total quantity of fat in the animal's body, 93 per cent. disappears. Other important organs suffer loss also to a large extent; while another very striking fact is, that the nervous system loses only 2 per cent. This small loss on the part of the nervous system is due to the peculiar way in which it receives its blood supply. Recently, as you are aware, fasting men have become so numerous as to become a perfect nuisance, because no new facts have been elicited by their mode of procedure; no scientific investigation has been made of the changes from hour to hour of their excretions, and no rigid scientific observations have been made on the conditions under which they have fasted. It has been proved beyond doubt that melancholics, before the days of forcible feeding, could live for over forty days without food; while many men, if starved, and can get a supply of water, can live, and have lived, from twenty to twenty-one days.

As regards fasting or enforced abstinence from food for any cause, much will depend upon whether the person so situated can get a supply of water—what watery vapour there was in the air, the temperature of his surroundings, and so forth. There is, however, one factor more in the question, namely, that under certain peculiar conditions of the nervous system, the tear and wear of the tissues is undoubtedly modified, as is proved by some cases of melancholia, where the persons lived for over forty days. There is a sharp difference between herbivorous animals, such as the ox and the cow, and carnivorous animals, such as the dog and the tiger, as regards fasting. A very few days of fasting will suffice to kill an ox, while a dog, lion, or tiger will live for

a very long time without food. Why should this be so? That is the result of the difference in their modes and times of feeding. The herbivorous animal requires an almost constant supply of food, the carnivorous animal eats when he can get food; he does not find his victim every day, and so his organism becomes used to long fasts and to heavy meals at long intervals. If, however, an herbivorous animal be starved it really and practically becomes a carnivorous animal, because it lives upon its own tissues; and one can find evidence of this in the altered character of its excretions. So much, therefore, for the loss of matter.

But matter is only one factor in the animal organism. The other great factor is energy. Now let me try and show you some experiments to illustrate what is meant by energy. Every one is familiar with the term an energetic man, which simply means an energetic man has the power of doing a large amount of work. So it is in the physical world. Energy has been defined as the power of doing work, and work is the power of overcoming resistance. When one works with his muscles, say by lifting a weight, he overcomes the resistance of gravity, and this he does in virtue of the energy evolved in his muscles. In the steam engine the movements of its various parts are produced by the energy evolved from the combustion of coal in the furnace, the water is transformed into steam by the heat from the combustion of the coal, and the steam moves the piston, and this in turn moves, by a suitable and appropriate arrangement, other mechanisms in connection with it. Instead of taking the steam engine, I take here a simpler form, and show you Hero's engine. You observe that when I heat the water in this small engine, by-and-bye steam is emitted from two tubes, and the machine itself begins to rotate with extreme rapidity. Here the heat of this Bunsen burner has so heated the water that the water becomes changed into steam, and the steam moves the whole machine itself. The source of the movement was the combustion of the carbon and hydrogen in the gas, and this heat has been converted into mechanical movement. Take another example of energy. Water is composed of two gases, hydrogen and oxygen in certain proportions. It is possible to decompose water and separate these two gases. This I now show you by the means of an instrument called a voltameter. Suppose I pass a very strong

current of electricity through this water. You observe bubbles of gas are rapidly given off, and I collect these gases in a tube inverted over a quantity of water. One can easily state what will be the quantity of gas obtained. In this case the electricity evolved in the galvanic battery has to overcome the chemical affinity of the gases composing the water. It has to pull them asunder, and in order to pull them asunder a large amount of energy is required. The two gases then are permanently divorced from each other, and they have what is called energy of position. They are ready to combine again under favourable circumstances. That they combine again I show you, for I now take these gases and explode them. The lighted taper by which I have exploded them caused them to re-unite, which they do with great energy, and a similar amount of energy is given out, but in a different form. You have light, as shown by the flash; sound, as shown by the fact that you can hear the explosion; and a certain amount of heat, so that the electrical energy which was expended in pulling these gases asunder, is obtained in a different form but in precisely the same amount when they united, and when they did unite a small quantity of water was formed equal to that which was decomposed to obtain these gases. It will be more interesting, however, if I project upon the screen by means of an oxyhydrogen light, the phenomena which can be seen when water is decomposed. You will observe now, shown upon the screen, the image of a trough containing water into which are placed two platinum wires, and when the electrical current is caused to pass through those wires and through the water you observe bubbles of gas are given off from those two wires. A shower or stream, as it were, of these bubbles proceeds from each pole, hydrogen from the one and oxygen from the other. Take another example of energy. Suppose instead of taking an electrical current to decompose water, I pass the electrical current round a piece of soft iron in the form of a horse shoe. You observe this piece of soft iron; till I pass a current through it, it will neither attract these nails nor these iron filings, but on passing an electrical current through it, observe now that it powerfully attracts those nails even from a great distance, while the iron filings are heaped up around the two poles of the magnet. The moment I cut off the electrical current it ceases to become a

magnet, and the iron nails and the filings drop from it again. In this case the electrical energy has been changed into magnetism, and from a certain amount of electrical energy a certain magnetic effect will be produced.

That is not all, however. Let us take another familiar example. Suppose a person winds up a clock ; he is conscious of a certain amount of resistance to be overcome before the weights are lifted ; or when he winds up his watch, there is a certain amount of resistance. In the latter case the spring is gradually made more tense, so that the relative position of its molecules is altered, and the energy which was evolved in his muscles is stored up in the bent spring, ready to be given off according to certain conditions. The energy, as it is said, is rendered latent in the spring. Energy stored up in a spring, or in a clock when the weights are lifted, is called potential energy, because it has the power to do work without actually doing it ; while, when this energy is liberated and work is done, the form of energy is called actual or kinetic. As long as the weights of the clock are raised, and they do not move the clockwork, that represents potential energy in these weights. When the weights of the clock descend, that is called kinetic or actual energy. But it is familiar to every one that the clock won't go, even if it be wound up, unless the pendulum be set agoing. The pendulum in turn sets the escapement agoing, and by this arrangement the potential energy is liberated, as one says, from time to time. There is, therefore, something more required than mere potential energy. There is something to discharge this potential energy—a discharging or liberating force is required. Once the pendulum is set agoing, then the clock will continue to go as long as the weights are raised above the ground. So it is with gunpowder. Gunpowder, or a lucifer match, contains a large store of chemical energy, but it requires the application of another form of energy, some stimulus or discharging force, to liberate that energy ; and every one knows that a very small spark is sufficient to explode the largest mine, but until this spark be applied no explosion can take place in the gunpowder or match. The energy of the chemical compounds is potential, the moment it is exploded the energy becomes kinetic. So it is in our own bodies. Energy is liberated from time to time by means of discharging forces. The

energy in our muscles is potential, but by an act of will you can move the muscle, and liberate the energy in that muscle, and thus we execute a voluntary movement.

In the act of respiration, which takes place sixteen or seventeen times per minute, there is a stimulus applied to the respiratory centre which liberates the energy at regular periods. Perhaps the most striking experiment that I can show you of a discharging force and the liberation of energy, is one which I show you here. I have here a large bottle. You see it has very thick sides and a very thick bottom. This glass vessel was, when it was being made, while warm, suddenly dipped into water. The consequence was that the surface of this glass became rapidly cooled, and a firm crust of rapidly cooled thin glass exists all over it, while in the interior, where the cooling went on more slowly, a different condition of the particles of the glass obtains; there is a balancing of the forces in the superficial stratum of the glass, and the deeper portions of the glass, and as long as this vessel is left alone and is untouched, it will remain in this stable condition. If, however, I drop into it the smallest tiny particle, about a sixteenth of an inch in size, and if this particle be angular, and I rupture even the smallest portion of the surface of the glass, that will upset the whole condition of its equilibrium. Energy will be liberated in one portion, the static system of its forces will be dislocated, and the glass will fly into shivers. This I show you now. You observe when I drop into this vessel this small angular hard piece of substance, a substance you cannot see, that instantly the glass flies to pieces. Here is an instance of a discharging force.

From these few experiments it is obvious that energy can change its form—that you have the transformation of one form of energy into another, and according to the quantity of energy expended you obtain an equal quantity of some other form of energy. That is the great principle of the transformation of energy.

Having explained to you what is meant by energy, let us see how this applies to the living organism. A living organism, such as a man or an animal, loses energy as well as matter. What are the proofs of this? In order to do work, energy must be evolved, and our bodily movements—by either the movement

of one part of the limb upon another, or by the movement of the whole body along a surface, as in walking or running—all involve the action of the muscles. The muscles are distributed in a certain definite and precise way over the body, and constitute what is ordinarily known as flesh. When they contract they act upon our bones as levers to raise or depress them; but in every case they do a certain amount of work. Suppose now I lift, as I do, this one pound weight to the height of one foot; we can very easily get a mathematical expression of the amount of work done, because the work which is done by any body is measured by multiplying the load by the lift. If I lift a load of one pound to the height of one foot, obviously the amount of work done is one foot-pound. If I lifted the same weight through two feet, the amount of work done would be two foot-pounds; or what is the same thing, if I lift two pounds through one foot, the result is equal to two foot-pounds. The foot-pound, therefore, is the expression of the unit of work, and a man doing an ordinary amount of manual labour by means of muscular movement, transfers outside his own body an amount of energy which in twenty-four hours does work equal to 480 foot-tons. That is to say, he does as much work as if he lifted 480 tons through the height of one foot, or one ton to the height of 480 feet. That is called external work, because it is transferred beyond his own organism. Let me show you how this external work may be very readily measured, and what happens when the muscle contracts. When a muscle contracts it shortens and it becomes thicker, but there is practically no change in its volume. I have here, in a moist chamber, a frog's muscle taken from its leg. I need not say that the frog was dead before I used the muscle, and the reason why the frog's muscle is selected is, because the frog being a cold-blooded animal, its tissues live for a long time after the animal's brain has been destroyed, and even after the heart has ceased to beat, that is, after the frog is dead in the ordinary sense, and dead in the eye of the law. Man himself is not an exception to this rule. His muscles live, or are excitable for a short time after death, but, of course, for a very much shorter time than cold-blooded animals like the frog. To this frog's muscle I have attached a lever, and to this lever there is a weight suspended, and there is an arrangement by which I can stimulate the frog's muscle to contract by

means of electricity ; and you observe, when I pass the stimulus through this muscle that it contracts—it shortens. By the index attached to the lever you can see that the lever is lifted, and if one knows the weight which is attached to the frog's muscle, and knows the height to which the lever is lifted—that is, the extent of the frog's contraction—then you ascertain what work this frog's muscle is doing. But you may go further, provided you know the sectional area of the frog's muscle. You may easily calculate what amount of work can be done by each fibre of this frog's muscle, so that the matter can be put upon a purely physical basis. In the doing of this external work, the raising of the weight, what takes place is, there is a using up or tear and wear of the muscle itself, or of certain substances stored up within the muscle itself, and we find that the contracting muscle gives off, amongst other products, carbonic acid during its action.

All the energy, however, which is given off by a man or an animal is not summed up in what is known as external work or bodily movement. Within the body itself a large amount of energy is required for doing what is known as internal work ; that is to say, the work of respiration, the beating of the heart, the work of digestion, of secretion, of thinking, and various other nervous phenomena. Take the heart for example. The heart beating sixty or seventy times per minute lifts a certain quantity of blood through a certain height. In doing so, of course it is overcoming resistance, and therefore does a certain amount of work. It is easy to calculate the amount of work done by the heart. The heart of the average man does an amount of work equal to 120 foot-tons in twenty-four hours. I show you now a frog's heart. The frog has been killed, but even after it has been killed its heart continues to beat for a very long time after the death of the animal, provided it be kept moist and supplied with oxygen. The heart will beat twenty-four to thirty-six hours, or even longer, after it is taken out of the body, if it be supplied with blood or some other nutrient fluid. The heart of a shark has been known to beat for three or four hours on the taffrail of a ship. In the beating of the heart there is a rhythmical discharge of energy from time to time. Suppose I cut out this frog's heart and place it under a lever, it will raise the lever, and therefore do a certain amount of work. And now I do the

experiment. You see that the lever is alternately raised and depressed. When the lever is raised that represents a contraction of the heart, when it is depressed that represents a relaxation of the heart; but you will notice that there is an interval between the beats, that the beating is not continuous. The heart, therefore, beats for a certain time and rests for a certain time. As a matter of fact, the working heart spends two-fifths of its time in action, and three-fifths of its time in rest or a period of repose. So that if we were to take a lesson from the heart it would come to this, that as regards muscle, one must give a longer period for repose than for action, in order that the tear and wear which accompanies and is necessary to action, be compensated during the period of rest. Suppose instead, however, of showing you the heart lift the lever, I project a view of the heart upon the screen. On my doing so you observe that the heart continues to beat in a rhythmical manner. You can also observe the intervals between the beats, the heart beating slowly and steadily, as the heart of all cold-blooded animals does. If, now, I apply heat to the heart by means of a spirit lamp, you observe in the first place that the heart beats quicker—the number of beats per minute is increased. Each single beat is quicker, and the interval between any two beats is shorter. This leads us to a study of the condition of fever. In fever every one is aware that the body rapidly wastes, and every one is aware that the central fact apparent to the patient himself, and to any one coming in relation to him, is an increase of temperature. An increase of temperature, no matter how it is caused, leads to an increased waste, leads to an increased tear and wear of all the tissues in the body. The heart in fever beats more rapidly, partly because the temperature is higher, and you will see, therefore, that in fever the heart is subjected to an excessive strain. It is, as it were, as if the candle were burning at both ends; because you have got 120 heart beats in the minute in fever, instead of 60 or 70, which is the normal number of beats per minute. You will see that something has to be curtailed, and, as a matter of fact, what does happen is that each single beat of the heart is shorter and quicker, and more rapidly executed, therefore requiring more energy, while the interval between two beats is diminished, and in fever it is especially this interval or time for repairing the waste which is curtailed. Hence, one of the reasons

why prolonged fever produces so serious an effect upon the heart. The heart having so short a time for repairing the waste which goes on in it, is apt to break down under the strain, and, in fact, in many cases undergoes an actual change in its structure. That is an example of excessive tear and wear from the absence of due periods of repose. All this makes it very plain, therefore, that rest is as essential for the healthy condition of the organism as action.

Bodily movements, however, are not the only means by which energy is given off from our bodies. Our bodies have a certain temperature, and the normal temperature of our body is extremely constant, being from 98° to 100° F., and this constancy of the temperature is very remarkable. Notwithstanding differences of climate, differences of food, differences of clothing, it remains fairly normal, and it is only within certain ranges of temperature that life itself is possible. Heat, then, is another form of energy which is given off from the body, and the amount in twenty-four hours is easily calculated, representing an amount of heat sufficient to raise 62 lbs. of water from the freezing to the boiling point. Then heat is given off partly by radiation, partly by conduction, and the heat which is given off largely from the skin and in breathing, and in the fluids and solids which leave the body, is formed in the body. The time at my disposal is too short to indicate to you how the heat value of foods which we take can be measured. I have, therefore, simply to content myself with a statement of the amount of heat which is evolved, and to indicate to you that that heat represents a large amount of energy which is taken in with the food.

Besides bodily movements and heat, if we were to pursue the subject of energy further, we would have to consider the energy which is required for the processes of digestion, the energy that is required for the processes of secretion (the secretion of saliva is accompanied by the formation of heat), and above all the energy that is required for the process of thinking and for other nervous processes. Mental work is notoriously severe work, and it is more exhausting than manual work. The work of the brain demands more energy of a certain kind than the work of the muscles. Why is it that continuous sustained mental operations, when unaccompanied by due periods of rest, are so detrimental to

the thinking organ itself, and to the organism as a whole? Everyone is familiar with the fact that it is not mental work which kills a person, provided this mental work be accompanied by due periods of rest or repose, or change of mental activity. One says it is anxiety or worry that kills. What does mental worry mean when interpreted on a physical basis? It means that there is a continuous tear and wear of the tissues of the brain itself, and consequent liberation of highly evolved and specialised forms of energy from the brain; that the brain has not a sufficient interval of time to restore its structure, and so there is a continual degradation in the molecular constitution of the brain itself thereby produced. Why, again, is sleeplessness so serious a symptom in the overworked man? Sleeplessness means absence of rest of the brain, absence of that process of repair which is necessary to the healthy action and continued existence of one's mental stability. It does not materially matter whether you regard mental phenomena as a direct product of the action of the brain, or whether you regard the brain as acted upon; in every case you have this fact, that brain action, whether it be a manifestation of consciousness, an act of thinking, or any other mental act, is always accompanied by a change in the physical and molecular structure of the brain; that is, it is always accompanied by a certain amount of tear and wear. Why is it that mental work is so exhausting? Mental work is not done upon starches and sugars, as muscular work is undoubtedly done to a large extent on these comparatively simple substances. In the brain you have in its chemical constitution highly complex molecular compounds, and these highly complex compounds are formed out of comparatively simple substances. This itself involves the expenditure of a considerable amount of energy, and it is the tumbling down of these highly evolved complex substances, upon which the act of cerebration, the acts of thinking and feeling, depend. That is why brain action is so exhausting if it be not accompanied by sufficient periods of repose. That severe mental work itself, when accompanied by sufficient periods of repose, does not kill, one can see every day in eminent members of the bench and bar, and in eminent statesmen, who, in spite of all the cares and anxieties to which they are subjected, often live to a ripe old age, only, how-

ever, when they have been careful to alternate their mental work with periods of mental relaxation, and to ensure for their brain sufficient, adequate, and well-regulated periods of repose.

We have seen, therefore, that a large amount of energy is evolved in the human body, the greater part of it being represented by bodily movements and by heat. Where does this energy come from? You easily see where the matter which is given out from our body comes from. As to the matter we take in with our food, I show you, for example, the diet of an English soldier on home service. This diet is complex enough in a certain way; but however complex this dietary, all the various substances present in it can readily be grouped under four heads. In addition to water, there is a group of proteids, or albuminous substances, like the white of egg; carbohydrates, like starches or sugars; fats and salts. There is, however, also what is not mentioned in this table, oxygen, which is taken in by the lungs and passes into the blood, the oxygen, of course, being in the air which one inspires. These are the substances which are taken in, and the average man takes in about 23 ounces of dry solids and 6 lbs. of water in twenty-four hours.

TABLE SHOWING THE INCOME AND EXPENDITURE OF THE BODY DURING TWENTY-FOUR HOURS.

<i>Income.</i>			<i>Expenditure.</i>		
		Grains.			Grains.
Solid Food,	. . .	8,000	Lungs,	. . .	20,000
Water,	. . .	37,650	Skin,	. . .	11,750
Oxygen,	. . .	13,000	Kidneys,	. . .	24,100
			Bowel,	. . .	2,800
		<hr/>			<hr/>
		58,650			58,650

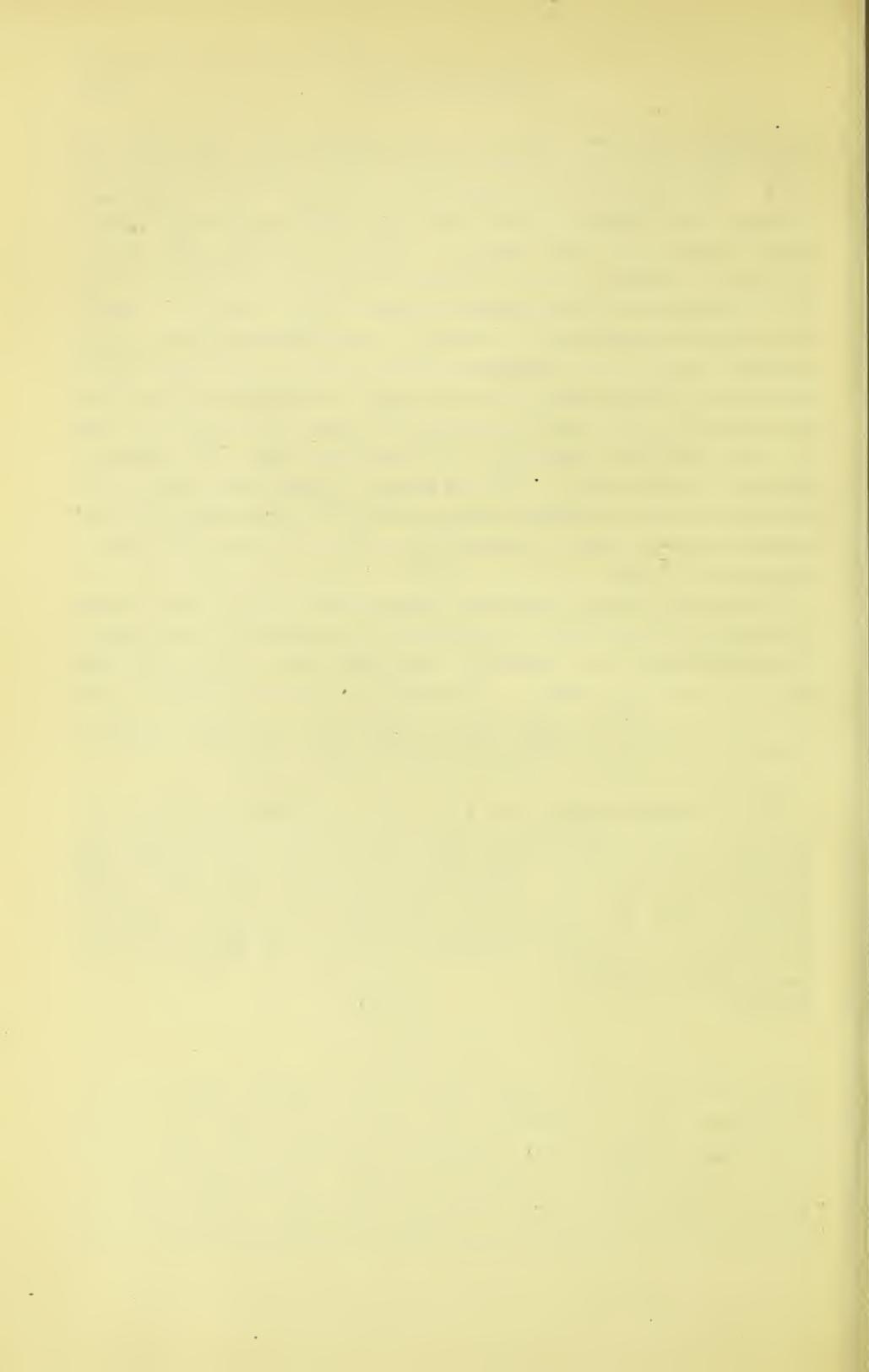
(Or $8\frac{1}{3}$ lbs.)

