

The Remarkable Botanist Physicians:

Preface

The year 2012 marked the one hundredth anniversary of what was, in some respects, the end of an era. Calcutta, which had been the capital of British India since 1772, ceased to be so in 1912. The founder, in 1787, and first Superintendent of the Calcutta Botanic Garden had been a Scottish infantryman, Colonel Robert Kyd. It is a remarkable fact that this Garden was subsequently superintended, with one important exception, by an almost continuous succession of ten Scottish medical doctors, starting in 1793 with the appointment of John Fleming and ending in 1905 when the then incumbent, Sir David Prain, left to become Director of the Royal Botanic Gardens at Kew (the important exception was the medically trained Dane, Nathaniel Wallich). So, for the best part of a century, throughout the directorships at Kew of Joseph Banks, William and Joseph Hooker and William Thiselton-Dyer, the most important colonial botanic garden – in the capital of British India – was run by an almost unbroken succession of Scottish medical doctors. This was, moreover, just part of a much wider phenomenon. In this period, Scots and Scots trained botanist physicians were to be found operating in most other parts of the Empire and also participating in most of the British voyages of discovery, land explorations and even diplomatic missions. This remarkable phenomenon requires an explanation.

Edinburgh University

In the late 18th century and early 19th century, when the Royal Botanic Gardens at Kew were being formed, the Scottish universities, especially Edinburgh, were enjoying a golden age. This was at the height of the phenomenon known as the Scottish Enlightenment. A problem with the two English Universities at this time was that they excluded many able students by allowing only Anglicans to take exams, and at Oxford in particular, a low priority was given to the non-mathematical sciences and the applied sciences – a situation that persisted until the mid-19th century. It was symptomatic of this that Joseph Banks (see below), while attending Oxford University, had to employ a botanist at his own expense to deliver the lessons the Professor of Botany declined to teach!ⁱ

It has been calculated that a remarkable eighty-seven percent of British doctors in the second half of the eighteenth century were Scottish trainedⁱⁱ. Much of medical treatment at this time, it must be said, was of limited value (the Scottish naval surgeon, James Lind, who in the mid 18th century advocated the use of citrus juice to counteract scurvy, was the first person known to have done any actual clinical testingⁱⁱⁱ). However, chemistry and botany, which were not yet considered academic disciplines in their own right, were taught in addition to human anatomy and physiology as part of a physician's education so that he would be able to prepare his own remedies even in far outposts of the British Empire. Some chose additionally to study geology. At some stage the environmental causes of disease also seem to have been part of the curriculum. With this scientific training many doctors were to find themselves in great demand in other fields.

John Hope, Professor of Botany at Edinburgh University Medical School (1761-86), was one of the first academics to teach the new Linnaean system of classification (in reality it was more of a plant identification key). This was a ground-breaking innovation that was a boon especially to plant collectors out in the field. He also, incidentally, created a new well-stocked botanic garden for the University that bore the title “Royal” before the one at Kew. His English students included James Edward Smith, founder and first President of the Linnaean Society (still, of course, in existence)^{iv}. Also, three of the English founders of the organisation that would become the Royal Horticultural Society – Richard Salisbury, Charles Greville, and John Wedgwood (son of Josiah) – were students at Edinburgh University at the time of Hope’s tenure. These Englishmen did not envisage a career in medicine, but most of Hope’s Scottish students went on to serve as doctors with the army, navy or East India Company and some of these found careers as part-time or full-time botanists playing crucial roles in Britain’s growing empire. This was the start of a trend that would persist for more than a century.

Sir Joseph Banks

Joseph Banks had sailed round the world as a naturalist on the first voyage of son-of-a-Scot Captain James Cook (*HMS Endeavour*, 1768-71). He returned to instant fame, became around 1773 the second unofficial Director of the Kew botanic garden (then in the ownership of “farmer” George III) and went on to serve as President of the Royal Society for 42 years. At a time of great imperial expansion he was the British government’s chief scientific advisor.

Understanding the extent to which the Empire was built on plants of economic importance (tobacco, cotton, sugar, etc.) Banks envisaged a network of botanic gardens all around the Empire with Kew at its centre and plants passing back and forth between them (the “hub and spokes” structure as it was called). He was interested in plants of all kinds out of scientific curiosity. However, of special interest to him were exotic ornamental plants, for which there was a burgeoning demand in the 18th and 19th centuries, and what Banks called “useful vegetables” that might be grown as cash crops on plantations in suitable parts of the Empire. He helped lay the foundations of the hub and spokes system, and under his successors at Kew – William Hooker, Joseph Hooker and William Thisleton-Dyer – the system, albeit of an informal nature, reached its zenith. As well as acting as an entrepôt for the interchange of plants throughout the Empire, Kew’s sphere of influence came to include the dissemination of botanical knowledge and advice, and the nomination of individuals for such positions as naval plant collectors and managers of colonial botanic gardens.^v

Banks and his successors often made use of gardeners as plant collectors and some of these went on to become managers of colonial botanic gardens. Excellent though these gardeners were – some of the all-time greatest plant collectors, such as Francis Masson, David Douglas and Robert Fortune, had been gardeners – a very different breed of professional botanist had also arisen – scientifically trained doctors who were sufficiently intrepid to go anywhere in the world, including such perilous war zones as the Caribbean and the Indian subcontinent. Fortuitously, these doctors were currently being churned out in large numbers by the Scottish universities, especially Edinburgh, in order to meet the medical needs of an ever expanding empire.

These botanist physicians that were such a feature of the Banksian and Victorian eras had their precursors. **(Sir) Hans Sloane**, an Ulster Scot, had collected many plants new to science in Jamaica while employed as the private