It is quite certain that what leaves the body is neither starch nor sugar, nor pieces of beefsteak. The substances which leave our body are infinitely more simple than those in their composition. They are chiefly carbonic acid, water, urea, and solids. There has, therefore, been within the organism itself a transformation of matter from complex to more simple

substances, but there has been something else. The food is inseparably associated with energy; the oxygen of the air, which one takes in, is loaded with energy. Our foods, the starches, and albumens, and the fats, all contain large quantities of energy. This energy is ready to be liberated under appropriate conditions, and when the material substance of the food itself has changed, so also has the energy changed. There is with the transformation of matter a transformation of energy, and this energy is a transformation of the energy stored up in the chemical compounds into the energy which results in muscular movement, in heat, the energy required for digesting, for secreting, and for thinking. So that there are two processes going on in the body. We are taking in potential energy, and we are giving out kinetic energy. These two processes go hand in hand, and in virtue of these two processes we have the phenomena of life itself.

I have now brought you back again to the position from which we started—that there is a continual tear and wear in our organism, that there is a continual tear and wear in our structure always requiring repair. This repair is accomplished by the food which we take in; and I have also shown you that the phenomena of life itself are inseparably associated with this process of tear and wear.

Before concluding, let me now just complete the lecture by reverting to the experiment which I showed you at the beginning, namely, that the guinea pig which we placed in this box has lost weight during the hour. You observe now that the index of the balance shows the clear loss on the part of the pig, so that we can measure accurately the loss per hour, or per day, or per unit weight of the animal.



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How Pleasant Surroundings and Conditions affect the Health and Happiness.

BY T. S. CLOUSTON, M.D.

To say that health and happiness are increased by pleasant surroundings and conditions of life, sounds like a truism. No one would deny it. It is a thing that "goes without saying" among all thoughtful persons. But notwithstanding this, we know that the practical importance of this truism to mankind has not been realized as it should have been in the placing of the houses of our people in country and town, in the construction of our surroundings, or in the creating of our conditions and modes of life, in so far as those are under the control of human power. I am not going to speak to-night of the necessities of life or of the sanitary conditions that the laws of health absolutely demand, such as good food and drink, suitable clothing, healthy work, and fresh air, which all give health, and pleasure too of the highest kind.

WHAT ARE PLEASANT SURROUNDINGS AND CONDITIONS ?

The pleasant surroundings of life of which I shall speak are what some utilitarian people would call the non-essential things, such as green grass, and trees, and access to fine stretches of country with hills and the sea, as nicely kept gardens and flowers, good streets and roads and public buildings, as some amount of roominess and light within and without our houses, as harmonious bright colours, pleasant furniture, and cheerful-looking homes, as clean well-fitting clothing made of suitable textures—the idea of exclusive possession, costliness, or luxury not coming in at all in most of these things. Under pleasant conditions of life I

would include suitable work for the doer of it with some leisure time, some agreeable companionship, games, amusements, newspapers, books, baths, liberty of action in small things, some orderliness and system in life, and such education as enables us to appreciate all these things, and so of getting the pleasure that they can give.

WHY DOES ONE THING GIVE PLEASURE AND ANOTHER PAIN ?

We cannot enter on the consideration of such a subject without being met at the threshold by the question, "What makes one thing produce a feeling of pleasure or satisfaction in a living sentient being, and another thing produce a feeling of pain or dissatisfaction ?

It is a question like many others, easy to ask, but very difficult to answer. Why is light pleasant to the eyes and to the mind, and darkness unpleasant? Why is green grass cheerful to look at, and mud the reverse? Why is a slovenly woman repulsive, and a well-dressed one agreeable to all well-constituted minds? Why is a butterfly nice to look at, and a black beetle loathsome? Most of these sensations are innate, and not necessarily dependent on or suggested by evil associations of hurt or benefit connected with the objects. We must accept many of them as ultimate truths regarding man and his environment that we cannot yet explain.

Even an attempt to answer these questions would take us into long disquisitions and very deep water. It will be sufficient to lay down this general principle of explanation, that it is a law of all living sentient beings, that whatever outward conditions promote growth, strength, and perfection of structure produce either conscious happiness or that lesser but equally important feeling, organic satisfaction. Whatever is harmonious with their being and its objects gives pleasure in some form.

WHATEVER IS GOOD FOR US IS USUALLY PLEASANT. WHATEVER IS
UNPLEASANT IS USUALLY BAD FOR US.

No doubt these general principles need qualifications and restrictions in some directions, but they are generally true. We must distinguish between one feeling of pleasure and another

often in estimating whether its effects are to be good or bad. Especially we must distinguish a kind of satisfaction that may be called an "organic satisfaction" or pleasure, which is not very consciously felt, but which pervades with a general sense of well-being the whole nature. This deep all-pervading, almost unconscious organic satisfaction in a living being means completeness of life, all its real wants being then supplied, all its essential needs being gratified, every organ doing its work well, and working harmoniously with all the other organs. It means *health* in the highest and fullest sense. Its existence proves not only that the whole organism is in health, with its essential wants, such as food and drink, supplied, but that the surroundings and the conditions of life are pleasant. A young cat, after a romp and a saucer of milk, lying on its mistress's lap in the sun, purring and stretching its limbs, and being stroked the right way, is in this condition. The romp and the food were all that were necessary for life, and even for ordinary health, but the extra warmth, the stroking, the soft bed, the satisfaction of its social instincts by companionship, were needed to produce the full "organic satisfaction" displayed. What would be of the greatest importance to mankind would be to find out how this comes about, the mechanism, as it were, through which these surroundings and conditions produce so pleasant a result. They have been evidently harmonious with the working of the organism of the animal, and clearly add to its health and happiness.

While this is the general principle, it is a useful and very practical inquiry to look a little into the details of its application in regard to our daily surroundings and conditions of life, and we must first look into the mechanism a little to do this. The most common rules for health and happiness are more vividly realised, and perhaps will be more commonly followed, if the basis on which they rest is in some degree thought about, and the mode of their working in regard to each organ and function understood. To look at the beautiful damask tablecloth turned out by the worker and the machine is interesting, but it is much more so if some pains are taken to go into the details of the process and the beautifully adapted parts of the machine. To listen to the conversation of a friend through a telephone is interesting, but to know something of how the electricity produces the wondrous

result makes it still more so. Even to see the signal lamp that stops the train is far more satisfactory than to be stopped without knowing the reason why.

ILLUSTRATIONS OF HOW SURROUNDINGS AND CONDITIONS AFFECT PLANTS AND ANIMALS.

Look at the mechanism of how light makes a flower to expand. It sets up a movement of the molecules of which the flower is composed, the effect of which is to expose the blossom to the light, and the effect of this is to give health and fruition to the whole plant. There is of course no conscious purpose in the flower in doing this movement, and no pleasure felt when it is done, but it exhibits a harmonious relation between its outward conditions and the mechanism of the flower's organism. The movement was made because the light was necessary to its organic existence, and the result of the movement is the increased activity, health, and productiveness of the plant. Going higher up in nature, we find when we get to the animal kingdom that in addition to movements in response to favourable outside conditions there are evidences of an organic satisfaction, or a conscious felt pleasure, or an increased activity of every function, or all three together produced by such conditions.

When the polar bear which has been for months dormant and its body wasting away is subjected to the heat and light of the returning summer, it becomes alive again as it were in all its activities: its suspended functions resume their energy, its wants are felt, its hereditary instincts appear, and its whole life passes into a higher level. The natural activity of any single organ always gives a certain kind of satisfaction, which is an "organic satisfaction." The combined and harmonized natural action of all the organs of a living animal gives a fuller and higher conscious felt pleasure to the organism. The more actively natural the working, the more pleasant the feeling, is nature's law. After a few weeks of sunshine and activity and proper food the bear becomes aggressive, vigorous, procreative, and joyous. External surroundings and conditions have transformed him absolutely. He was, so far as action and feeling go, dead, and they have brought him to life again. Now the altered conditions

of the bear are very marked indeed and strongly contrasted. The cold and darkness produce his suspended life, heat and light cause his resurrection, and this has become hereditary in his species. Such a fact brings vividly before us, when we think about it, the absolute dependence of a living organism on its outward surroundings and conditions.

Look now at an illustration of the effects of surroundings and conditions on an animal much higher in the scale and with a brain much more highly developed than the bear, viz., the dog. Everyone who has had experience knows that puppies are most sensitive to the conditions in which they are reared. In comfortable clean quarters, with regularity of suitable feeding, and with a nice sunny garden or field to romp in, the most delicate breeds of dogs will thrive, and be the happiest of creatures, growing fast and coming quickly and steadily to full perfection, looking the pictures of organic and conscious happiness, while if kept in a dirty, dingy place without air and sunshine they will, however well they are fed, not develop properly, and will look seedy, moody, and apathetic. I had a couple of dogs once, one of whom was a very finely bred setter, who was younger than the other dog, and had been brought up as a puppy with him. He was a most social, affectionate, joyous fellow when in his usual circumstances; but take him away from his companion, or shut him out of the garden, or take him to a strange place, and he would be dejected, with no play or fun in him, no appetite, and even his hair less glossy and sleek. He would not look like himself at all on board a steamer tied up by himself on deck. No sea-sick passenger looked more utterly miserable, or took less food than he, though he was not a bit sick.

For the perfect health and happiness of all the more delicate domestic pets, not only the necessaries of life are needed, but many of its amenities and luxuries. I don't know any animal that does not soon respond visibly to its surroundings and conditions of life apart from food and the "necessaries of life."

HOW THE BRAIN IS AFFECTED BY IMPRESSIONS FROM WITHOUT.

It will be well here to look at the physical effects on the brain and on the whole body, which are known to be produced by pleasant impressions from without on the one hand, and by un-

pleasant or painful impressions on the other. Take one of the most obvious outward results. A person suddenly comes in sight of a beautiful landscape or a striking building, or the ocean smiling in the sunshine. With the feeling of pleasure there is seen a flush, or at all events a heightened tone of colour in the face, and an increased brilliancy of eye, and very likely a change of attitude. What has happened to produce these physical effects? Physiologists have ascertained that the nervous apparatus that regulates the flow of blood through the blood vessels is affected by such pleasant feelings very much as the flow of water through a pipe is affected by the opening wider of a stop tap at the source end of an india rubber tube. The flow of liquid is quickened, and the pipe expands, and carries more water through it. In the living body the nourishment of every organ depends largely on the amount of blood that is supplied to it. If there is plenty of good blood, the nourishing process is well sustained, and the particular organ gets large and healthy, and does its work well.

Now we are here dealing with the one mighty and dominant organ of the body. It is the brain that receives the pleasurable impression from the beautiful landscape. It is the brain which then, as it were, automatically turns on an extra tap of blood on itself, for it is self-regulating in nearly all its functions; just as if a locomotive could turn on a higher pressure of steam to go up a hill with. The brain is supplied by the same large artery that supplies the face and the eye. The flushing that we have seen in the face has just as surely taken place in the brain. Its blood-vessels have become fuller, and its tissues have, in consequence, become more active. To use the modern scientific term, it "energizes" more vigorously, and, as a matter of fact, it gets better nourished by this process. For the brain has an enormous blood supply, far greater than any other organ of its size, and it needs, and it takes and uses up the very highest constituents that the blood contains, for the blood is literally a "universal provider." To the bones it supplies bone material; to the muscles, muscle material; and to the brain, brain material; which last is the richest of all, and the most precious material we know in nature. Just look at how the brain is supplied with blood. Certain parts, and these the most active parts of it, are almost literally half blood-vessels and half brain-tissue. Now if this enormous blood

supply can be increased and enriched by a pleasurable outside impression on the eye or ear, and the increased supply tends thus to nourish the brain better, to enrich it more, enable it to do its work more actively, its work being all-reaching in body and mind, then it needs no further demonstration that pleasurable impressions are good things for the health. Such impressions in this way at once touch the inner mechanism of life. They set into greater activity the subtlest energies in man. They not only serve to accentuate the co-relation and harmony of the outer world with man's subjective feelings, but in doing so they increase the nourishment and strength of the whole brain, the highest part of man's body.

It is one of the efforts of medical science to find out agencies that will thus send, or, as we say, "determine" more blood to the brain, and stimulate its functions in certain diseases. Some medicines do so, and we call some of them nerve-tonics; galvanism and electricity applied in certain ways will do it, and they are largely used in consequence; and alcohol does it, but often in a dangerous way. But we have provided abundantly in the world, scattered with a lavish hand, as nature is apt to do, things that will produce pleasant impressions on man's eye and ear, on his taste and smell. Things as common as the grass and trees, the hills or the ocean, will in time produce the same kind of physical effect on the brain in increasing its blood supply as a very powerful medicine, nitrate of amyl, which has this effect, or as a powerful galvanic current or a dose of alcohol. The difference between the two is that the effect is naturally produced in the one case, and artificially in the other. And of course the natural stimulation of the brain and its blood-vessels is far more beneficial, and is not attended with any bad results. The great difference between natural agencies and artificial means of acting on the human body commonly is that the former have no drawbacks, while the latter often have. We can produce many remarkable results on the human body and brain by means of medicines now-a-days, but the trouble is, that with good results there are often also bad results. If the brain won't take its natural rest in sleep at the regular periodic intervals, it is easy, by many agents now known, to produce sleep. Yet we commonly find that this sleep, which looks natural enough while it lasts, has not the restorative effect of

“Nature’s sweet restorer, balmy sleep.” So we try fresh air and exercise to produce fatigue and sleep, finding that an hour’s natural sleep produced in that way does more good than four hours of artificial sleep. So it is with the stimulus to the brain produced by pleasant sights and sounds, pleasant feelings and pleasant conditions, as compared with stimuli such as alcohol. They are both brain stimulants, they both act in much the same way, so far as throwing more blood into the brain is concerned, but the good effects of the one are lasting, and extend to the whole health of the body, while those of the other, if overdone, are apt to be transitory, and accompanied by marked drawbacks.

To realize fully the mechanism through which pleasant impressions produce good and healthily stimulating effects on the brain, we must look at the effects of unpleasant and painful impressions also. One of the greatest living authorities on the brain, Meynert of Vienna, maintains that the conscious feeling of pain is always caused by a sudden contraction of the small blood-vessels in the brain. We know that fear and pain and bad news and the sight of any disagreeable thing such as blood will blanch the face, and undoubtedly the brain is blanched at the same time. Bad news will depress the circulation and the whole brain-working. Seeing a man badly injured will do the same. A walk through the Canongate at 11.15 on a cold and rainy Saturday night will have the same effect on any sensitive person. When such impressions are in operation for a long time, or are frequently repeated, the brain is weakened all round, in all its energies, and especially in its highest controlling power by the continued depression. The blood not only carries nourishment to the brain, but also fresh air which it absorbs in the lungs and carries to every organ, just as water is made to carry heat from the boiler in the cellar to heat the upper rooms of a house. Little blood in contracted arteries in the brain means therefore both starvation and choking. In many persons of a sensitive mould the sudden sight of a corpse or of a surgical operation will through the brain produce almost a stoppage of the heart’s action and a loss of consciousness, or swooning.

HOW THE REGISTERED IMAGES OF IMPRESSIONS ARE WRITTEN
INDELIBLY IN THE BRAIN.

But the immediate effect of an unpleasant or painful impression is not the worse part of it. We first have the disagreeable impression from the outside through the eye or the ear. Let us take our walk in the Canongate at 11.15 of a rainy cold Saturday night. The poor women and children in rags and barefoot, the drunkenness, the degradation and degeneration of humanity that so abound, produce a strongly unpleasant impression on the brain of the onlooker, which thus is made bloodless. He feels uncomfortable, and even natural appetites are checked. If he was hungry before, his appetite leaves him. Those miserable feelings suggest miserable trains of thought. One unpleasant thought follows another by association. But when he goes into Princes Street, and leaves the painful sights and sounds, there is *not* an end of the matter. Each painful emotion and each unpleasant thought has left an image written in the brain, a registered imprint which is as much an actual fact as the sun is in the heavens. This impress is like a photographer's undeveloped plate. The picture is there ready to come into view, but is not before the conscious vision. Constantly repeated unpleasant impressions all leave such "registered images" in the brain. They lie there like immense bundles of dry plates, that have undeveloped pictures on them, or like a book shut up, whose leaves are printed full of horrors, that have only to be opened to be seen. It is an uncomfortable cargo, for they are at any time liable to be called up before consciousness and memory, and whenever they are called up, the recollection of any one of them acts much like the original sight of them in depressing the action of the brain by contracting its blood-vessels, which is thus acted on, not only by the outside original impression, but by the image of that impression which it always carries about. Any chance event may suggest and call up any one of them. We have to take into account not only the mental depression and unpleasant feelings such impressions cause, but their physical effects on the health are decided. Such an unpleasant physical effect, caused not by a real impression on the senses, but by a registered image of one on the brain, is illustrated by the fact, that some persons will

get sea-sick the night before a voyage, or when they step on board a ship before she begins to move. Boerhaave, the great Dutch physician, relates a story in point. He says that he passed a spot where years ago the smell from a dead horse made him vomit, and that the mere recollection of that occurrence always produced nausea. It is of the highest importance for the health and for the happiness that the innumerable leaves all printed over with the records of past impressions in our brain should contain a preponderance of pleasant impressions, and not of unpleasant ones, when memory or association opens their pages and their contents come before our consciousness, as happens every day. It makes all the difference whether they are sad or not. So far as our consciousness is concerned, our past lives consist of such stored-up images and the thoughts and emotions they have suggested. A brain full of pleasant memories is thus a perpetual source of health and happiness. One mostly stored with depressing recollections is, on the other hand, a perpetual fount of unhappiness. It seems as if in some cases of depression of mind the brain, from some defect in its nutrition or working, opened out to consciousness only the leaves on which were written the unpleasant sights and sounds, the miserable thoughts and feelings experienced in the past, while the leaves containing the bright and pleasant impressions and feelings will not open at all in such cases.

THE EFFECTS OF IMPRESSIONS ARE TRANSMITTED FROM ONE
GENERATION TO ANOTHER.

One other fact we must take into account before we leave this part of our subject—that is, the law of the hereditary transmission of human qualities bad and good from generation to generation. If the brain is subjected to constant outside impressions that are pleasant, and its blood supply is thus constantly increased, and its vitality and nutrition improved from one generation to another we will have in time those acquired good brain qualities transmitted onwards by a law of heredity. If the fathers have been made cheerful and happy by pleasant surroundings, the children will have a natural tendency to be cheerful. On the other hand, if the fathers have had nothing to look at but ugly houses and muddy streets, the children's dispositions

will correspond to the mud and the ugliness. This law of transmission, beneficent or terrible, according to the way in which it operates, should loom out largely in every question that affects the health of mankind. If the evil effects of outward conditions died with the generation on which they operated, and the next generation could begin a fresh page of life unaffected by them, they would not be so serious a matter. But when the fathers eat sour grapes, and the children's teeth are thereby set on edge, it intensifies the reasons manifold why sweet fruit should alone be eaten. To think of the gloom of the Cowgate at this time of year being written on the brains of children before they have ever seen it, generation after generation, is a sad enough thought, and should be an extra stimulus to those who are working to sweeten the surroundings and improve the conditions of life of our city population.

To sum up this part of our subject. Things that are harmonious with the working of the organism of living beings give pleasure. Things that are inharmonious or antagonistic to this give pain. There is an "organic satisfaction" in living beings that need not be consciously felt at all, but which is the highest evidence of perfect health. Disagreeable and pleasant impressions on the senses and on the organism of living beings act on them through a mechanism which lies chiefly in the brain. The former depress the action of the brain, the latter stimulate it. All impressions made on the brain from without, all feelings and thoughts from within leave registered images, which lie usually hid, but can be recalled when active memory or reminiscence take place. The memory of unpleasant impressions depresses the brain, and makes it bloodless in the same way but to a less degree than the original impression. A brain filled chiefly with registered images of unpleasant impressions made on it carries with it at all times a source of depression and also of lowered general vitality, and even of ill-health. Most important of all perhaps, the bad and the good results of the gloomy and the cheerful impressions are transmitted hereditarily onwards to future generations, not dying out with the lives that first suffered from them.

I know that there is much difficulty in our realizing some of those things as actual facts. We are so accustomed to separate mind and body that we do not readily connect a pleasure with

a blood-vessel, or a sin with a brain cell. It is not easy to understand why two brains that look alike can the one be full of evil registered images, and the other of pleasant ones. Yet it is essential to connect body and mind if we want to understand how our health and happiness are affected by things without us. A needle is changed after it touches a magnet ; though it seems the same, its qualities are different. So a brain is changed most certainly in its qualities and attributes after it has been subjected to terrible sights and the feelings they have aroused.

WHY ARE OUR WORKSHOPS NOT MADE MORE PLEASANT ?

Some persons are much more consciously sensitive to agreeable surroundings than others, but it does not follow because a person is not consciously sensitive to them or to unpleasant surroundings and conditions that they have no effect on the health. Two workmen may be employed side by side in a dingy ugly workshop. The one may have a conscious dislike to the place every time he goes into it ; the other may have no such feeling, and never think about it at all. Yet both may suffer in health and in spirits from working in such a place. And while I am speaking of workshops, I cannot but refer to the extraordinarily little pains that seem to be taken in most places to make them pleasant. We are all proud of Edinburgh as being the Queen of cities. Some of our streets have no rivals in the world. But are our workshops up to the standpoint of our city ? Printing is one of our great trades here. It is one implying intelligence and education among the workers, who are certainly very capable of appreciating and benefiting by pleasant surroundings. Now go into most of our printers' workshops, and say if sweetness and light are their prevailing characteristics ? A little more light or a little more colour, a little more amenity generally would make a great difference in the general impression produced on the mind on entering one of those establishments, in which so many men spend most of the day. I take this trade because it is one of the best and healthiest, as well as best paid. It should be one of the ideal handicrafts, for it exercises pleasantly body and mind, without being a drudgery. If our printers' workrooms mostly do

not produce as pleasant impressions as they might, what shall we say of many other kinds of workshops? Why should any dirty bit of ground that is good for nothing else be considered just the thing for a range of workshops?

THE MINER, AND HOW HE SUFFERS FROM THE DEPRESSING
IMPRESSIONS ON HIS BRAIN.

If any one wants to see the full evil effects of unpleasant surroundings and conditions on health, and I think on happiness, go and see the miners coming up from the shaft of a coal mine at one of the shifts, especially those who have been working during a night-shift, and during a whole winter have never almost seen the sun or the sunlight, for they must of course sleep most of the day. Far too many of them look pale or ill-coloured, languid and wanting in spirits. They have not the appearance of men "in good condition." They don't look as if they had that sense of well-being or organic happiness without which the health cannot really be said to be good. Walk through Bonnyrigg or Loanhead even on a fine Saturday afternoon, when most of the miners are out, and you will see evident traces of the unpleasant conditions of their work in the miners' faces and attitudes. They are in far too many cases sitting on their hunkers, and not chatting or laughing, as they should if they were in good health. They don't seem to take to anything else as much as they should, such as a bit of garden, or the cultivation of flowers, or to games, which would be a corrective to the necessarily depressing conditions of their underground life. I cannot help thinking that the dismal and forlorn appearance of so many mining villages is connected with the lowered vitality of their inhabitants, and the want of ambition and pleasure in life resulting from that lowering. Surely ground could be got for small gardens if the men wanted them. For men who have to be eight hours a day underground the strongest efforts should be made to encourage them to get into a sun bath whenever they can, to look on the cheering green of grass and the enlivening colours of flowers, to provide bowling-greens and games of all sorts. No one can look at their weary countenances, as they emerge from underground, without seeing how much need there is for such counteractives. I cannot

help attributing some of the vacancy of face too that is too common in the miner to his surroundings. Each mining village would need to be made a sort of cheap miniature "Palace of Delight" in the centre of its village green, where light and beauty would abound to correct the effects of the darkness and gloom where they work.

And with the lowered health of the miner and his lessened organic happiness we must connect his too frequent craving for excessive smoking and drinking. It is pathetic to look at a group of miners emerging into the open air after an eight hours' imprisonment in the dark, and to see the eagerness with which in so many cases pipes are lighted, when the physiologist knows that the craving for some stimulant which they feel should be satisfied with food and sunshine instead of tobacco and beer. For these long eight hours, day after day, unpleasant and depressing impressions have been registering themselves in his brain. The leaves there have been printed over with gloomy views till they are full to overflowing. No wonder that a brain stimulant of some sort is craved for. If it were not possible to get any other and more efficient stimulant and counteractive to those gloomy impressions than such artificial means as tobacco and alcohol, then one might, with Burke, become very tolerant of gin, on the simple principle that it seemed on the whole to produce some happiness in those who otherwise would have none. But we know that there are natural counteractives and healthy stimulants that are attended with no drawbacks whatsoever, that on the other side of the leaves in the brain that are printed over with the gloomy impressions of the mine, we can print the cheerful impressions of the sunshine and the garden, of the prattle of children, and the orderly beauty of a clean and comfortable home. In such a case as that one must look on men and women from a large and scientific point of view. If unhappiness is due to the state of the brain and health induced by unnatural and bad conditions of life, we must try and make those conditions natural. If immorality springs from the same cause, we must apply the same cure. For all must admit that immorality is chiefly due to lessened self-control, and we know that self-control is a brain quality that is apt to disappear when the brain health and vigour get impaired.

THE COWGATE *VERSUS* NEWINGTON.

I have taken the miner as a striking example of the effect of unpleasant conditions and surroundings, but all that I have said about him applies with great force to the inhabitant of some of our narrow streets and sunless closes. They, too, are apt to crave tobacco because their brains receive mostly unpleasant impressions from without, and are lowered in tone. They cannot control the thirst for whisky, because healthier brain and mind stimulants are not available to them. Can any sensible man aver that if there is more drunkenness in the Canongate and Cowgate closes than there is in Newington and Morningside, it is not largely caused by the absence of pleasant surroundings and conditions of life in the former? If we could suddenly transfer the inhabitants of the High Street and Canongate out to the Newington villas, and the inhabitants of the villas into the closes of the Canongate, we should see a marvellous change in the health and happiness and the morality, for the better in the former case, and for the worse in the latter in two years' time. Why, at present the conditions of life seem so happy and pleasant in our suburban districts, with their airy houses, their beautiful gardens resplendent with flowers, their sunny exposure, and glorious views of the hills or sea, that their inhabitants seem too happy to be grossly immoral; for who ever heard of a villa householder in Newington being taken up for being drunk and disorderly by the police? And they are too healthy to need the services of doctors, for I have heard of several of our profession being starved out there lately! They do not seem to die of anything but old age there, because the mortality rate is there only about 12 per 1000. I don't wonder that the owners of these little paradises below do not, as a general rule, want to go too soon to the paradise above. I have seen two sights which seemed to me the very perfection of pleasant surroundings and conditions of life. One was the sight one gets from the top of the Morningside cars of a summer evening of the south-side villa resident smoking the pipe of peace, with his wife beside him watching his children and their friends playing a game at lawn tennis in his garden, behind the high wall of which he has the privacy which our nation loves, because the idea of privacy is connected in our minds with domesticity. It is lucky

for the travellers on the car tops that tramways were not invented when these south-side garden walls were built, otherwise we should certainly have had them built high enough to exclude our prying eyes even from that vantage ground. The other sight that could compare with this was the American after he had returned from business in New York, and come home to his summer quarters in one of those delicious little suburban towns, say Orange, New Jersey. His house is a gaily-painted tasteful wooden residence, with a great balcony in front quite open to the public road, with no fence between them, or any division between him and his neighbour's plot of grass. In this balcony he sits in a rocking-chair of a bright red colour, with his legs high in the air, and a big fragrant cigar in his mouth, his shady straw hat and light coat looking the picture of coolness. Round him sit his wife and daughters all in gauzy dresses, talking to his neighbours' sons. Restfulness, coolness, and happy country life are embodied there, while the whole surroundings of green lawns, trim roads along which bowl spider-like buggies behind fast-trotting horses, rows of houses all painted brightly, a background of wooded hills in their glorious autumn rainbow tints, are all such as produce feelings of cheerfulness and health.

PLAYGROUNDS FOR CHILDREN AS NECESSARY AS HOUSES.

It is certain that we cannot all hope to be Newington householders, with gardens to ourselves; but public gardens, and lawns, and greens can and ought to be easily accessible to every man, woman, and child in the country. I hope to see the time when the law will compel every man who builds a dwelling-house anywhere to provide an open space equal in area to the combined floor space of all the storeys. The concentration of human beings implied in large four and five storey blocks of dwelling-houses, and the deprivation to the children of air and playgrounds and grass, is monstrous at this time of day. There is plenty of land to spread over. Science could now provide means of communication. We know what the laws of health demand, but we do not carry them out. We know that a nation's flesh and blood is by far its most precious possession, and yet we are deliberately allowing cities to be built in such a way that a deterioration of health must neces-

sarily and surely take place in them. We allow trades and occupations to be followed under conditions which are slowly killing and deteriorating the workers. We are spending every year thirty millions on our army and navy, while all the time the men to handle our guns and ships are getting smaller in stature and less in weight. Big changes for the better, I am well aware, cannot be made at once; but if those facts and conclusions as to the effect of surroundings and conditions on health and happiness I have been pointing to are laws of nature, then most surely they cannot be set at naught without a penalty being paid. Science clearly points to a much wider meaning of sin than our theologians have taught us. Is not the breaking or setting aside of any law whatever a sin? And is it not a law that children who have no green grass to play on, no orderly, pleasant surroundings, who have no proper outlet for their energies, will grow up pale, weak, deficient in self-respect and self-control in appreciation of order or beauty, and ill to manage at home? Then is it not a sin not to compel those who build houses for our workers, and make a profit by so doing, to provide also playgrounds for the workers' children—these playgrounds being really as necessary for the race as houses? Are we to have another impenetrable mass of buildings, other dozens of solid High Streets erected on the flat stretch of ground between the Canal and Corstorphine Hill for our successors to have to pierce and pull down to let in sunshine and fresh air? We need at present another Jeremiah to denounce the sins against physical law through which our children are deprived of the necessaries of their growth and due development. These children we bring into a "plentiful country," but instead of "eating the goodness thereof," they are starved, and their heritage is literally "defiled, and an abomination." This is done more or less in every city of our land, and yet "we are not ashamed." There is no problem of the present day that approaches in importance this one of rearing a strong and healthy race. Our climate is good for this; our race is manifestly a strong one; our country districts rear fine men and women. Why should our cities swallow them up and deteriorate them? If it is a law of nature that pleasant surroundings and conditions are necessary for the happiness and health of mankind for its due and proper development, then it is time that they were more

fully known and more vividly realised, and more earnestly striven after. Nature's laws work slowly but surely. The sunshine that the fathers have enjoyed in their country homes where they were reared does not fade out at once in its effects even in the first generation of children. It takes long to build up a good race and many favouring conditions, and it takes long, too, to destroy its good qualities. But the poorer parts of our great cities, with their total want of amenity, are doing so on a great scale. Yet the victims of this Moloch rush in greater numbers year by year from the country into the cities, apparently regardless of the destruction that awaits their children. When one walks through Argyll Street or Jamaica Street in Glasgow of a winter afternoon, and hears every other passer-by speak with a Highland accent, one cannot but contrast the glens where these people or their fathers and mothers were reared, their fresh air, sunshine, and quiet life, with the tumultuous rush of those streets, their muddy pavements, and the smoky pall that overhangs them. One wonders how long the sunshine absorbed in former generations in the glens will last, and counteract the Glasgow fog. Money and work may be more plentiful in Glasgow, but one cannot but see that they are paying a great price, and running a great risk for their children, by coming to such a city.

It is wonderful, however, how the unpleasant surroundings of a city can be in some ways counteracted even by small things. In a very poor street in Glasgow, the other day I saw one house or flat so contrasting with the others as to brighten up half the street. The windows were filled with flowers, the panes of glass shining like crystal, the stonework round the window was painted white to reflect more light inside, while clean lace curtains were hanging inside, and a canary in a brass cage was singing cheerily. Now why was there only one such house in that street? I wondered whether it was an English couple that lived there, with their greater appreciation of neatness and beauty. That house was an educating influence, I have no doubt. If the inhabitants of the houses round had not been dull and unappreciative of beauty and of pleasant impressions, it is certain more of them would have followed, in some degree, this example.

PARAFFIN OIL AND ITS LIGHT.

Take one discovery of recent times, that of "paraffin oil," and see how it has affected the cheerfulness of life in country districts. Most of us can remember the time when the long winter evenings had to be passed in our country cottages, the work and the reading done, in the dim light given by a small oil cruze or a poor tallow candle. Paraffin has changed all that. The poorest cottager in Britain can now, and does now enjoy a light as clear and cheerful as the richest man in the land at the cost of a half-penny a night, or so. This light is a pleasant surrounding. This light of a winter evening has added greatly to the happiness of our poorest people. I am not sure it has not added greatly also to their intelligence and morality. I once got myself into much trouble in an argument with a dear old lady friend, of strict church principles, who was holding up the old times as being far better than the new, and depreciating modern improvements in living. I turned on her suddenly with the question: "Now, whether do you think paraffin oil or the Free Church has done most for Scotland?" I certainly meant no disrespect to the Free Church. If it or any other church has added as much moral and spiritual light to our minds as the other has added physical light, it will have no reason to be ashamed of its work. When we have attained to a lamp for our paraffin that is tastefully simple, easily lighted and safely put out, cheap and safe to carry about, smokeless and durable, then unquestionably one most important pleasant surrounding and condition will have been perfected for rich and poor alike.

ALL THINGS FOR THE COMMON USE SHOULD PRODUCE
PLEASANT IMPRESSIONS.

It is a great advantage to a community when everything that is for the common use is tasteful, orderly, clean, and pleasing in effect. Whatever is done by the community or any part of it for universal benefit should be especially well done. The public buildings, the streets, the public baths, the public parks and gardens, the tram cars, the railway carriages, the steamers, the theatres, and especially the public schools, if they are all good,

exercise an immense educative influence on a people. This principle seems to have been better realized in Greece and Rome than in modern times. One cannot travel in America in their beautifully constructed railway carriages, occupied by all citizens alike, without becoming dissatisfied with ugly things at home. The most ignorant and tasteless persons cannot spend an afternoon in Princes Street Gardens in summer without receiving a cheerful mental impression from the beauty of the walks, and grass and flowers, and the taste displayed throughout. The feeling of the labour and thought that have gone to produce all this instinctively causes admiration, and rouses too our protective instincts. The feeling of dissatisfaction which we experience when we pass from Princes Street Gardens into a humdrum ugly street, is very marked. The impressions of the one have been pleasant, and have produced happiness: the impressions of the other have caused dissatisfaction, and therefore, to a certain extent, dulness and a lowered tone of action in the brain. The one has elevated the taste for the beautiful and the harmonious, the other has lowered it. The one is in accordance with the incomparable harmony and fitness that are everywhere seen in nature, and are especially to be found in the structure and working of our own bodies. When we consider the delicacy of our senses and nerves, the orderly complexity of structure in our brains, and the marvellous adaptation of working of one part with another within us, it is no wonder that such harmony instinctively responds to what is beautiful and harmonious without us.

HOW FOLKSTONE AFFECTS THE DWELLERS IN THE EAST END OF LONDON.

If anyone wants to realize thoroughly the effect of a change of surroundings from the east end of London to the seashore at Folkstone, let him read the account of "Homes for our East End Poor," by Mrs Reaney, in this month's *Sunday Magazine*.* She has been the means of establishing a house where there are glorious sunshine, bracing sea breezes, green grass, the ever-changing ocean, quietude, orderliness, domesticity, cheerfulness, well-cooked wholesome food, and a reverential sense of thankfulness to the great Giver of all good things. All these "bits of

* November 1887.

Heaven" on earth have been provided for wearied sons and daughters of East End London to stay a few weeks of summer in. Mrs Reaney describes vividly the effects of that change on health and happiness—how puny London children, white-faced, weak-eyed, and torpid became "high-spirited" and "round of limb," and "full of merry laughter," how their overworked weary mothers get soon so full of energy that they have to work off some of their superfluous gratitude and strength in "washing dishes" for the love of it! Efforts of the same sort have been made with equal success nearer home by Edinburgh ladies, who arrange for numbers of our town-bred children going to country farms and cottages for a few weeks each year.

It is well known that some of the inhabitants of the deeper Swiss valleys where the sun never penetrates are stunted, deformed in body, and mentally enfeebled. The gloom of great mountain ranges always impresses itself on the men and women who live under their shadows, in their poetry, and in their superstitions, while the sunny plains and bright skies of such countries as France and Italy have produced a gay and cheerful population.

CHEERFUL IMPRESSIONS CURATIVE TO DISEASE.

In the treatment of disease mental and bodily, especially the former, cheerful surroundings have been found of the highest value. Indeed their full effects are not in my judgment yet realized. A hospital or an asylum should be cheerfulness itself. Everything that colour, light, and beauty can do should be tried so as to affect the mind and body. Those are all cheap. They are all counteractive to low vitality and low spirits. The use of them is plainly indicated by the laws of nature and of our being. Our schools, where the susceptible, sensitive growing minds and bodies of our children are liable to be especially influenced for good or evil by their surroundings, should be full of them. Rest assured that the rearing of generations of children in our large towns is a terribly risky business. Their surroundings and conditions there are full of peril to morals, to mind, and to health. Everything however small that helps to be counteractive to those dangers may count for a great deal in the end.

I am well aware, and am thankful for the fact, that those

doctrines are neither new nor neglected in the present day. Our whole life has been upwards of late years. Our new streets are less gloomy than the old, our houses are better, our playgrounds more numerous, our schools infinitely finer, our hospitals, asylums, poorhouses, and gaols far more counteractive to the evils that they combat. And in consequence our population is healthier and happier, on the whole, and life is altogether more cheerful with a larger number of us. But there is still room for much improvement, and this will only be effected by increased knowledge leading to increased effort.

INDIGESTION: ITS CAUSES AND ITS CONSEQUENCES.

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BEFORE entering upon the subject proper of my lecture, permit me to recall to your memories the facts connected with the organs with which to-night we have more especially to deal. These organs are known collectively as the Alimentary System, that is, the system which elaborates the food we take, to make it fit to aliment or to nourish the various organs and tissues of the body.

You must not suppose that any part of the food eaten goes directly, in the state in which it left the kitchen cooking-range, to repair the tear and wear of the adult body, or to supply building material for the growing body of youth. Before Nature allows it to be used for either of these purposes, she passes it through a whole series of mills and laboratories—tearing, and mashing, and dissolving, and extracting by very marvellous and very effective processes.

The food is no sooner brought to the mouth than it is, or ought to be, operated on by a machine whose thirty-two exquisitely wrought ivory teeth are perfectly adapted for cutting and mashing. To facilitate the work there is a fluid poured out, which you know as saliva. It is mixed with the broken material, and aids in its conversion into a pulpy mass, while at the same time it acts chemically on certain of its constituents. The production of this pulpy mass is the function of the first chamber of the human alimentary system.

From the mouth the food passes by a long, straight tube, called the oesophagus or gullet, into the stomach. The stomach, as you see in the diagram, is a bag somewhat of the shape of a flask.

Its wall is not thicker than ordinary tweed cloth. Its structure has an important bearing on our subject. Part of its thickness is occupied by continuous layers of muscle, which contract and relax, under the stimulus of the food stuffs introduced into it, but independently of the Will. This distinguishes it from the muscles of the limbs, which are under the control of the Will. By means of alternate contractions and relaxations the contents of the stomach are kept moving, and become thoroughly

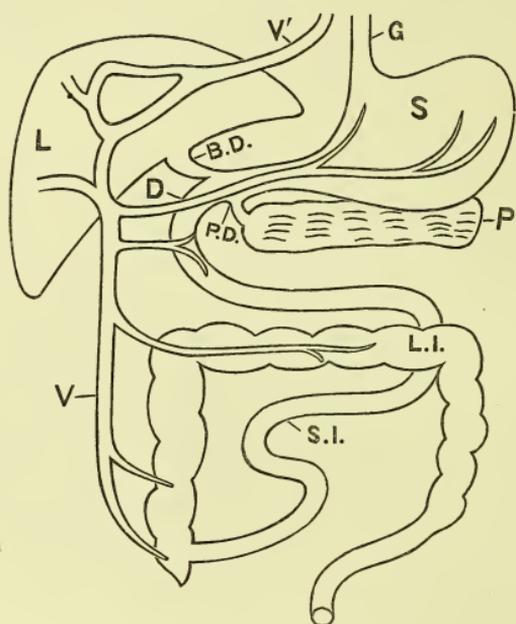


DIAGRAM OF THE DIGESTIVE SYSTEM.

G., Lower end of Gullet; S., Stomach; L., Liver; P., Pancreas; D., Duodenum; L. I., Large Intestine; S. I., Small Intestine; B. D., Bile Duct; P. D., Pancreatic Duct; V., Blood Vessel, with branches from Stomach and Intestine going to Liver; V', Blood Vessel from Liver and going to Heart.

mixed with the stomach juice. This is a purely mechanical arrangement. The juice itself is produced by an innumerable number of delicate little structures shaped like glove fingers, which lie side by side, and open on the inner surface of the stomach wall. It is possessed of potent properties capable of dissolving, or breaking up, or digesting certain substances.

This part of the process is purely chemical, as the preceding was purely mechanical. The active ingredient of this gastric or stomach juice is called Pepsin, and is largely used in medicine, being obtained from the stomach of "our four-footed congener" the pig, and also from the stomach of the calf.

When the food has been made into a gruel-like consistence, it passes from the stomach into the first part of the intestine or gut, that is, the Duodenum. Here it is further acted upon by two important fluids: the one, formed by the liver and poured out by the gall-bladder, is the bile; the other is produced by the sausage-shaped gland called the pancreas. This gland is familiarly known as the sweetbread. From this point the materials not already absorbed have to pass along 20 feet of small, and 5 or 6 feet of large intestine. At every step the material fit for absorption is taken up in a manner which, however interesting the description of it might be, we cannot now wait to examine. It is sufficient for our present purpose if it be understood that, when the digestive processes have been performed properly in the stomach and duodenum, much of the food we eat is, in its altered state, passed directly or indirectly into the blood, and the life and the health of the individual depend on a plentiful supply of a pure blood of a sufficient richness: for the blood is the life. Substances, on the other hand, which have resisted the action of the various digestive fluids, or ferments—as they are technically called, or have had all the good extracted from them, pass through the intestine, and are discharged as effete matter, and of no further direct use for the purposes of the animal organism. There is a fact bearing upon these effete substances which it is important to fully realise and to bear in mind. It is this: those substances which are unfit for further use undergo changes of great interest in their journey through the intestine. Some of these changes are of the nature of fermentations, and are produced by micro-organisms, or germs—those minute living bodies which have created such a stir in our day, and the discovery of which, along with the revelation of the important part they play in the economy of Nature, is one of the outstanding discoveries in this, the most wonderful of all ages, the Victorian epoch. Well, during these fermentative processes poisons are produced, which, if retained in the intestine, pass into the blood, and the individual suffers

as surely as if he had swallowed a dose of an ordinary narcotic poison.

This, then, is a brief sketch of the digestive processes as they are normally performed; to-night we have to deal with the pathology of digestion; that is, conditions in which it is not performed normally, where, instead of digestion, there is indigestion. Need I tell you of the prevalence of this? Do not some of you know enough and to spare, if less than we doctors know? I shall only remind you of the princely charities of Holloway of pill renown to make you realise the millions upon millions of little pellets swallowed by suffering humanity in the fervent search for deliverance. Do not the pages of every journal and magazine we take into our hands teem with Holloway's competitors? Pills worth a guinea a box, antibilious pills, stomach pills, liver pills—such an infinite variety that the poor sufferer is bewildered, and flees for relief to his private physician, and, perhaps, gives him up for the first old lady who preaches salvation by a special nostrum of her own, or of which she has become an apostle.

We may now proceed to consider the causes of this indigestion or dyspepsia.

I have already drawn your attention to the processes which the food undergoes in the mouth. The starchy matters, that is, the material of which arrow-root, corn-flour, &c., are formed, are in part acted upon by the saliva and converted into sugar. When thus converted, they are fit for immediate absorption by the stomach. It will then be apparent to you that if these substances are bolted, as they are, shall I say by ninety-nine per cent. of people—at all events by most of us—the saliva does not become mixed with them, and part of the chemical transformation which ought to take place in the mouth does not take place. But this is by no means the greatest error which may be made in the mouth. An infinitely greater wrong is done by the neglect of the process of mastication. Do not be offended if I tell you that the vast majority of people swallow their solid food long before it has been reduced to that state of division and pulp for the production of which it may be presumed we were provided with teeth. You know that in fowls there is a structure called the gizzard, which is in reality a grinding mill, in which the food

is broken and mashed in order that it may the more readily undergo the strictly chemical changes which take place in the true stomach. You also know that in ruminants, as the cow and sheep, there is a pouch into which the food passes, and from which it is again taken up into the mouth for additional mastication before it is passed into a series of true stomachs. Man, however, in this matter of mastication as in other matters, is a voluntary and self-restraining agent—his being is indeed surrounded on all sides by the necessities of self-restraint. It may require a highly-developed self-restraint in a hungry man, or in a hurried man to masticate his food properly, and yet, if he has not learnt this, he breaks the physiological law, and he suffers as surely as if he had broken the moral law. The point is of such fundamental importance that I may be allowed to particularise, so as to fully bring out its significance. Let us begin with an ordinary Scotch breakfast of ham and egg, or fish, and bread. You get out of bed perhaps with scant time to reach business at the appointed hour, breakfast is allowed some ten or fifteen minutes, and you pride yourself on being a quick eater and not wasting time over your meals. This means that the ham, or fish, and bread are swallowed in considerable lumps, and not in that state of division and pulp which physiology requires. The poor stomach has to pay the penalty of boasted expedition; it tries to dissolve those great lumps by means of its powerfully solvent juice, and for a time it succeeds, but only by making great efforts. A time comes, however, when the excessive strain and repeated irritation can no longer be endured, and there results all the horrible discomfort of flatulence, acidity, and perhaps pain, which inform you that you have a stomach, although erewhile you may have lived in the blessed unconsciousness that you were the possessor of this organ. You find people who tell you that this and that and the other thing does not agree with them. This one is very fond of some of our native fish, but if he partakes thereof, he is reminded from time to time during the whole forenoon of what his breakfast consisted. This unpleasant and unsatisfactory experience is ended in many instances by taking sufficient time and trouble to make a complete pulp of the savoury morsels before they are passed on to the stomach. The same is equally true of other food materials. Then comes dinner, over

which perhaps a little more time is spent, but a habit has been unconsciously, and probably ignorantly, acquired; potatoes slip down in lumps of a size which, if presented of equal size as boluses by the doctor, would lead to expressions of indignant horror. And yet thus it is, and again the ill-used stomach has to set itself to a task which ought not to be laid upon it, and a time comes when it has its revenge, and potatoes are discovered to be indigestible. And so it is with various other substances, which people discover in time "do not agree" with them, as they say. One sometimes wonders if the law of evolution may not ultimately save man the trouble of growing teeth, and dentists the profit of replacing them, seeing that their function is so indifferently exercised. For unused organs are prone to deterioration, and to probable final extinction. Were it not that man is a voluntary agent, he might have been provided by a beneficent Creator with a gizzard like the barn-door fowl, or with a pouch like the ruminant. Think what this latter would have been to the man of highly-cultivated palate! Would not the pleasures of the bovine system have indefinitely retarded at least the intellectual evolution of the race? An eminent and aged statesman, as full of energy as he is of years, is credited with masticating his food with the same energy that he displays when assaulting his opponents, and, it is said, his physical vigour owes not a little to this habit. In this matter there can be no physiological doubt as to the wisdom of the right honourable gentleman's policy!

I put this point somewhat strongly, for experience impresses me more and more with the certainty that this simple fault is the cause of much of the indigestion among all classes.

It is necessary, of course, to have at least a moderate number of sound teeth, which can be used without pain or discomfort. If they are wanting, the dentist's aid ought to be sought without delay.

Improper food is the next cause of indigestion. You have all heard of the enormous infant mortality in the country. According to the Registrar General's returns, the mortality in England under one year of age is in one quarter no less than 33,352, or one fourth of the total mortality for a like period. Of these thirty-three thousand children a very considerable proportion died of gastro-intestinal affections alone. With the mortality reaching

such a height some estimate may be formed of the amount of sickness in infants, the seat of whose illness is in the digestive tract. It must of course be vastly greater. Experience, especially that gained at the medical charities in cities, shows that one of the most common causes of sickness in infants is indigestion, which has its origin in improper feeding. The fond, and ever-anxious, and over-willing mother, thinking she can doubly ensure her infant's nourishment and growth, administers, in addition to its natural food, stated quantities of arrowroot, corn flour, or some similar starchy compound. The poor infant's digestive organs are no more fitted to grapple with this stuff than they are to digest powdered corks or boiled ashes. It becomes restless and fretful, and the mother soothes it temporarily by pouring into it a fresh supply of nourishment. Everything is greedily taken, and the mother does not understand how her babe should be as it is, when, what she calls its appetite, is so excellent. What has happened is, that the so-called food instead of being digested remains undigested, and becomes the seat of certain fermentations which lead to irritation of the inner coat—that is the mucous membrane—of the stomach and bowels. The result is that even the natural food is no longer digested, but is either rejected by vomiting, or passed through the bowels almost unaltered. The irritation becomes inflammation, plumpness gives place to emaciation, the merry laugh and quiet sleep are replaced by the cry of suffering and by restlessness, and it requires all the physician's art to save the little victim's life.

Before leaving this subject I shall tell you of some important observations recently made by Dr Woodhead and Dr Macfadyean of this city on milk. To understand the subject I must say a few words by way of introduction. You all read the newspapers, and therefore know that many diseases may be set up by, or are at least greatly influenced by, minute parasites, which are known as micro-organisms or germs, and that consumption is one of these diseases. Now, cows are subject to a disease of their udders in which a micro-organism similar to that present in consumption is found. This organism has been found in the milk given by cows whose udders were thus affected. Consumption of the bowels (Tuberculosis) is a common disease in children, and the important question arises : May children really get this disease from the milk they drink ? Well, however unpleasant such a

possibility may be, science answers with a fairly strong affirmative. Here however, as in most departments, a little knowledge is dangerous and tends unduly to alarm. The fact is that the healthy stomach and healthy intestines do not readily permit these organisms to take a lodgment in them, but repel and probably even kill them ; but, if the intestines become the seat of such an irritation as I have indicated as resulting from improper feeding, then the resisting and fighting power of the mucous membrane is lost, and those microscopic enemies of the race may take root, and breed, and multiply, and complete the destruction which was initiated by an error in feeding.

Strange thoughts are suggested by the scientific certainty of recent discoveries. We have long known somewhat of germs, and of the havoc they might effect. The genius of Lister, than whose name there is none greater on the roll of the Edinburgh Medical School, interpreted what modern methods have demonstrated. We are in a world surrounded by enemies, invisible to our unaided senses, and only recently revealed to us even by our microscopes. There is indeed a constant feud going on between the germs around us and our bodies. When we, that is, our tissues and more especially our mucous membranes, are in good health, *we* are the victors : if we are in bad health, some germ which has a special liking for that something in us which we call our constitution, gets the upper hand, and we are laid on a bed of sickness. Our present day belief is not then so very different from that of "the good old times" when people believed they were surrounded, and influenced, and affected by invisible spirits of evil.

Let us return, however, to the first head of our discourse—that of improper food. I have referred to what we talk of as our constitution. This constitution is what makes individuals and families and races differ from each other. It may be a physical or a mental difference, or it may be a combination of both. It shows itself along many different lines. All individuals cannot be developed into athletes ; no amount of training would develop the majority of persons into crack cricketers, brilliant football players, and so forth, any more than they can be developed into poets, or statesmen, or indeed physicians. People are born with brains and muscles capable of so much, and of so much only. This is generally recognised, but that individuals are born with

digestive organs which are also only capable of so much, is not so universally understood. There is indeed as much difference between the digestive organs of individuals as there is between their muscles or their bones. True it is that the man with only two talents may double them as surely as his more liberally endowed brother, the possessor of five, but it does not follow that the former can, even by the exercise of great industry, attain to an equality with him who started so far ahead. These individual peculiarities have to be borne in mind. They are to be seen almost in every household, and they constitute a grave anxiety to thoughtful parents. As they show themselves in matters of diet, they specially interest us now. Some of you may have discovered that, although porridge and milk is a dietary which deservedly occupies a high place in your esteem, it does not suit every child. It may, of course, be bad temper, or a desire for what it considers better things, that makes a child strike against its morning meal, but it may be the loathing of a food which the stomach cannot digest with comfort. Not unfrequently one sees adults and children as to whom there can be no doubt that our excellent native food is at the bottom of their troubles. This can sometimes be remedied if the porridge be made of a finer meal, or if it be soaked in water overnight, and then thoroughly well cooked by long boiling. But in a certain number of cases city men, and even city children, suffer from indigestion if they take porridge and milk, save in small quantity. I have in my mind an old gentleman whose life was saved by stopping what he considered a very wholesome, harmless, and moderate supper of porridge and milk.

Other people suffer from indigestion if they partake of what is known by our friends on the other side of the Border as Scotch broth. The constituent in it, which most commonly leads to indigestion, is the barley, which is frequently very imperfectly cooked, the grains being raw in the centre. Others cannot use the commonest vegetables with impunity—such, for instance, as potatoes and cabbage. The individual stomach asserts itself, and the possessor of that stomach, if a wise and an observant person, will be guided by its dictates. Cumberland wisdom has formulated the phenomena of idiosyncrasies into a proverb, "There's nowt so queer as fowk." Remember, however, that I have already impressed on you that many simple articles of diet, includ-

ing those I have just been speaking of, often produce indigestion because they are not sufficiently masticated. And by that I mean a much more thorough mastication than is popularly held to be sufficient.

I need not enumerate all the various articles of diet, excellent enough in themselves, which may induce indigestion. Cheese, shell-fish, made-up dishes, and a legion of things, the product of modern culinary art, are among the number.

After these hints on improper food, let us look for a moment at the question of fluids taken with meals. First there are the effervescing waters, as soda and potash. These are alkaline in reaction, and for digestion to proceed in the stomach its contents require to be acid; the alkaline water neutralises this, and indigestion may result. Then come alcoholic liquids, and here I approach dangerous ground. I may then at once state that, in youth and in health, alcohol of any kind is absolutely unnecessary, either at dinner or at any other time; and I wish all our youth would be guided by this absence of need. In later life, when tastes are not so apt to develop into vices, and when the strain and weight of a profession or of business make excessive demands upon the economy, there is no doubt that the glass of wine, the tumbler of beer, or a little whisky and water at dinner time may be of the greatest service in preventing indigestion. In most cases of indigestion, however, they make the condition of the sufferer infinitely worse. That extraordinary habit which some persons cultivate, of swallowing alcoholic fluids at odd hours, and on the most trifling occasions—pay-day, or the casual meeting of a friend—is to be utterly reprobated from both its moral and its physical aspect. Last and greatest of all is tea, a beverage than which there is none more blessed, of infinite value to the intellectual and the physical labourer, and yet which, by virtue of its very excellencies, threatens to further the deterioration of the race on a scale doubtfully exceeded by alcohol itself. Its injurious influence is, like alcohol, moral as well as physical. It is teaching, indeed has taught, multitudes among the artisan and labouring classes habits of wretched laziness and miserable improvidence. This is the wife's department, but to enable her to spend her time gossiping with neighbours in the stair or in the court, she sets

before her husband and children two or three meals a day, the staple of which is tea, bread and butter, or bread and cheese. The moral aspects are interwoven with the physical. The slothful woman provides the family meals at a minimum of trouble and forethought, and what she does provide is a fruitful cause of indigestion. Tea morning, noon, and night is the pernicious programme—pernicious because it takes the place of a properly prepared meal of more highly nutritious and strengthening substances, but pernicious also because it interferes with digestion when taken at an improper time. It is in our large manufacturing centres, amongst the factory operatives, where the effect of the perennial tea and bread and butter is leaving its deepest marks on the physique of the mothers of our future men. Our cities, as dwelling-places for the poor, are bad enough, but city dwelling, plus this kind of feeding, is deteriorating the race of men in our land. If evidence is wanted of this, it will be found in a communication made by the Director-General of the Army Medical Department to the British Medical Association last August.

Error in Quantity.—This is one of the most common causes of indigestion, especially amongst those with whom it is not a financial consideration whether they eat much or little. The well-to-do classes suffer most. The hard-working professional man, the active man of business, and the man who neither toils nor spins, are alike subject to it. The business man has an early breakfast, and a light luncheon, and sits down at his own table to a late dinner with a model appetite; he partakes largely of all that is set before him, and greatly beyond physiological requirements. His digestive organs stand this for a while, but they sooner or later rebel. The rebellious appetite is whipped up and stimulated by sherry and bitters, until the poor goaded stomach and liver are at last overwhelmed, and there follows what he calls a bilious attack. A blue pill and a few days' moderation, and he is able to resume his old ways; the story repeats itself until the digestive organs become so exhausted that a life of abstemious moderation becomes slowly recognised as absolutely essential for physical comfort. The same is true of the hard-working professional man. Do not suppose that this is necessarily to be regarded as a manifestation of gluttony; they are active men, and, when the dinner-hour comes, they are hungry men, and the system is crying out

for a fresh supply of fuel to carry on the consumption in brain and muscle. Eating is continued to the extreme limit of satiety. This limit may perhaps be a safe enough line when hours are spent in the pursuit of game over a Highland moor, or at the gentler art with rod and reel and line, or in the royal game over any of our national golfing courses ; but with hours spent in the city smoke, in the office, the study, or the council chamber, the limits and dictates of appetite no longer constitute a scientific frontier. It is under the artificial, or, if you like the term better, the highly developed conditions in which we work in cities that the umpireship of appetite is discredited, and its duties have to be transferred to observation and experience. Even the city clerk suffers from excessive eating—the languor of mind and body after his mid-day dinner is an indication of it. In his ignorance it is attributed to physical debility, and he puts himself on a tonic and eats still more largely, with the result that his languor and sense of misery increase.

In the front rank, however, of those who suffer from excess stand the glutton and the epicure—the former is the more vulgar fellow, although they both belong to the same family. The latter discourses on the merits of *entrées* and salads, of wines and liqueurs, and he only dines where his palate will be titillated by cunning admixtures from the kitchen, and the choicest stores from the cellar. This epicureanism is a fashion of our time, to follow which many excellent people aspire. Social ambition is hardly satisfied until the dinner ritual is opened with oysters and chablis, goes on to soups and sherry, fishes and hock, *entrées* with French god-mothers, washed down with champagne, then more solid viands, to be top-dressed (as the farmers put it) with puddings, sweets, and cunningly devised salads. To cool this steaming and heterogeneous mixture, some iced cream is administered, and to counteract this a *thimbleful* of liqueur distilled by monkish ingenuity. Fruits and wines and coffee complete the appalling programme. Some few live through it to the three score years and ten ; others early show signals of distress in the heightening colour of a prominent organ. Certain prudent persons carry patent digestive tablets in the waistcoat pocket, or ease the liver by a blue pill before retiring to bed. These orgies are physiological atrocities, and this view might be commended to the

attention of that nautical body whose dining powers outstripped all precedent, and made them the wonder if not the envy of last season.

I have indicated to you that the digestive organs are influenced by the conditions in which the individual is placed, that in fact the city dyspeptic does not necessarily carry his dyspepsia to the highlands or the seaside. To understand this, we require to consider a large factor in the production of indigestion, namely, want of exercise. I must again explain to you certain facts bearing upon the functions or processes which are carried on in the body. Part of the food, when digested, has to pass through the liver, where it undergoes still further changes before it is passed into the blood in a condition fitted for the nourishment of the various tissues. This function is one of very special interest, and you will be able to understand its importance when I tell you that the products of digestion in the stomach are poisonous, and would probably prove fatal were it not for the changes they undergo in their passage through the liver. Part of this material is not passed immediately into the blood, but is stored up in the liver and is given out as required. In addition, however, the liver plays an important part in the removal from the blood of the waste substances produced by the activity of brain, muscle, and other structures. I need not weary you with an elaborate account of how it performs these functions—it suffices if you remember that it exercises the functions of a very vigilant detective department, ready to intercept all noxious matters, and to transform them into useful and needful substances, or to eliminate them in its own special secretion, the bile, or so to change them that the kidneys may eliminate them. This organ is thus one of the most important in the body, and the efficiency with which it performs the work allotted to it often determines our happiness or misery. For its efficient working various conditions are necessary : it must not be given too much work to do ; it is capable of transforming and of storing a good deal for daily requirements, but its liability is strictly limited, and if too great demands be made upon it there is a crisis, which takes the form of a bilious attack, with foul tongue, loss of appetite, headache, and sickness. If an active out-door life is being led, there is a greater demand by the system for the substances prepared by the liver, which are

then rapidly passed on, and the organ does not become clogged by their retention. Out-door exercise, however, does more than this—it accelerates the circulation of the blood, and it expedites and helps changes by the increased quantity of oxygen taken into the blood. The more severe forms of exercise act on the liver directly, for it is so placed under the diaphragm or midriff that every breath we draw and every physical effort we make compresses it and influences its function for good. It was the experience of this which led Lord Palmerston to say that “the outside of a horse was the best thing for the inside of a man.” Walking, rowing, and gymnastics are alike excellent. Walking is available to all, and in Edinburgh we have the most patent of remedies at our doors—a stated pilgrimage to the top of Arthur’s Seat.

Overwork, especially mental overwork, worry, and anxiety, from the exhaustion they produce, are causes of indigestion among intellectual people and persons occupying positions of responsibility. Grief is well-known to destroy the appetite; sudden fright or severe mental shock has been known to produce jaundice. These all act through the nervous system, for there are a couple of great nerves which stretch like telegraph systems from the lower part of the brain down through the neck and chest and on to the abdomen, where they are distributed to the various organs. Along these there is a constant current of energy passing to supply the nervous influences essential to the proper performance of the functions of the various organs, necessary for the movements of the stomach, which I told you are essential to successful digestion, but also necessary for the secretion of the juices peculiar to the stomach, the liver, the pancreas, and other organs. These functions, are fortunately not under the control of the will: we cannot send a message along these nerves telling the stomach, for instance, to provide more juice, as a large meal is about to be partaken of, but although we cannot do this, these same nerves conduct emotions, and transmit messages of joy and of sorrow. This is what is popularly known as the sympathy of one part with another. But, mark you, there is an effect which has more practical bearings for most of us, and it is this, the normal stream of energy which passes from the brain to the organs may be weakened as part of a general lowering of the whole vital energy. The result

is that the muscular wall of the stomach has not sufficient nervous energy sent to it to keep the food moving on, the glands which secrete the various digestive juices are not adequately stimulated, the food ferments and gases are evolved, and there follow all the ghastly miseries of indigestion. The resulting indigestion makes things worse, and the stomach becomes dilated under the pressure of work which it has not nervous energy enough to successfully grapple. And truly the state of that man is sorrowful.

Constipation is by no means an infrequent factor in the production of indigestion; in fact in some cases it appears to be the essential factor, for when it is removed the indigestion vanishes also. That it should be so is what might be expected, even if we had nothing but the liver to consider. The liver, you remember, arrests deleterious substances, and discharges some of them in the bile, to be mixed with other useless or deleterious substances, which are all carried along the intestines and discharged. If there is not both a regular and a sufficient discharge of these waste substances, some of them are reabsorbed, and the extra work of again eliminating them is thrown on the liver. The chances are that it is already working up to its collar, and if it is, dyspeptic squalls follow.

In the last place we come to the influence of cooking.

Man has been defined as a "cooking animal," and the cook's art is to be despised by no man. Much might be said on this point were opportunities not wisely provided by the committee of this Society to have it fully brought before you. Bad cooking ought, however, to embrace not only the insufficient or excessive use of heat, but also bad catering. I have referred to the cooking of two common articles of food,—porridge and barley broth,—to which may be added potatoes, green vegetables, and many other articles in general use, all of which may be indigestible when insufficiently cooked. I also referred to the subject of catering when dwelling on the excessive use of tea by the working classes, and I need hardly do more now than add whatever weight my testimony may have to the importance of this subject. The absence of knowledge amongst our operative classes of a rational and economical dietary is, I think, deplorable; and I am pretty strongly of opinion that it has often not a little to

do with that stomach craving which sends men to the public-house. I doubt if there could be any more philanthropic movement in our midst than an extended effort to bring knowledge of this kind within the reach of every woman. In the olden times, it was a custom amongst women to give proof to their future husbands of their skill with the needle ; it would, I think, tend to domestic comfort and matrimonial felicity if they had now to give evidence of their attainments as cooks.

From the causes we now pass to the consequences of indigestion. This is a part of the subject which might be thought unnecessary, as its miseries are sufficiently known. But there are many aspects of it which are not generally known or understood. Everybody with average knowledge knows that he or she is suffering from indigestion if there is a sensation as of a ball stuck somewhere between the back of the throat and the pit of the stomach ; or if there is a sense of burning heat somewhere about the same spot ; or if there is much flatulence, acidity, or pain after food. Other persons suffer most from a despairing sensation of gnawing or sinking in the region of the stomach—this is the class of dyspeptic who discovers that a *nip* of whisky relieves, but ere long finds that the remedy requires to be repeated at ever shortening intervals : his friends notice an alteration in his habits, and if he does not bring himself up, he developes into a chronic toper, or an habitual drunkard. Alcohol, however, is not the only solace which may end in slavery. You all know of that great master of classical English who began by using opium to alleviate a painful condition of stomach, brought on by severe hardship and want of food, and who, almost unconsciously, slipped the iron collar of habit round his neck, and has left to us that record of groanings that cannot be uttered of a soul struggling to free itself from the fiendish grasp of a physical craving. I refer, of course, to De Quincey.

The longer I live the more convinced I become that this stomach craving and sinking, which is but a symptom of some form of digestive derangement, leads to tipping, and this ultimately to the establishment of a habit. One, I think, of the saddest and most humiliating amongst the infinitude of sad experiences which the medical man has, is to note the growing habits of tipping amongst the other sex, not a little of which, charity prompts

us to believe, has its origin in this same stomach craving and sinking. Its phases are manifold : with one it is brandy or some of our commonly used spirits, with another it is eau-de-cologne or some spirituous preparation of camphor or opium, with others it is chloral, and so on. I would fain leave this unsaid, but I may perhaps be pardoned for lifting a finger of warning.

Another and very common type of dyspeptic suffers from overwhelming mental depression and physical languor. There is a wretched feeling of weariness, the limbs feel as if weighted, and there is fatigue on the slightest physical effort. The brain-worker can no longer work with pleasing ease, but only by efforts of self-assertion, which are hardly possible save under circumstances of sheer necessity and an inexorable *must*. The active mind becomes sluggish, the genial temper is replaced by irritability and sullenness, and the optimist becomes a pessimist. The man is no longer a good citizen or a good Christian. Hypochondriasis and melancholia were correctly referred by the Greeks to the region of the liver and its special secretion, the bile. You all know what a martyr Carlyle was to the "hag Dyspepsia," as he termed her, and how she probably influenced his social and domestic relations, and deepened the stern gloom of his mind. Let me quote what Sydney Smith says on this subject:—"Happiness is not impossible without health, but it is of very difficult attainment. . . . The longer I live the more I am convinced that the apothecary is of more importance than Seneca ; and that half the unhappiness in the world proceeds from little stoppages, from a duct choked up, from food pressing in the wrong place, from a vexed duodenum, or agitated pylorus.

"The deception, as practised upon human creatures, is curious and entertaining. My friend sups late ; he eats some strong soup, then a lobster, then some tart, and he dilutes those esculent varieties with wine. The next day I call upon him. He is going to sell his house in London and to retire into the country. He is alarmed for his eldest daughter's health. His expenses are hourly increasing, and nothing but a timely retreat can save him from ruin. All this is the lobster ; and when over-excited nature has had time to manage this testaceous encumbrance, the daughter recovers, the finances are in good order, and every rural idea effectually excluded from the mind. In the same manner

old friendships are destroyed by toasted cheese, and hard salted meat has led to suicide. . . . Of such infinite consequence to happiness is it to study the body."

George Sand, in her life, says that biliousness produces symptoms "of profound sadness and a wish to die. Since my disease first appeared I have had many happy years, and when it seized me again, although I was in the condition most favourable to love of life, I felt myself suddenly seized by a desire for eternal repose."

As to its far-reaching consequences, hear what one of the subtlest of American minds (Oliver Wendell Holmes) says—"A man's breathing and digestive apparatus are just as important to him on the floor of the Senate as his thinking organs."

What is the meaning of this? I have already referred to the important part taken by the liver in the elimination of waste substances from the system, and the prevention of noxious matters passing into the circulation. I also pointed out that exercise and fresh air, and the thorough and regular removal of waste substances from the intestine, are essential to the efficient performance of these functions. When these conditions are not fulfilled, what happens is that the liver becomes clogged, and various poisonous substances pass into the general circulation, that is, the blood. But there is more than this—the effete matters retained in the various tissues are also poisonous; and the presence of these is the cause of the sensations of weariness, languor, and weakness to which we have referred. Extra supplies of stimulating and strengthening food are often taken to relieve these symptoms, but this only aggravates the mischief, and is, as Dr Lauder Brunton aptly puts it, like heaping coal on a fire already nearly smothered in its own ashes. It is this which produces that form of indigestion which it has become the fashion to speak of as *gouty*—a definition which, it is not perhaps to be wondered at, is more acceptable, and leads to a more careful attention to the physician's orders than results from the coarser definition—too much food and too little exercise.

Still more serious consequences, however, follow upon prolonged indigestion. The kidneys are the organs which remove much of the effete matters from the blood, and, in the conditions which at present concern us, a greater amount of work is thrown on them, and they have also probably to remove substances which

they are not called upon normally to remove ; this leads to their irritation, and, in the long run, to the establishment of a form of what is commonly known as Bright's disease.

It also leads to disease of the walls of the arteries, and, at the points where they are diseased, they are liable to burst, just as a rotten leaden water-pipe may burst, and if this takes place in the brain, as it often does, the individual has a "stroke," that is, an attack of apoplexy.

Some derangement of the digestion, either from too large a meal, or from a meal containing some indigestible substance, is frequently the immediate cause of those sudden deaths in old persons who have weak hearts—the extra strain or the extra poison paralyses the already enfeebled organ, and the "golden bowl is broken and the wheel broken at the cistern."

I have thus, ladies and gentlemen, tried to lay before you in the brief course of a single lecture some of the more important facts bearing on the most commonplace of ailments, and the hints which I have thrown out may, I hope, help some of you to live up to the adage that "prevention is better than cure." This is not always easy, for you will often find the truth of the Apostle's teaching, that "there is a law in our members warring against the law of our minds," and which may assert itself in the face of and in spite of light and knowledge.

HEALTHY CLOTHING.

BY ALICE KER, M.D.

IT is, perhaps, hardly necessary to enter into any explanations as to why the subject of clothing should form part of a series of lectures on general health. And yet, when we consider the actions of most of the people whom we see around us, and when we try to understand what are the rules, whether of health or of beauty, according to which they have arranged their dress, we may begin to think that it is not so unnecessary after all to point out that clothing does indeed have a very great influence upon health, and that it may affect it very powerfully either for good or for evil.

We may, I suppose, take it for granted that all who are present here have some interest in the subject of health itself. Most of us probably realise the advantages of being in good health rather than in a constant state of half disease, but certainly everyone does not regard the question of personal healthfulness with nearly all the importance which it deserves. Next to moral health—with which it has a great deal more to do than is generally supposed—there is nothing in the world which any man or woman ought to strive after with so much earnestness. It ought to come before everything else except pure right and wrong; by which I mean, that while we may not do anything actually wrong for the purpose of preserving our physical health, no consideration of prudence, or expediency, or desire for doing as others do, or striving after gain, has any right to come before our care for our own health. Money can be gathered together, lost at one blow, and gathered together again; but health that is once lost can never be regained, at any cost of toiling and regret in after life. The God who made us has given to each of us a very

wonderful body, formed like nothing else which we can see or even imagine, and He expects us to show our sense of the greatness of His gift by bestowing upon it the care which He has been teaching us ever since the foundation of the world, and by governing it according to the rules which He has found us so stubborn to learn, even after we have felt again and again the punishments which have followed the breaking of them. God means us to take just as much care of our bodies in their particular way as of our souls ; and although, as I have already said, the concerns of the soul must come before those of the body, yet the body in itself is infinitely more precious than the external circumstances of wealth and station in life, to which it is so often sacrificed. Truly, "the life is more than meat, and the body than raiment."

If this be so, then it is indeed the duty of every one of us to see to it that we are doing all we can to keep this wonderful body in the best working order that is possible to it. At the very outset, we are obliged to acknowledge that most of us are in circumstances where the healthiest life is impossible to us. All who live in a town are living in surroundings which are more or less unhealthy, from the mere fact of so many human beings living and breathing within a comparatively small space. All of us, too, cannot live in houses which give our bodies the best chance of working in a natural and healthy manner, and some of us may find ourselves obliged to earn our living at occupations which are more or less unhealthy. But with all those things which are beyond our own control, there is one thing which every one of us, man or woman, who has come to a full-grown age, can arrange entirely according to our own will, if we choose, and that is our own clothing. I shall try to show how important this is, and how much the neglect of making it healthy may add to the evils of the sources of ill health which are beyond our own control.

The first object for which clothing was worn was apparently ornament. The savages of the present day are quite comfortable without any covering on their bodies at all, and when they wear a blanket or the skin of an animal, it is entirely for the sake of its dignity or ornament, as they are said to take off their covering at once if rain comes on, in order to keep it from being spoiled, exposing their own skin freely to the weather. It is true that the only unclothed savages which we now know live in

countries which are warmer than ours, but in these very islands our ancestors, the ancient Britons, wore nothing but a staining of blue woad, and there is no evidence that in their days the climate was any warmer than it is at the present day. And if we examine the question, we shall find it to be, after all, very much what we call "a matter of habit." We have all accustomed ourselves to expose the delicate skin of the face without any covering to all changes of temperature, without feeling any inconvenience or injury from doing so. The sailor faces the coldest north-east wind with his neck and chest as bare as his face, and the Highlander's knees are uncovered to every blast that blows. Yet we never hear that sailors suffer from cold in throat and chest, or Highlanders more from rheumatism than others who have the same kind of life, but whose clothing does not leave any part of their bodies exposed. We can imagine that the first races of mankind began life, like the ancient Britons, with no covering except that which was worn for ornament, and it is quite possible that the ornaments came gradually to cover more and more of the body, until the skin became so unaccustomed to the air that a constant covering became necessary for comfort. However it may have been, it is certain that a complete covering of some sort is now necessary for all the civilised races of mankind, we are now all clothed animals, and it only remains for us to consider whether we, as a rule, clothe ourselves in the best possible manner, and, if not, what changes ought to be made in our dress, in order to make it suitable to our needs.

As we have got beyond the age of dressing only for the sake of ornament, then, when we ask ourselves the reason why we wear clothes, we must answer that it is for the purpose of covering our bodies. This is necessary in all climates of the world, whether in the cold of the arctic regions or in the great heat of the tropics. But it is quite possible for us to take too much pains to cover up our skins against both heat and cold, and to forget that, although we are now clothed animals, Nature has intended us to be able to live, if necessary, without any artificial aid to the arrangement which our own skin contains to protect us against changes of temperature. For the skin is not a mere envelope covering over the whole of the body without serving any more important purpose; it is a wonderful structure, con-

taining many curious pieces of mechanism, all intended to help in the active life and work of the body. It contains a large number of little blood-vessels, through which blood is continually flowing, and when we are exposed to any great heat, or when we take violent exercise, those little blood-vessels become larger, and more blood flows through them. Moisture is at the same time continually passing through the skin into the air, in the form of vapour, passing even when we are not aware of it, and passing more freely, in the form of visible perspiration, when we are undergoing great heat or exertion. This constant evaporation helps to keep the blood at the same temperature, whatever may be the heat of the external air, and it is only when evaporation can go on freely that we are able to support a very high temperature. But, on the other hand, when the body passes into a temperature which is much colder than the blood, the little muscles which are found all over the skin and in the walls of the blood-vessels contract involuntarily, without our having to think of them, and a much smaller quantity of blood flows along to be cooled by the outside air or by evaporation. We see, then, that there is a sufficient arrangement in the skin itself to enable it to avoid injury from change of temperature, but if we always keep the skin so much covered up that the little muscles have no chance of contracting, they lose the power of doing so, as every muscle does when it is not used freely, and then, if we are exposed to a sudden draught of cold air, as must sometimes happen to nearly every one of us, the little blood-vessels do not shrink up quickly enough, too much blood passes on and gets chilled, and we feel the consequences in what we call a "cold," which affects first whichever part of us happens to be at the moment the weakest. If I have made this clear, you will understand how it is that too much clothing is perhaps even more likely to give cold than too little. But if we give the little skin muscles sufficient exercise, they will respond to it as every other muscle in the body does, and will become more active, so that a change of temperature as great as from the neighbourhood of a large fire into the frosty air will be followed instantaneously by a contraction of the skin and blood-vessels, and we shall suffer no more from the change than a dog does—I mean a hardy dog, which has not been pampered with too much petting.

The next thing to be considered is—what form and kind of clothing will interfere least with the natural action of the skin? And, first of all, it is clear that any clothing which presses so closely against the skin as to keep the little muscles from acting—and a very small amount of pressure is sufficient to do that—will prevent us from having the full benefit of this natural arrangement. Another purpose which the skin has to serve is that of carrying off the extra heat of the blood by means of evaporation, as has been already mentioned. For this purpose it is necessary that the material of which the clothing is composed should be such as will not interfere with this evaporation, but will allow the moisture, which is generally in the form of vapour, to pass off into the outer air at once. The worst material for this purpose is linen, as vapour will not pass through it at all, but will be condensed on touching it, so that a dense layer of moisture will be formed all round the body, chilling it in cold weather, and preventing the free access of air to the skin which is so refreshing in the heat of summer. Calico is not quite so injurious to wear as linen, although it possesses many of the same faults, but the only material which is comfortable, healthful, and equally suited to both hot and cold weather, is wool. It is porous, allowing the moisture from the body to pass away freely, and not condensing the vapour; it is a bad conductor of heat, so that the animal heat of the body is not dissipated; and it radiates heat well, so that it does not feel too hot even in summer. It also contains in its meshes a large quantity of air, which serves to keep the body warm in winter and cool in summer, air being one of the worst conductors of heat. It is the presence of a layer of air round the body when the clothing is worn loose, which makes a loose dress so much warmer in winter, and so much cooler in summer than a tight one. The best material for clothing, then, in this changeable climate at least, is wool, and if we would get the most good of the woollen clothing, it should be worn with no outer covering of calico or linen. No cricketer will ever cover his flannels with calico or linen, knowing by experience that he is most comfortable when wearing the flannel garments alone, even if he may not be able to express the fact that the moisture from the skin would condense on the calico, and form a chill, cold layer between the flannels and the

outside air. Another of the actions of woollen clothing is to stimulate the skin by its faintly pricking action, so that the blood circulates freely through it, and enables all its functions to be carried on vigorously. One of the characteristics of the skin which has not yet been mentioned is the secretion of a greasy or oily material, which is contained in the glands surrounding the little hairs which are found all over the body. This matter, which is called sebaceous matter, serves to keep the body warm in cold climates, and prevents the sun from scorching the skin in the tropics, and the more thoroughly it is secreted within the limits of health, the more comfortable the skin will feel. Of course all this extra action of the skin will make frequent and extensive washing necessary, but that is now brought within the reach of all in the establishment of public baths. We must not forget that a healthy condition of the skin is a necessary condition for healthiness of the whole body, and the ancient Greeks and Romans, who spent so much time and trouble in bathing and otherwise attending to the skin, were rewarded for that care by the splendid condition of their bodies, which we admire so much in ancient statues.

I must not leave the subject of the skin without a word of warning against articles of clothing which are not only passively but actively injurious to it. I mean poisonous dyes. We must all remember the excitement caused some twenty years ago by the discovery of how much arsenic could be put into articles of dress, the tarlatan required for one ball dress containing enough to poison several persons. Every sensible person has avoided bright green fabrics ever since then, with the result that the colour has become unfashionable. But arsenic is a very cheap article of commerce, and it is very convenient for fixing many colours besides green, and so it comes to pass that every now and then in medical papers, cases are reported of troublesome and painful eruptions of the skin, traced again and again to the dye from various articles of clothing. Dark red is a very dangerous colour, whether in the form of shirts, gloves, stockings, comforters, or hat-linings, all of which have been known to cause an eruption on the skin, incurable except by leaving off the article in question. Any colour which stains the skin should be regarded as suspicious, and it is safer to wear no underclothing which has been dyed.

But the skin is not the only organ of the body which suffers from the mode of dress of the present day, it is perhaps not the one, even, which suffers most, although I have dwelt on it so long, because its sufferings are so universal and have hitherto been so little considered. Now the object of clothing is to protect our bodies in such a way that they shall be placed in the most favourable circumstances for performing their necessary duties, that we may each do our life's work in the world in the most comfortable and complete manner possible. One of the most important of these functions is breathing, which every one will agree is one of the most necessary conditions of our continuing in life. We all know something of how the act of breathing is carried on by means of the lungs, wonderfully delicate, spongy organs, enclosed in a bony case, strong enough to protect them from injury, and yet flexible enough to allow for every possible variation in the capacity of its contents, with those wonderful rows of ribs, each curved on itself in every direction, so that by raising themselves up, stretching out, and turning round each on its own axis, they can enlarge the cavity of the chest to the greatest possible extent. All these arrangements have been made as only divine care could have made them, but Fashion steps in and says, "It is quite unnecessary to have the lungs enclosed in a flexible case, it looks untidy, and must be made more trim and neat." So the beautifully flexible ribs are enclosed in a stiff, rigid case of whalebone or steel, with tight webbing stretched across, and as the whole of the lungs are evidently too much for everyday use, the lower parts are made useless by the fixing of the lower ribs, and all the work of breathing has to be done by the upper half of the lungs, until at last Physiology books coolly state that the natural—the *natural*!—method of breathing in women is different from that of men. Friends, this is too serious to be made a jest of, as is too often done, for it affects most powerfully the health and happiness, not only of the half of the community whom it directly concerns, but of every one with whom they have to do. And the men among my audience need not think that they are entirely free from the guilt of this deformity of the human form, for every man who admires unreasoningly what he calls a trim, neat waist, and calls a waist which is of the proper size floppy and untidy, is doing all that he can to perpetuate the evil. Let

us just consider for a moment what it means. In a recent number of the *New York Medical Journal* there is a paper by Dr Dickinson of Brooklyn, on the subject of corsets, the results of some experiments undertaken for the purpose of finding out for himself what really is the effect of that article of dress. He tried to find out what amount of pressure it exercised on the body, and found that the loosest corset—I mean the one which made least difference in the size of the waist—often exerted as much pressure as one that was tighter, when the muscular walls of the body were strong and vigorous. The lowest pressure he found was 21 lbs., and the highest 88. The average difference to the size of the waist in fifty-two cases was $2\frac{1}{2}$ inches, and the greatest difference was $5\frac{1}{2}$ inches. In some cases the waist measured as much with a corset as without, but there was no room for expansion in breathing, and the natural outline of the body was completely altered. Will any one dare to say that one half of mankind is made so carelessly that a matter of $5\frac{1}{2}$ inches—or even of $2\frac{1}{2}$ —in the circumference of the body, at the very part where the most important vital functions are being carried on, makes no difference to the organism?

It is curious to note how long continued and wide spread has been this custom of compressing the waist. The ancient Greeks used many folds of stiff bandages, which were spoken against by the physician Galen. In the dark ages, not to be called dark in this sense, the tightening of the waist was given up, and the dress of women as well as of men was loose and flowing. The Normans introduced a close-fitting dress, but quite soft and flexible, as can be plainly seen from old pictures, and in the fifteenth century a heavy girdle, called a cingulum, was worn lower than the waist, resting safely on the hip bones, probably for the purpose of keeping the dress in place. In the sixteenth century deformed waists were again introduced, and the corset of Queen Elizabeth's time was a fearful metal machine, which actually caused the death of its wearers every now and then. In the time of the French Revolution, the present kind of corset was introduced, and it has held its ground until the present day, with the exception of a year or two in the beginning of the century when the short waists of our great grandmothers were in fashion. We are fond of ridiculing the

Chinese women for pinching and deforming their feet until they cannot use them, but we are worse in our boasted civilisation, for we deform organs which are infinitely more necessary to life than feet are, while the Chinese women's dress is the most healthy and sensible of all the nations of the world.

Even when a corset is not tight enough to compress internal organs, it prevents the external muscles of the body from acting as they ought, so that in time they become feeble from want of use, like the muscles of an arm which has been bound up in a splint. There are about seventeen little joints, too, in the spine, which are more or less immovably fixed by the wearing of a stiff whalebone down the back, so that I can really never understand what people mean who insist that loose stays can do no harm. If a garment that is fixed over those flexible joints is either tight or stiff, it must do some harm, and if it is neither one nor the other, it cannot be called a corset.

But I do not mean to speak exclusively of women's dress tonight, so I shall only stop in passing to point out to my sister women the folly of the present fashion of long, full, heavy skirts, picking up every particle of mud and dust they touch, and weighing down the knees and ankles until it is only by a constantly recurring miracle that women are able to walk as much as they do, while the dress is said to be so heavy in itself as to require a wire cage, weighing nearly a pound itself, to help to carry it. We have really no strength to spare for carrying our clothes; we need it all for the daily work of our lives. Light, warm skirts, clinging closely to the limbs, and short enough to avoid dragging, will soon prove themselves so comfortable that they will not be given up again by any sensible woman, and the want of pressure on the blood-vessels and on the muscles will cause greater warmth, from increased circulation on the one hand, and from greater capacity for exercise on the other.

It is generally supposed that a lecture on dress will concern itself entirely with the dress of women, and that there is nothing to be said against male attire. The subject is one on which I cannot, perhaps, speak with so much authority, and the evils are not so pressing; but still we must acknowledge that men's dress is not hygienically perfect. It is said by its advocates to be at least convenient, even if not beautiful, and to give the greatest possible

ease in moving about. I venture to call even this in question. The clothing of the lower limbs seems to contain no superfluous or insufficient material, but I observe that if any extra exertion requires to be taken, another form of garment than that in common use is adopted, and for much walking, shooting, or riding on wheels, knickerbockers, or knee-breeches, are worn. If they make movement more easy, why should they not be worn always? They would be much prettier, and would give more variety to a man's dress, besides being more cleanly in not picking up mud, and more economical, as a pair of stockings costs less than a yard of broadcloth. There is not much reason displayed in the garments for the upper part of the body, consisting as they do of one garment with the back cut away, covered by another garment with the front removed, or at least not used, while all the warm covering is cut away from the delicate organs of the throat and chest, which are covered by two or three folds of linen stuck together with starch, which a medical journal has called a waste of valuable food, and a means of rendering clothing colder and less useful. The throat is then closely encircled by a tight band of similarly stiffened linen, pressing on the veins, and preventing the unfortunate man from bending his head further forward than its sharp edge. Surely no article of woman's dress is more uncomfortable and irrational than a masher collar. If I might venture to point out how male attire might be reformed, I should suggest the wearing of knickerbockers or knee-breeches instead of trousers, with ribbed worsted stockings for everyday wear, and silk for great occasions, and the replacing of the two half-garments above by one, buttoned up to the throat and down the front, like a military coat, with some soft woollen garment underneath, instead of the stiff shirt-front. The subject of collars is more difficult, but I can see no reason why they should not be made of white flannel, as in a cricketing suit, if a soft, unstarched ruffle is objected to. Whatever may be adopted, at least the collar should not be very stiff, very tight, or very high.

From the point of view of health, as well as that of appearance and of common sense, men would be wiser not to deprive themselves of the covering with which Nature has provided their faces. The constant irritation of the skin by means of the razor in shaving makes it more liable to be affected by the cold to which they

are still more exposed when the natural covering is removed, and it seems as if it were a judgment on the fashion of removing the hair from the face that we find it so often removing itself early from the head. It is interesting to notice that the class of men who become bald earliest are those who are most given to the wearing of hard, close, and heavy hats, such as professional men generally, while those whose occupations cause them to wear light open caps and straw hats preserve their hair much longer. We seldom or never see a bald railway guard, or omnibus conductor, or sailor, and women's hair, which is allowed to grow long and is often dressed in ways which twist and drag it out of its natural position, very seldom falls off. The cause of baldness appears to be partly the pressure of the blood-vessels of the scalp between the hard hat and the bones of the skull, preventing proper circulation, and partly the fact that the impenetrable nature of the material of which the hat is made prevents the head from receiving a proper supply of air, so that the hair is both starved and poisoned. There is certainly not much to be said for tall silk hats on the ground of either healthfulness or reasonableness, and man would do well to adopt some form of head-covering which would be lighter and better ventilated.

Let us turn now to an article of dress with regard to which both men and women are equally neglectful—the covering of the feet. Nature has provided us with a most wonderful contrivance for the support of our bodies in our feet, such comparatively small surfaces on which to rest the whole size and weight of the body, and yet so marvellously suited for the purpose. The arch of the instep is arranged so that the weight shall be distributed fairly to all the bones, and at the same time all shocks prevented from injuring the spine or brain. Then the front part of the foot is divided into five flexible toes, full of joints, intended to grasp the ground firmly and then to spread apart for the purpose of giving spring to the step. But although Nature has given us five toes, the shoemaker allows us only one, and that one in the middle of the foot. Then the arch of the instep is raised up at one side so that the pressure from the weight of the body comes to fall on parts of the bones that were never intended to bear it, and the arch consequently gets weakened by the weight rested on it, instead of strengthened as it ought to be. The balance which

is thus disturbed is not only that of the foot itself, but of the spine and the whole of the body, for if the foundations are off the straight, the whole building must be uneven.

If we would enjoy the full benefit of the form of our feet in walking, we should wear shoes with low, broad heels, no higher than the front part of the sole leather, and have the soles cut broad across the toes, and straight up the inside, or side next the great toe, so that this important member may have plenty of room to take its proper share in the work of walking. Such shoes are not very easy to be procured, but if every one would refuse to buy those with pointed toes, the makers would be obliged to supply them of the proper shape. And until they do, we cannot do better for our children than allow them to walk about with no shoes at all, so that their feet may be permitted, for some time, at least, to take the shape which Nature gave them, instead of that which the shoemaker considers best. Low shoes are more healthful and comfortable than boots, besides being cheaper and lighter, but if boots are worn, the upper leather should not be higher than just above the ankle bones, or they will interfere with the movement of the muscles of the calf. I may also add, that it is of no use to put high, stiff boots on children with weak legs which are inclined to bend. If support is needed, it ought to be given by proper surgical splints, and if it is not needed, the muscles will grow stronger by being left uncovered; but it is of even more importance in such cases than in ordinary ones that the shoe should be of a proper shape, giving room for all the toes to rest on the ground. Little children suffer even more than grown up people from the shape of their shoes, and when we look at the beautiful foot of a little baby, and watch the constant motion of its tiny toes, we cannot look without a shudder at the shoe into which we are asked to push the lovely little piece of mechanism, in which all its beauty will be deformed, and its various movements stopped for ever. I never pass a little child in the street with his best shoes on without my heart aching for the little feet as they trip along, stumbling sometimes every step or two, because the toes cannot spread out as Nature intended, to make a broad enough surface for supporting the little body, and it is very difficult to keep silent when one hears the little thing scolded and

sometimes shaken for not walking properly, when one can see plainly that the cause lies in the shoes which have been given to it.

I should have liked to have said something specially about the dress of children had time permitted, but all that I have said may be taken as applying to them with even greater force, because any injury to their bodies is tenfold greater, partly on account of their greater softness, and partly because it interferes with their growth.

There is also a great deal about the dress of men and women which I have not touched upon, or on which I have not said all that might be said, but I think I have said enough to indicate, at least, what an important bearing on general health our style of dress may have, and how dress may be raised out of the region of fashion into that of duty and principle.

If, as the French proverb has it, "the dress is the man," let us each see to it that our dress may indicate a man whose ruling principle of conduct is not what others do, but what the teachings of his own heart show him to be in accordance with the eternal laws which lie at the foundation of the whole universe of God.

HEREDITY:

ITS INFLUENCE ON MAN IN HEALTH AND DISEASE.

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MR CHAIRMAN, LADIES, AND GENTLEMEN,—I ask your attention this evening to a subject of great interest and immense importance, a subject which has occupied the minds of men throughout long ages. It is impossible to conceive of a more influential factor with regard to mankind than heredity. It affects in a most marked manner, not only each individual, but also each family, each race, inhabiting this globe. What do we mean by heredity? It is a term used to denote the principle or law, according to which animals or plants develop the characteristics of the parents or ancestors from whom they have sprung.

Each individual born into this world is characterised by definite, and often well-marked, mental and bodily peculiarities, transmitted by inexorable laws from its progenitors—laws not simple, but highly complex. These laws obtain throughout the whole of the vegetable and animal kingdoms, but nowhere is the importance of their results so evident as when they are seen in Nature's latest production, man.

I propose in this lecture to bring before you the effect of heredity on man in health and disease, and shall only incidentally refer to its influence on the lower animals.

Some years ago, when travelling in Central Africa, I was shown a remarkable baby. Although its parents were dark-coloured, almost coal black, this wonderful baby was perfectly white (Albino), and it caused no little commotion on its arrival into the world. Its father and mother were horrified, their friends and

relations, in fact all the villagers, were called to examine and criticise it. Why such surprise? Why such commotion? The answer is self-evident; the law of heredity had been broken. You do not expect to see a white child in a country where all the inhabitants are coloured, and I am quite sure that should a black child under like circumstances be born here, just as much astonishment would be felt. We naturally expect like from like, and everyone knows that no sooner is a child born, than the happy mother takes counsel with her friends as to whom the child resembles, its father or its mother, its uncles or its aunts.

Let me begin by calling your attention for a few moments, and as simply as possible, to the method of growth. Broadly speaking, this method of growth applies to plants and animals alike. The union of two cells gives rise to one cell, which is then endowed with the power of development into a being resembling its progenitors. This single cell may be said to contain an innumerable number of minute particles, each possessing inherent attributes, and each destined to produce some definite portion of the new being. We can imagine one particle or series of particles possessing the power of forming the bones, another set of particles producing the muscles or the skin, another the brain and nerves, and so on.

But in human beings this wonderful cell contains also particles carrying with them, not only the physical attributes, but the mental characteristics and the tendencies to disease, or the power of resisting disease, which belonged to its parents. There are two physiological explanations of the way in which this germ cell, endowed with such peculiar powers, is produced—(1) The substance of the parent germ cell, after having produced the new being, may still possess the power of producing new germ cells containing hereditary tendencies within that being; or else (2) the parent germ cell may contain in itself indestructible particles which have the inherent power of developing hereditary tendencies in the new being.

I have said that the laws of heredity are not simple but various. I mean that a child is not always exactly like its parents. The principal laws may be summarised as follows:—

1. The law of direct heredity. This is the greatest and most

universal influence exerted by parents upon their offspring. The child may resemble them equally, or it may reproduce one of them particularly or chiefly. The son may resemble the father, the daughter the mother, or the daughter may resemble the father, and son the mother. I have endeavoured to illustrate these varying forms of direct heredity on the diagrams.

2. The law of atavism or reversional heredity, according to which the child may resemble its grandparents, that is to say, the grandson may resemble his grandfather or the daughter her grandmother, or *vice versa*.

3. The law of collateral heredity, by which a child manifests the characteristics of uncle, aunt, or cousin, out of the direct line of descent.

4. The law of pre-natal heredity. This is the influence exerted by circumstances affecting the mother before the child is born, and it is of extreme importance to the future of the child.

5. The law of initial heredity, by which the child inherits the particular qualities which predominated in the parents when its existence commenced.

It is not my intention to-night to relate many curious facts to prove these laws. It would be interesting to do so, but would serve no practical purpose. I shall content myself therefore with three or four well-marked illustrations—first, in regard to the transmission of physical characteristics.

The various races of mankind set forth distinctly the power of heredity. The Negro, the Chinaman, the Red Indian, the European, the Egyptian, have all well-marked physical characteristics by which they can be at once recognised. Take, for instance, their skulls. If you look at a European skull and the skull of a Negro, you see at once that they are very different; it is impossible to mistake the one for the other, and it is heredity that propagates each variety. The same holds true with regard to their other physical features. The Austrian lip, the Jewish nose, the Bavarian chin are reproduced from generation to generation, while the woolly hair of the Negro, the oblique eyes of the Japanese, and the oval face of the Esquimaux are all inherited.

As a rule, in every race the height of children is about that of their parents, and it is a well-known fact that the majority

of individuals of a given race have about the same height. If you look at Mr Galton's diagram upon the wall you will see the height of a million people graphically represented. The average height is taken as 5 feet 6 inches, and you will notice that the vast majority are that height. Indeed, there are only 200 individuals out of every million who are above 6 ft. 6 inches or below 4 feet 6 inches, and very few below 5 feet or above 6 feet. Giants and dwarfs produce children of the average height, and only by a careful selection either a race of giants or of dwarfs could be produced. Frederick the Great produced his famous giant Guards by means of such selection; tall men were compelled to marry tall women, and thus the gigantic race of Guards came into existence.

In certain families definite peculiarities are handed down for generations. In a case with which I am myself acquainted, a gentleman had a peculiar formation of the right eyebrow. It was strongly arched, and some of the hairs in the centre grew upwards. Three of his sons have the same peculiarity; one of his grandsons has it also; so has his great-granddaughter, and, if we are to believe the artists, this gentleman's grandfather and great-grandfather had the same peculiarity.

There was a family in France, of whom the leading representative could when a youth pitch several books from his head by the movement of the scalp alone. His father, uncle, grandfather, and his three children possessed the same power to the same unusual degree. This family became divided eight generations ago into two branches, so that the head of the above named branch was cousin in the seventh degree to the head of the other branch. This distant cousin resided in another part of France, and on being asked whether he possessed the same faculty, immediately exhibited his power.

These are simply curious instances illustrating everyday facts, such as must be known to all of you, for is it not a matter of common experience to notice likeness between parents and offspring, and to remark almost identity in gesture, voice, gait, and habits in members of a family? The mere fact of physical resemblance between children and their parents is indeed so evident and so universal that there is no need for me to try and prove it; but this does not lessen its importance, an importance

often overlooked, and which is infinitely greater when the question involved is that of mental heredity.

Turning for a moment to the lower animals, we find that knowledge is transmitted to them, not merely from parent to offspring, but the total experience of generations has been so firmly engrafted as to become what is called instinct. As an example, I may relate an observation made by Spalding. He says : "So old is the feud between the cat and the dog, that the kitten knows its enemy before it is able to see him, and when its fear can in no way serve it. One day, after fondling my dog, I put my hand into a basket containing four blind kittens three days old. The smell that my hand had carried with it set them puffing and spitting in a most comical fashion."

So, too, the senses in man are transmitted in varying degrees of intensity. Sight, hearing, taste, smell, and feeling, may all be either exaggerated or diminished by hereditary transmission ; for instance, Schook relates the case of a family, nearly all the members of which could not endure the smell of cheese, and some of them were thrown into convulsions by it.

Special genius for art is also hereditary. A very good example of this is seen in the family of Titian, which included nine painters of merit. Upon the wall is a diagram representing his genealogy. According to Ribot, the family of Sebastian Bach is one of the most distinguished instances of mental heredity on record. During a period of nearly 200 years, this family produced a multitude of musicians of the first rank. They were all organists and church singers, or belonged to municipal orchestras.

It is well known that mental traits or peculiarities run in families. Some are gifted with tenacious memories, others are celebrated mathematicians, some families produced doctors for generations, others are noted for their piety. For instance, Darwin sprang from a lettered and intellectual race. Forbes, the professor of botany, inherited his mother's passionate love of flowers ; Jussieu, one of the greatest of botanists, was a member of a very eminent family of botanists, who were all very short-sighted, and whose ancestors had been lawyers for generation after generation.

On the other hand, beggars and criminals propagate their species, and dull intellects may be expected to produce the same.

Galton relates a noteworthy instance of the perpetuation of the criminal class by heredity. The genealogy of the Jukes family in America includes no less than 540 individuals, most of whom were criminals, paupers, or diseased. Out of thirty-eight individuals belonging to one branch of this family, sixteen had been in jail, eleven others led openly disreputable lives, four were very intemperate, the history of three had not been traced, and only four were known to have done well.

So well was the principle of heredity recognised by the Hindoos, that in India the system of caste is based upon it. The Brahmins, for instance, are well educated, and possess considerable mental power ; the Vaishya, on the other hand, possess less cultured minds, but are superior craftsmen. It is taken for granted that a Brahmin's son will be capable of becoming an educated priest, and that the son of a Vaishya will make a good artizan. On this principle each man that is born into the world has his calling settled for him.

Both the father and the mother tend to transmit their own characteristics to their children, but as they are never alike, the child may be regarded as the result of a compromise. It cannot be exactly like one parent, but you will nearly always find that any common characteristic is transmitted in an exaggerated form. Should both father and mother possess bad tempers, the child will, probably, manifest a worse ; should both parents be highly musical, the child will have the musical sense considerably enhanced ; should both the parents possess a low development of brain, the child will follow suit. By the kindness of Sir William Turner, I am able to give you a graphic illustration on this point. In a workhouse in the north of England, there resided a young man and a young woman. They were lazy and ignorant, and their features exhibited a low type. Every method had been employed to try and make them industrious and useful members of society, but without result. As time went on, they fell in love, and requested permission to marry. The guardians discussed the question, and at last gave their consent, thinking possibly that the responsibilities of the marriage state might awaken industrious habits. I now introduce to your notice casts of the heads of the bride and bridegroom, and I think you will agree with me that the guardians came to a very risky decision. In process of time

a daughter was born, and here is her head ; I think you say that she resembles her parents, and she is certainly neither more intelligent-looking nor more beautiful than they. Then another daughter arrived, who looks even more idiotic than her sister. A brother next made his appearance ; you see with what result. And lastly, another young lady completed this interesting family. The children were all idiots, so that the guardians, instead of having two useless individuals to support, had finally six.

It is interesting to note that some apparent contradictions to the law of heredity may occur. All must admit that resemblances are caused by heredity, but differences are difficult to explain. That races should possess different characteristics, and that people of different families should be unlike, can be easily understood ; but it may be asked, how is it that sometimes a son does not resemble his parents, or a brother his brother ? For example, a remarkably intelligent or highly scientific man may have a very stupid son ; one need not suppose in such a case that the law of heredity is broken, for the mother may have a dull intellect and have bequeathed it to her son.

Another explanation of the dissimilarity of children to their parents is found in the law of reversional heredity, otherwise called atavism. In explaining the theory of growth, I told you that definite particles in the germ cell had the power of transmitting various characteristics, but those particles require a suitable soil in which to grow, and it does not always follow that they find this soil in a definite individual. If they do not, one of two things happens ; either the particle dies or loses its power, or else it remains latent, passing on to the next generation, and, finding there soil fitted to its growth, it at last reproduces the latent characteristic. It is by this means that both physical and moral characteristics may skip one, two, or three generations, to reappear in the next ; and so we often find that a seeming exception to the law of heredity is only a reversion to the original type.

Should parents have opposite characteristics, these are usually neutralised in the child, and therefore the character of a child may be as different from that of its parents as green is different from blue and yellow. Therefore direct and immediate heredity may

also cause variation. In those cases where both parents possess some well-marked and definite characteristic, a curious result obtains. For instance, supposing a white man with great intellectual power, marry a negro woman of great physical beauty and stamina, the result will be a mulatto who inherits from his father intellectual capacity and from his mother physical powers. And more than this, it inherits from his mother a peculiar insusceptibility to some diseases. Nott says that a quarter of black blood is as sure a protection from yellow fever as vaccination is from small-pox. It has been said that crossing between whites and blacks deteriorates the progeny ; this is, however, not always the case, as, for instance, in the island of St Paul, where the half-breed population is distinctly superior to the old native race. This has been caused by the recognised union between the races, the half-breeds having just as good a social position as their fathers. In countries where such a good rule does not obtain, I admit that the crossing of races does harm, for in those places the half-breeds are looked down upon, and they usually possess the bad characteristics of both parents.

This leads me to remark that environment also causes variation, and in environment we find the great opposing force to heredity. The child is necessarily influenced by its surroundings, and whether those surroundings be good or evil, they will invariably affect its character. It is most important for you to remember and thoroughly appreciate the immense influence which environment and education will have upon a child. If you look at the diagrams you will see this result graphically depicted. Under that picture of a child you see the question, "What will it become?" Then follows a fanciful delineation of its progress through life. On the one hand it goes to school, thence to the university, it reaches honourable success, and finally honoured age. On the other hand, it is supposed to pass uncared for to the street, there to become idle and dissolute, from thence to pass on to vice and misery, and to end its days in beggary. These two courses represent, therefore, the influence of education and morality on the one hand, and of ignorance and vice on the other. There is no doubt that the most potent power in regard to education and surroundings is the influence which the mother exerts upon her child during the first five

years of its life. So that this influence must be placed in the forefront of the forces which go to modify heredity.

Turning for a moment from the individual to the race, we see these two forces of heredity and environment working side by side. How is it that races fail to become acclimatised in lands which have a different climate to their own? The explanation is simple. The race or races inhabiting these islands for example, have for centuries been surrounded by a definite environment, and have received generation after generation a definite hereditary impress. They cannot therefore remove and thrive in places having a totally different climate and inhabited by races possessing different hereditary tendencies. In the course of generations, however, this is accomplished in some parts of the world, but you will invariably find that the characteristics of such emigrants, both physical and mental, become altered, as witness the Anglo-American of to-day, and what we may call a new race of Britons dwelling in that part of Greater Britain known as Australasia.

In concluding this part of my subject, I would make one or two practical remarks.

In face of this strange and indeed awful power of heredity, we must consider how as parents we can utilise this knowledge for the benefit of our individual families, as also for the race at large. It is surely a serious thing to know that our failures and the bad points in our characters will be inevitably transferred to our children, and by them handed on to an indefinite number of human beings. It seems to me that this is one of the most important incentives for us to curb the evil that is in us, and to develop those virtues which we may possess. It should also incite us to use the utmost care in the training and education of our children. We should endeavour to check in them those tendencies from which we ourselves have suffered, and to provide them with an environment which will aid, instead of retard, their moral, intellectual, and physical growth. And now a word of warning. Do not let us bring our children up to positions for which they are unfitted. I am sure that the failure of so many young men in the present day to get on in life, is due to the laws of heredity being too little considered. Children whose parents for generation after generation have tilled the soil, or wrought nobly with their hands,

receive nowadays an advanced education. They imbibe the idea that they are superior to their parents, and that manual labour is below them. With an outfit of self-conceit and a thin veneering of culture, they leave the haunts of their childhood and the honest labour of their fathers, gravitate to the great centres of commercial activity, and enter the vortex of brain competition. And they fail, most of them, because their hereditary tendencies unfit them for the struggle. Instead of forming useful members of society and enjoying the life which has been given to them, they either die young or crowd our hospitals, or they unfortunately help to swell the numbers of the criminal population. Let those whose exceptional mental capabilities fit them for rising to a more intellectual state than their fathers, leave the old pursuits by all means, but it would be well if the vast majority of us would follow St Paul's example and say with him, "I have learnt in whatsoever state I am therewith to be content." The wish of young people to begin where their fathers left off is one of the greatest curses of our day, and one which brings many sorrows in its train, and tends more than perhaps anything else to the degeneracy of the present age.

Man is not born like some of the animals with the early power of putting all his faculties into play. A long education is needed. It is in this education that much good or evil may be accomplished, but although training undoubtedly does much, it can never overpass the hereditary capacity of the individual. The power of education is limited by race and by individual characteristics. For example, you cannot raise the Negro to our level in one generation, you can only elevate him to a certain point. His children, however, can be raised to a greater intellectual height than he. I know that there are noteworthy exceptions to this statement, but I speak of the race *en masse*. Neither can you by means of education alone, in any race, raise every individual to the height of a Wellington or a Newton, although by the use of judicious means you may awaken in any one individual latent powers and advance the development of all his faculties.

I must here say a word which is especially addressed to ladies. I have every sympathy for them, and respect the endeavour so many of them are making to raise themselves and their sisters to a more independent position, but at the same time I would re-

mind them that heredity has left its impress upon them, and though it is possible for some of them to compete with men in men's special callings, and although I would throw open to them every calling, every profession, which they may wish to enter, of this I am convinced, that their influence should be rather used for that most noble of all callings—the management of home. In this calling there is scope for all the faculties that the most highly gifted woman can possess. But I do not think it is sufficiently recognised that it needs as special and as thorough a training as is required to fit a man for any post that he may occupy.

I now pass on to the second part of my subject—the influence of heredity in connection with disease.

We have just seen the power which heredity exerts in the production of bodily and mental characteristics. We have now to classify the influence of heredity, either in the production of disease, or in the transmission of the tendency to suffer from special diseases.

1. A diseased condition of function or structure of any organ in the body may be hereditary.

2. Certain constitutional diseases affecting the whole body are transmissible, the tendency to them not showing itself until certain epochs of life.

3. There is an hereditary susceptibility to suffer from certain contagious diseases, as, for instance, from scarlet fever.

4. The power of resisting certain diseases is inherited.

Now, although it does not follow that every person who suffers from a disease which is usually hereditary, must of necessity have inherited it,—for these diseases may all occur in an individual who has inherited no tendency to them,—yet, speaking broadly, the diseases of which I have made a list on the diagram may all be transmitted from parent to child. You will see that the list is a long one. We may tabulate these diseases as follows:—

1. Blood diseases, *e.g.*, scrofula, tuberculosis, cancer, ricketts, and syphilis.

2. Nervous diseases, *e.g.*, epilepsy, chorea, insanity, hypochondriasis, neuralgia, apoplexy, paralysis, asthma, gout, rheumatism, diabetes.

3. Physical deformities and deficiencies of special senses, *e.g.*,

spinal deformities, club foot, cleft palate, hair lip, stammering, blindness, deafness.

4. Early degenerations, local or general, *e.g.*, degenerations of vessels, fatty changes in organs, want of elasticity in the skin, premature greyness or baldness, loss of teeth, and other signs of decay. Emphysema.

5. Some skin diseases, especially lepra and psoriasis.

6. Gravel and urinary calculus.

7. Some diseases of the liver.

8. Hernia.

9. Cretinism and albinism.

Of course I am not going to refer to all these diseases, and shall only select two or three of them with which to deal rather fully.

Hereditary diseases, and tendencies to disease, are produced in exactly the same way as the physical and mental characteristics which we have been considering, and in the same way too they may remain for a longer or shorter time latent or asleep, only to awake and to make themselves visible at an advanced period of life. This is especially the case with regard to insanity and nervous diseases, which also often skip one or two generations.

It is well, too, to remember that in many cases heredity is *only* a tendency, and that with care and proper precautions, nearly all hereditary disease or tendency to disease may be nipped in the bud. As you will have learnt from lectures which have been given before this Society, preventive medicine is advancing by rapid strides, and you have been instructed how to prevent the spread of fevers, &c. But preventive measures may also be devised in combating the tendency to hereditary disease. These measures may be employed in two ways—(1) By abstaining from ill-assorted marriages; and (2) by recognising hereditary taints at the outset of life, and by regulating both the education and the method of life in children suffering from such taints. In some cases it may be necessary to commence this preventive treatment before the birth of a child, and in some, precautions have to be taken throughout the whole of a long life. There is no doubt that were this more seriously recognised, an immense benefit would be conferred upon mankind at large. I make bold to assert that the time will come when due weight will be given to this subject, and

when one of the most important duties of a doctor will be to advise his patients as to the means of preventing the development of evil tendencies. A time will come when parents will seek advice as to the education suitable for their children. They will not wait, as is now too often the case, until a mistaken method of education has ruined a promising child, but, understanding their own tendencies, and, therefore, the probable tendencies of their offspring, they will do all in their power to bring such influences to bear upon them as will tend to make them strong in those points where by nature they may be weak.

To make my meaning clear, I will take the case of a boy who is slightly delicate, rather dull at school, and who comes from a nervous stock. It is useless to think of bringing up such a boy to enter a profession which will entail a large amount of brain work, or to choose for him a trade which will involve indoor and sedentary life. Such a boy should only have a moderate amount of schooling, plenty of food and fresh air, and be trained to follow some outdoor or manual employment. In many cases, too, it may be advisable to sever, for a time, home ties, and to provide for him fresh surroundings. A boy such as I have described might be pampered at home, his slightest aches and pains magnified, and he become a spoilt child, and unfitted to take his place as a useful member of society ; but give him such surroundings as I have indicated, and his morbid tendencies may be overcome, and he develop into a strong, healthy man, capable of doing good service in his day and generation.

I will now say a few words upon the subject of the hereditary transmission of phthisis (consumption). It is all the more important because the strongest family tendencies can often, under favourable circumstances, be held in check, if they be early recognised, and proper precautions be taken. If we examine into the family history of any number of persons suffering from phthisis, we find that those whose relations are consumptive are prone to the disease ; and again, such persons are liable to be attacked by the disease earlier in life than those who have no such history. This may be proved by the following figures, which I take from Dr Thomson's book on Family Phthisis. In 1603 cases of consumption which occurred in persons whose relations had been affected, 1131 occurred before twenty-five years of age, and 477 after thirty

years of age. In 1608 cases, in which there was no such history, only 871 occurred before the twenty-fifth year of age, and 737 after thirty years of age. It is also a fact that those persons whose father and mother have both been consumptive are attacked at a much earlier age than if only the father or the mother had been diseased. In families in which phthisis is hereditary, it is proved that females are more likely to become diseased than males ; in every 100 cases of phthisis one sees in male patients, 63 will be cases of acquired phthisis and 37 of inherited phthisis. In every 100 female cases, we find 41 acquired cases and 59 inherited. In 80 cases of inherited phthisis which Dr Thomson examined, he found that 24 were inherited from the father, 30 from the mother, 14 from both parents, and only 12 from ancestors.

Having given you these facts, it is my duty to state that it would be better if consumptive patients refrained from marriage ; as, however, I am afraid that this advice will not be heeded, I would strongly urge consumptive persons to be very careful not to marry persons suffering from the same disease or from a tendency to it, and in any *such* case it were best to delay marriage until thirty or thirty-five years of age, especially if the patient be a female. In dealing with children who are descended from consumptive parents, it is very necessary to remember that by carrying out certain precautions the phthisical tendency may either be eradicated or held in check. Great care must be exercised in the rearing of such children, everything being done from the very first to secure for them healthy surroundings. They should be fed with plenty of good and wholesome food, they should have as much fresh air as possible, their apartments should be properly ventilated, exercise should be strictly enforced, with such gymnastics or drill as is suited to the age and requirements of the child. Care, too, should be taken in clothing them properly, and in girls tight-lacing should be especially eschewed. Children of consumptive parents should not be over-educated, nor should their education be commenced at too early an age, and if possible an outdoor active life should be chosen for their future occupation, for it is found that phthisis attacks clerks and artisans in preference to farmers and professional men. It would also be well, if possible, to select either a permanent residence, or at any rate schools, for such

children in districts where it is known that the mortality from phthisis is small, and indeed emigration can be strongly urged in many of these cases. It is well known that many young people who have a tendency to phthisis become perfectly strong and healthy after a year or two at sea, or after a residence of some years in one of the colonies. Some parts of South Africa, some parts of Australia, New Zealand, Tasmania, and parts of the United States and Canada may be well chosen for the residences of such children, with the strongest probability that they will grow up into healthy and useful men and women.

I will now briefly touch upon the subject of nervous diseases and insanity. I take these two subjects together, because they are to a certain extent related. There is no doubt that individuals may inherit a positive tendency to either some special nervous disease, or to some form of insanity from which one or other of their parents or ancestors have suffered. The child of an insane person is distinctly more liable to suffer from insanity, under the ordinary conditions of life, than the child of perfectly sane parents. Again, a child descended from ancestors suffering from nervous disease, may either suffer from the same nervous disease, or from some other, because there appears to be a relation or kinship between nervous diseases, so that they may interchange places, or become transformed in different generations. For instance, the child of an epileptic parent may either be insane or an epileptic, or the child of a parent who has suffered severely from neuralgia may be affected by either epilepsy or chorea. A dipsomaniac may have children who are either idiots or insane, or who have a tendency to commit suicide. It is not necessary that every child belonging to a family nervously affected should become diseased; the tendency may lie dormant in the system, and be transferred to the next generation, or the tendency may die out either by the children becoming idiots and dying unmarried, or a judicious marriage may minimise the tendency in the children.

In a paper which Dr Stewart published in 1864 on hereditary insanity, he found that out of 901 admissions into an asylum, 477 of the patients had insane relations; the diagram upon the wall shows the various relationships.

With regard to hereditary predisposition to dipsomania, I will quote some observations made so long ago as 1858 by Dr

Thomson of Alva. He published the observations he had made of ten families, in which there were nineteen dipsomaniacs living, and eighteen who had died in consequence of the disease ; three others were epileptics, and ten were insane. In one family alone the father was intemperate, and died from a burn sustained when drunk, his two sons and his nephew died of delirium tremens, and one nephew, four grandsons, and three grand-daughters were all victims to the love of drink.

With regard to the prevention of the effects of hereditary predisposition to insanity and to nervous disorders, nearly all that I have said with regard to phthisis will again apply ; at the same time, it is most important that the moral training of the children should be very carefully attended to. Firm and judicious training is especially necessary, for these children are apt to be precocious or bad tempered, or to possess some moral obliquity. In most cases judiciously chosen boarding schools are the best places for such children, for it is well to remove them, if possible, from constant contact with their parents. The mismanagement of children by neurotic parents is one of the chief causes of the development of a nervous tendency into actual disease. Another frequent cause is the curious inclination of neurotic persons to marry others possessing similar tendencies.

I must just glance at one more disease, namely gout. We find that doctors in all ages have attributed most of the cases of gout to heredity. Gairdner could trace an hereditary influence in 140 cases out of 156. Braun found it in all of 65 cases he treated at a Spa. Garrod says that half his hospital cases of gout could be referred to heredity, and three-quarters of his private cases. One gouty patient told him that the disease had been handed down from father to son in his family for 400 years.

I must now bring this lecture to a conclusion. I have drawn your attention to the fact that heredity plays a great rôle in the drama of this world of ours. The picture I have painted is in some respects a very dark one, but it is not all dark, for do you not perceive the bright colouring in this fact—that good characteristics as well as bad may be transmitted from parent to offspring. As Dr Samuel Cox so truly says: "We are quick to recognise the transmission of ancestral vices, perils, defects, quick to mark how the deformities and taints and faults of even

some remote ancestors may reappear in their descendants ; but we often fail to notice how their sturdier and better qualities, their capacities and dexterities, their virtues and excellences, also reappear." This, then, is the saving clause, this the silver lining to the dark cloud. We may transmit good qualities to coming generations. It is the wish of all parents to leave an inheritance to their children. Some fathers and mothers strive earnestly, month after month and year after year, to leave to their loved ones position or wealth. Would it not be better if, instead of this material treasure, they sought to leave them a more enduring substance? Let the strength that is so often spent, or wasted, in amassing wealth, be devoted to the establishment of physical and mental health and to the formation of noble character, so that they may give to their children the inheritance of sound constitutions, capable minds, and noble parts. Then may it well be said of their offspring, in the words of Sir Thomas Browne : " Bless not thyself only that thou wert born in Athens ; but, among thy multiplied acknowledgments, lift up one hand to heaven that thou wert born of honest parents, that modesty, humility, and veracity lay in the same egg, and came into the world with thee." Yes, even the poorest among us may leave a legacy to his offspring of which no one can rob them ; a legacy of purity, of virtue, of generosity, of obedience, of self-control. Surely this should bring an inspiration into every man's life, and stimulate him to develop all the good, and to curb and restrain all the evil of his nature.

No one who realises the immense power of heredity can help feeling that we labour under a terrible responsibility ; a responsibility not bounded by a limited or an appreciable horizon, but stretching out into the far distant future along the line of our descendants.

"Till at length the burden seems
Greater than our strength can bear,
Heavy as the weight of dreams
Pressing on us everywhere."

But do not forget that although the power of heredity is great, each individual does possess or can obtain the power of mastering it. There is hope for everyone, however unfortunate

his hereditary tendencies may be ; if only he will surrender himself to his conscience, a wonderful transforming power will enter into his soul, and a new nature will be developed in him. Sweet are the uses of adversity, and how do we know that the hereditary taints which are apparently so adverse to our progress may not be blessings in disguise ? They are but waiting to be conquered, and on their dead ashes we may rise to nobler and to better things.

“ St Augustine, well hast thou said,
That of our vices we can frame
A ladder, if we will but tread
Beneath our feet each deed of shame !

All common things, each day's events,
That with the hour begin and end,
Our pleasure and our discontents
Are rounds by which we may ascend.

.

We have not wings, we cannot soar,
But we have feet to scale and climb
By slow degrees, by more and more,
The cloudy summits of our time.

.

Standing on what too long we bore,
With shoulders bent and downcast eyes,
We may discern—unseen before—
A path to higher destinies.

Nor deem the irrevocable past
As wholly wasted, wholly vain,
If, rising on its wrecks, at last
To something nobler we attain.”

THE CHANNELS OF INFECTION.

BY ARTHUR W. HARE, M.B., F.R.C.S.E., F.R.S.E.

SIR DOUGLAS MACLAGAN, LADIES AND GENTLEMEN,—It is by no means a sign of strength of mind, nor is it usually successful in attaining its object, when a lecturer commences his address by an attempt to deprecate the criticism of his hearers. Nevertheless on the present occasion I shall venture to adopt that course in respect to two classes of the community who, it may be, are represented here this evening. I am here simply in the capacity of a witness, giving evidence before you, a special jury, in a case of capital importance; and, as you are aware, in the good old phraseology of the courts, my evidence must be “the truth, the whole truth, and nothing but the truth.” The Statute-book unfortunately makes no provision for its being pleasant information; and in fact a large part of what I have to say is far removed from being so. Hence I must ask any here present who have come even to a health lecture in the pursuit of pleasure to reconsider the serious nature of the case, and to modify their anticipations *in toto*. No less must I beg those who may expect to hear a statement of the most recent advances in the elucidation of infective processes to minimise their desire; for it is essential at the present moment that I should confine my attention to the A B C of this extensive subject, and my remarks to as clear and simple an exposition of its fundamental truths as I am capable of attaining to. In the first place let us define the scope of our enquiry. Infectious diseases and infective processes form a distinct class of affections which have certain special characteristics in common. These are the group of symptoms which accompany the condition of feverishness, along with other phenomena differing in the case of different members of this group of diseases, but constant in and special to each several variety, con-

stituting each a *specific*, or distinctly separated fever, and one capable only of producing its like in the case of its infection passing from one person to another. The whole group have this further in common, that they are propagated by the transference of a minute poison which is capable of rapid and immense multiplication in the body that becomes infected. This process of infection and its result was long ago recognised as very similar to the well-known action of a ferment; hence this group of diseases has been called *zymotic* or fermentative. The origin of many of these diseases is hidden in the mists of hoary antiquity, and it will probably be for a long time a puzzle to explain how they first came to attack the human race. But in the case of one or two of them a distinct origin, both as to time and place, has been traced out, and has become as definite an event as most of those which we are accustomed to look upon as strictly historical. Thus in Paris, in the year 1510, a new and striking disease appeared, attacking large numbers of the inhabitants, and passing thence to other countries, where it still maintains its hold under the well-known name of Whooping Cough. Similarly, Scarlet Fever and Measles have been distinctly traced back to their origin in Arabia, whence they gradually spread in various directions till they have now attained a world-wide distribution. Corresponding to this origination of new diseases from time to time, I am glad to be able to give you an obituary notice of some more terrible than any I have as yet mentioned. For instance, we may take the case of the Plague, or Black Death, which destroyed in the fourteenth century about a third of the population of Europe; and which, on its last visit to Great Britain, in 1665, was fatal to 68,500 of the citizens of London, then a city of half a million inhabitants. This terrible scourge of mankind appears to have taken its final departure from Europe, driven out before the sure, if slow, advance of civilization and sanitary knowledge. But to return to the process of infection:—it may be defined as the transference of an infective particle by various channels to a body susceptible to infection. To make the matter as clear as possible, I shall first discuss the nature of the infective particle, then the peculiarities of the human body that make it susceptible to infection, and, lastly, some of the more usual channels by which the one reaches and affects the other.

1. *The infective particle.*—The minute poisonous particle to which I have referred receives the general name of a *germ*; and it is essential that I should give you a distinct idea of what that term implies. Firstly, as to size; germs are in general extremely minute; not only are they microscopic objects, but by far the greater number of them are so extremely small as to be invisible except by the very highest magnifying powers that can be adapted to microscopic work. This must stand as the explanation why so much is left still uncertain and indefinite in regard to their habits and the conditions surrounding their life, for the practical difficulties attending this form of research are so enormous as to prevent anything but very slow progress in its prosecution. Secondly, germs belong to the vegetable kingdom, and largely fall within the order of the fungi; a few are closely allied to the algæ or sea-weeds; and some present anomalous characteristics which make it very hard to say to what group of vegetable forms they should be most properly attached. As a general definition we may describe germs as microscopically minute masses of living matter (protoplasm), which are usually supplied with a body wall or investing membrane, that endows them with considerable resisting powers. They may be said to be absolutely ubiquitous in their distribution in nature. No domain is perfectly free from their presence at all times; and though there are positions where it is rare to find them, as in the atmosphere at high altitudes, in glacier water, or in snow or ice, even such situations are at times found to have been invaded and shew evidences of their presence. In ordinary conditions, earth, air, and water teem with them in one or other of the conditions of life in which they are found. And this suggests an essential point in their nature which I must for a moment dwell upon, namely, that they are found in two quite distinct conditions as regards their manifestation of vitality—first, as actively living organisms, which have for the most part a strictly ephemeral life and pass rapidly away; and secondly, as resting spores, similar in all respects to the seeds of cereal plants, that may be preserved indefinitely and yet retain their powers of germination. So in the formation of resting spores one finds the active germs passing into a state of quiescence, withdrawing, as it were, all their vital powers within themselves, and remaining reactionless often for long periods of years. They lie thus

quiescent, apparently bereft of all life, until under the influence of certain favourable outward circumstances, which may be generally stated to be the presence of light, heat, and moisture, they awake from their long sleep, take on once more their habits of active growth, and pass through the whole cycle of existence once again. It is this peculiarity on their part which renders the oft-renewed suggestion that the infectious diseases ought to be extinguished by systematic isolation and disinfection of the cases in which they occur less directly feasible than it might appear. Do not misunderstand me in regard to this point. I also believe that this class of diseases might be, and will be in the future, entirely extirpated. It is stated, and generally conceded, that whatever their primary origin in the past, these diseases do not nowadays arise spontaneously, but are invariably propagated by infection. It would follow from this that perfect isolation and disinfection should preclude their advance and cut short their existence at the termination of any cases thus treated. But in view of the fact that many infectious germs form resting spores, we should be prepared for the occasional occurrence of *apparently* spontaneous cases of disease where the infection is so delayed, from the cause mentioned, as to preclude any possibility of tracing the true channel of infection, and the real origin of the outbreak.

Passing now for a moment from the infective particle, or germ, may I draw your attention to the way in which it acts when planted in some situation suitable for its development.

Let us take in the first place a well-known example of this—say one of the moulds, such as the common cheese-mould. The usual experience in the matter is that a new cheese is cut into, and that a few days thereafter the well-known delicate fluffy-blue fungus has made its appearance. *Now, where has it come from?* One of three things has happened. Either what would really be a miracle has occurred, and something has arisen from nothing; or the seeds of the fungus were present in the cheese, and merely required light to cause them to flourish, as snowdrops spring up after the dismal winter season; or thirdly, something has found its way to the cheese, and has there found supplies of food and other conditions suited to its growth. The last is now generally admitted to be true: and that *something* which has gained access to the cheese is one of those resting-spores we were just now talking about.

In the cheese, the fungus spore finds a congenial resting-place, where it is supplied with abundance of nourishing material, and it is soon found in a state of active vegetation. A delicate network of fibrils derived from the original spore penetrates the cheese in all directions and absorbs nourishment from it, as the roots of a plant do from the earth; but as the chief glory of plant life is above, and not under the surface of the soil, so the highest development of the cheese mould is upon the cut surface of the cheese: in this position it forms a soft, downy-looking carpet, which the microscope resolves into a forest of graceful trees with waving feathery branches, on which are borne the ripe fruit or spores of the fungus.

The spores which occupy the branches of these minute palm-like growths in due time become ripe, and drop off the parts to which they are attached; and, becoming dried and hardened, they are wafted through the air, or drifted by water, or buried in the earth; and remain dormant till some chance disposition of outward circumstances allows them once more to vegetate, and to develop once more into the fully-matured form that we have now been considering.

But I have said nothing as yet in regard to the material in which a germ carries on its existence and upon which it subsists. This also is altered considerably in its character, the germ having extracted from it some of its most nutritious elements, adapting them to serve its own uses and to carry on its life.

Thus the cheese is altered in its chemical composition slightly, and, as a practical outcome, decidedly altered in its flavour. In the case of the cheese these alterations are of no great import, save to increase its scientific interest in the eyes of the gourmand; but when we come to other forms of fungus growing upon other substances than cheese, we shall have to acknowledge that the changes which are thus produced are of paramount importance to the human race.

Perhaps I may most aptly illustrate the changes set up by the presence of a germ in the material in which it is living by a reference to the well-known phenomena which occur in the brewing of beer, the making of bread, or the manufacture of wine. All these processes depend upon the presence of sugar in the material used, and upon the action which a special germ, the

yeast plant, carries on when brought in contact with sugar in the presence of moisture. Yeast consists of oval-shaped cells, which are accumulated in immense quantities at the lower part of the beer-vats. They increase rapidly in numbers by extruding small protoplasmic buds, which are soon detached and become themselves fully formed yeast plants. Whilst they are thus living in the malt liquor, they are constantly hard at work producing alcohol, which remains in the liquid, and carbonic acid gas which passes off in bubbles if it is permitted to do so ; usually, however, its escape is prevented, and remaining in the liquid it gives rise to effervescence when it is poured out. So hard do the yeast plants work in this way, that the malt liquor becomes heated by the chemical changes they give rise to, unless express means to prevent this be employed ; for instance in the great Austrian brewery of Dreher, it is stated that no less than 45,000 tons of block ice are annually consumed in cooling the beer-vats, the contents of which are thus preserved from the danger of acid fermentation following the alcoholic fermentation just described. The same process occurs in the making of bread, in which, according to Bloxam, the following takes place :—“ In the common process of bread making, the carbonic acid gas destined to confer sponginess upon the dough is evolved by the fermentation of the sugar contained in the flour ; the latter having been kneaded with the proper proportion (usually about half its weight) of water, a little yeast and salt are added, and the mixture is allowed to stand at a temperature of about 70° Fahr. for some hours. The dough swells or *rises* considerably, in consequence of the escape of carbonic acid, the sugar being decomposed into that gas and alcohol, as in ordinary fermentation. The spongy dough is then baked in an oven heated to about 500° Fahr., when a portion of the water and the whole of the alcohol are expelled, the carbonic acid being also much expanded by the heat, and the porosity of the bread increased. The granules of starch are altered by the heat and become far more digestible. Although the temperature of the inside of the loaf does not exceed 212° Fahr., the outer portion becomes dry and hard, the hottest part being even torrefied or scorched into crust.”

If supplied with all the materials requisite to their growth, germs will grow and multiply at an almost incredible rate. From their lowly position in the scale of organised Nature, their require-

ments are necessarily of a comparatively simple character, a fact that might also have been inferred from the result of a chemical analysis of their constitution. Such an analysis shows them to consist of 88 per cent. of water, 2 per cent. of inorganic salts, and 10 per cent. of organic compounds. This composition gives a clear indication as to what substances they will chiefly require to maintain their life and permit of their rapid multiplication. The organic compounds required are chiefly those rich in carbon and nitrogen; and, among the mineral substances, the salts of potassium and compounds of phosphorus. These, with the presence of abundant moisture and the action of a moderate heat, constitute the conditions favourable to the most rapid growth and development. Germs differ to a very marked degree in regard to their dependence upon or independence of the presence of oxygen. Some species of germs—as, for instance, the common moulds—are so dependent on the presence of oxygen that they can only grow on free surfaces where it is abundantly supplied to them. Others, and notably those belonging to the group of the yeast fungi, are capable of passing through all the stages of their life-history, and of increasing to an enormous extent without obtaining any oxygen other than the scanty supply derived by their power of breaking up complex chemical compounds. If, for instance, a lighted candle be placed in the empty air space at the top of a beer vat in which fermentation is going on, the light is put out, and if a man be placed in the same position he is soon bereft of life; the reason being that there is no oxygen gas present to support the combustion of the candle or the respiration of the man, and instead of it the space is filled by carbonic acid gas, which is incapable of supporting either life or combustion. Now the yeast plant obviously can live without free oxygen, for it flourishes in a liquid itself saturated with carbonic acid, and thus fermentation has been defined as “Life without Air” by M. Pasteur, the great French chemist. In this respect the yeast plant differs from many germs to which it is closely related in other respects, and becomes more nearly allied to those that attack and flourish in the tissues of the human body, giving rise to *zymotic* or fermentative diseases.

From these examples, and many others that might be quoted, it appears that the chief requirements of a germ for its active

development are food suited to its constitution, warmth, and moisture ; and as we proceed, as I propose to do in the next place, to consider the peculiarities of the human body that make it susceptible to the rapid development of disease germs within it, we shall find that these three *desiderata* of germ life are fulfilled by it in a most complete manner.

II. *The human body as a seat of infection.*—I think it will be apparent, from what has been already said as to the wide distribution of germs in nature, that the body is loaded with them on all its free surfaces—that is to say, on the outside surface of the skin, and on the inside surfaces formed by the alimentary and respiratory canals ; but it is now clearly proved that in conditions of health they do not obtain access to the interior of the tissues of which the body is formed. The invasion of the living tissues by germs is a subject which it is certainly very difficult to explain. The power of resistance offered by the tissues to their attacks comes to be one of the most striking facts in physiology, when one considers how constantly and persistently those attacks are taking place. In regard to the causes which prevent or hinder their ingress into the tissues, Sir Joseph Lister has pointed out that the chief obstacle is the vitality of the living tissues themselves. In healthy conditions it would appear that the microscopic elements of which the tissues are formed are specially prepared for repelling attacks, and that certain cells (Leucocytes) which wander about amongst the tissues, like special constables along our streets and by-ways, are ever ready to pounce upon and devitalise such germs as attempt an invasion. Tissues, then, of what may be termed a standard vitality resist perfectly the entrance of the invading germs of disease ; but let this standard be in the least degree lowered, and the chance of an invasion at once becomes great. Hence I need scarcely draw your attention to the great importance of a close observance of those laws of health that have already been spoken of by my colleagues in this course of health lectures ; for all measures calculated to secure and maintain a high standard of vigorous health are death-blows to the insidious invader. If it be admitted that this theory of a standard vitality is correct, it follows that in ordinary conditions of health these minute germs would be continually and efficiently excluded from the tissues of the body ; but, unfortunately for us there are certain

very powerful allies of disease constantly in action, through whose aid the vitality of the tissues is lowered, and the process of infection becomes not only possible, but likely to occur. The general vitality of the body may be depressed by cold, want of food, want of sleep, alcoholic excesses, and irregular or unhealthy habits of whatever kind. Even fear, anger, and other strong emotions may act in the same way by altering the secreting tissues of the body and the secretions they prepare, thus interfering with the proper nutrition of the tissues generally and reducing their vitality. Thus, *mens sana in corpore sano*, a healthy mind in a healthy body, along with certain reasonable precautions for the avoidance of infection, is the golden rule by which exemption is attained. There is no more striking illustration of the proverb, "Prevention is better than cure," than this subject of which I am speaking to-night: for though a great deal can be done to avoid and repel infection; yet when it is once established, and the particulate poison has once gained a footing in the tissues, it can hardly be eradicated by any curative means as yet at our disposal, but must be allowed to run its course unchecked, save by such means as will strengthen the tissues and assist them to throw it off the more completely when its energy of action naturally tends to decline. This difficulty of checking infective diseases during their course depends upon the fact already mentioned, that the living body, if its vitality be in any degree lowered, becomes an ideal medium for the cultivation and multiplication of the germs of disease. The rich juices in which the bodily tissues are constantly bathed afford abundant supplies of food and moisture for the invading germs, and the heat naturally present in the living body completes its special adaptation for their growth and widespread distribution. In such advantageous circumstances it is no wonder that germs, possessed of great vital and reproductive activity, should seize upon all parts of the body with startling rapidity, and involve it in a general feverish process; nor that they should maintain their hold upon the tissues till the latter are so much altered that they no longer supply the requisite nourishment for the continuance of the process. Then what is known as the crisis of the disease occurs, the invading germs die out, and the tissues of the body are left to recover their lost healthy vitality as best they may.

III. *The Channels of Infection.*—And now let us consider the chief routes by which infective particles gain access to the body. We shall trace these channels backwards to their source as far as possible, so that we may be able to judge at what point we can most easily interpose in our attempts to prevent the occurrence of infection. I have already explained that we are not accustomed to look upon infective particles as arising *de novo*, but that so far as practical investigations can inform us at the present time, such infective particles are derived solely from pre-existing cases of disease. They are given off from the body of a diseased person in exhalations, excretions, the desquamation of the skin, and the expectoration from the mouth and lungs. The fate of these infectious particles depends a great deal upon the nature of the case from which they are derived. For instance, infective particles derived from a case of scarlet fever are much more easily disseminated than those from a case of typhoid, for while the former are so light as to be easily wafted through the air, the latter are not capable of this means of distribution, and are known to be usually carried by water, or to reach their destination by the actual contact of the person infected with a patient suffering from the disease. This difference has led to a distinction between the terms *infectious* and *contagious*, which, however useful it may be as expressing distinct individual features of distinct infective diseases, is not found to hold with absolute certainty in the case of any of them, and therefore is not a very satisfactory basis on which to classify them. Further, this additional analysis of the process of infection does not in any way affect its essential nature, but refers solely to the mode of its occurrence; hence we shall be wise to consider the whole process as essentially one and the same, merely remarking in regard to it, that in varied circumstances it occurs in a variety of ways. The chief channels by which the infective particles are carried are the air, water, food materials, especially milk, and household surroundings, such as a patient's friends, his or their clothing, domestic animals, and any other transferable object that may act as the vehicle of disease. Considering, in the first place, the air as a channel of infection, I may perhaps indicate the nature of the danger by the following illustrative case.

“A father and daughter left London on the evening of the

2nd of August, and arrived here on the morning of the 3rd. On the 4th they both awoke feverish, and on that evening, when first visited, the daughter had a well-pronounced scarlet fever eruption, and the father a severe sore throat. Inquiry made out that in the same compartment of the railway carriage they had as fellow-passengers a lady and her son, a lad about fourteen years of age, sickly looking, and apparently affected with some throat trouble. It was known that they were on their way to one of the watering-places on the Clyde. With this clue an investigation was instituted, when it was ascertained that a younger brother was attacked with scarlet fever after the arrival of the other at his destination, and that the latter had been seen by a medical man in London on the 27th, 28th, and 29th July, on the last of which occasions he complained of sore throat. Scarlet fever was not suspected. From the facts adduced, however, the doctor is now of opinion that the disease was scarlet fever. (I have since learned from the medical attendant in — that the boy in due time desquamated. The evidence therefore is complete and conclusive.)"—
[*Monthly Report by Medical Officer of Health, Greenock, 7th September 1887.*]

In this particular instance the conditions most favourable to infection through the air were very perfectly fulfilled. We all know what the air in railway carriages tends to become during a journey with all the windows closed. Every cubic inch of it has probably been breathed once or twice at least by every passenger in the compartment, the diseased no less than the healthy, and thus any infectious particles that are capable of being wafted through the air have every opportunity of gaining access to the tissues of healthy persons by way of the respiratory channels. In the case I have just quoted there was no option in the matter. The affected person was an invalid; cold draughts of air must be avoided for his sake. There was no wonder in the circumstances that his fellow-passengers became affected, rather would it have been astonishing had they escaped. Yet many people do escape the most violent types of infection in almost similar circumstances. How often must the medical man approach and closely examine a patient suffering from some desperately infectious malady, and yet how rarely does he suffer any evil consequences! It is not that he is protected by any magical

charm, or that he is the object of some protective supernatural interposition, however much he might merit such tutelage in his professional labours: it is rather that the results of scientific observation have given him a new instinct of self-protection. Picture a medical man on a visit to such a case as we have imagined. Let us say it is a blustering windy day outside, the stairway is both high and steep, and the doctor reaches the patient, as we say, "out of breath;" that is, he is taking more rapid and deeper breaths than he would do in ordinary circumstances. But you will notice that he does not approach the patient's bed at once, but waits and converses with the attendant at a distance for a time, and only approaches the patient when his own breathing has become soft and regular and has lost its previous exaggerated character. Further, you will notice that in carrying out his examinations he is careful to avoid catching the patient's breath. He knows that, breathing in his ordinary way, the danger is sufficiently great, but that should he continue to take deep breaths the chances of infection would be vastly increased; since in exaggerated breathing the air inhaled passes further down the respiratory channels than in ordinary breathing, and hence the infectious particles may reach an area where they are much more likely to give rise to trouble. These facts, among many others of a cognate nature, are present in a doctor's mind and produce a protective instinct that he constantly and almost unconsciously employs. It is fortunate that there are such methods of diminishing the chance of infection in such cases, for it is by no means easy to *disinfect* the atmosphere around a case of infectious disease; that is, to use means for destroying the infective particles without injuring the patient's health at the same time. What one should aim at is to prevent the transference of infection beyond the walls of the sick room; to stop the spread of the disease, just as one would cut off the extension of a conflagration by interposing an impermeable screen. This can be done in a sick-room by hanging a sheet in the doorway, and keeping it constantly moist with carbolic lotion. Then, the disease germs which encounter the surface of the sheet are at once destroyed, and the atmosphere near the sheet is purified by the evaporation of the acid and its dissemination in the air around. When the patient can be removed from the sick-room, its air, as

well as everything else in it, must be disinfected. I need not tell you exactly the method employed, for in this enlightened city the public authorities do all these things for us, most efficiently, if we only ask them. A thoroughly equipped department under the charge of the Medical Officer of Health is ever ready to secure the public safety by these means, and we are most negligent in regard to our own and our neighbour's welfare if we do not make use of its services on every occasion where there is a chance of the spread of infection. Water becomes a channel of infection in a different way. Where infection is traced to the use of water, it is invariably found that the source of supply has not been properly protected from sewage contamination. It is particularly in such diseases as typhoid fever and cholera that water appears to exert this malign influence, through the disease germs that have gained access to it. It is not wonderful also that many other channels of infection gain their dangerous character from the use of impure water. For instance, if milk cans are washed with contaminated water, the milk put into them subsequently becomes a yet more fertile source of danger, for the germs of disease grow and multiply in the milk at a prodigious rate. If such water be actually added to the milk, the risk is of course immensely greater. Where a city's water supply is drawn from a river, in the course of which other towns are situated, it is very difficult indeed to prevent its becoming contaminated from time to time in the way I have mentioned. In such cases the most careful examination of all possible sources of pollution and their removal when discovered are the only hope of safety. Here we are very fortunate in avoiding this terrible risk. The water supply of this city comes as directly from the clouds as any large supply can do, and on the open summits of the Pentland Hills there is surely little chance of its becoming polluted. Still so pure a source must be jealously guarded from all possible risks, if we are to maintain our fortunate position as a city with a remarkably low death-rate from fever. I have mentioned one way in which milk may become a channel of infection; another and still more frequent occurrence is that it becomes contaminated by contact with dairy workers who are or have been affected with some infectious malady. In the case of scarlet fever this has been proved time after time to

be the origin of the most appalling epidemics of disease. After suffering from this disease a person may be a source of danger for many weeks, although in every respect apparently quite well. The light branny scales which separate from the surfaces of the skin after the acute stages of the disease is past are extremely infectious. Should some of them drop or be wafted into a milk can, the whole of its contents become so infectious, owing to the growth of the germs, that they can only be described fitly as a *deadly poison*. And yet the milk merchant, quite unconscious of what he is doing, offers this poison freely to the public, with what dire results we have recently had painful experience in Edinburgh. It is very difficult to adopt a complete remedy for such a state of matters. Thorough boiling of the contaminated milk would remove its dangerous nature, but it is scarcely to be expected that such an addition to domestic labour will be generally adopted, or if adopted for a time, that it will be constantly maintained. Such a method would be useless unless it were always continued, since it is uncertain at what time the danger may arise. Further, the danger only does arise occasionally, and the public would continue to run the risk involved by drinking unboiled milk, as cheerfully as they run that of travelling in a railway train. The only measures, as it appears to me, that can be expected to yield good results, are such as aim at cutting off the poisonous material at its source. To keep milk pure and uncontaminated from the first will surely not be an impossibility, when the danger is once duly recognised; and the obvious cure consists in the frequent inspection by official inspectors of all dairies that supply the public; in making the milk trade a licensed trade, where a licence may for sufficient reasons be withdrawn; and in the compulsory notification of every case of infectious disease to the proper authorities directly its presence is distinctly recognised. These are reforms we may shortly hope to see carried out; for public interest, in and out of parliament, is now thoroughly awakened in regard to these and similar matters that greatly affect the health of the community at large.

I need say little here on the subject of infected objects which have come in contact with a diseased person, and are thereafter great sources of danger to other people. All such things should be disin-

fect, by strong antiseptic lotions if they can be washed, or by heating in suitably-prepared ovens, if the application of water would spoil them. But I may just remind you that a variety of objects likely to be overlooked may thus become the carriers of disease. If such an object can move about by itself, so much the more likely is it to escape from the process of disinfection and to produce mischief. And this explains how a favourite Persian cat, on friendly terms with many households, was able to spread scarlet fever amidst quite a large community of children in Chicago last year. This animal had been petted by a child lying in bed ill with the disease, and in its subsequent visits to several neighbours' houses it carried the disease with it. Nothing is more natural than that its thick fur should harbour infective particles from the patient in large quantities, and nothing more likely than that these should be removed and wafted through the air every time its fur was stroked afterwards.

Our great safe-guard against infection in its several channels, is to maintain an efficient department of public health in every city and district throughout the country, and to see that it is enacted that every case of infectious disease must be reported as soon as it occurs. Thus the public health authorities, duly notified from day to day of the presence and amount of infectious disease, can take immediate measures for the proper isolation and disinfection of cases that occur; and if many cases occur simultaneously in any district, can at once search for a source of infection common to them all, and if such be discovered, can remove it. This plan is now working admirably in Edinburgh, and there is no reason why it should not be extended to all other cities and towns, and particularly to rural districts, where it is quite equally needed. For the rest, ladies and gentlemen, I can only beg you not to be unduly anxious when from time to time epidemics appear in our midst. In such an event, individual fear is really a great source of danger; while widespread panic may precipitate the most frightful catastrophes. Take all wise precautions to avoid infection; see to it that the health of those around and dependent upon you is kept at as high a level as possible; and keep brave hearts yourselves. The coward is often he who perishes in the battle that the brave man survives. This is no new doctrine. Horace, the Roman poet, nineteen hundred years

ago wrote about it, and I cannot finish this lecture more fitly than in his words :—

How sweet 'twere e'en to die for thee, dear Fatherland !
Nor yet does Death refrain his withering hand
From men that feebly flee from danger's face,
Nor spares their coward back, their trembling knees' disgrace.

“ Dulce et decorum est pro patria mori ;
Mors et fugacem persequitur virum ;
Nec parcat imbellis juventæ,
Poplitibus timidoque tergo.”

HORACE, *Carmen II.*, Lib. iii.

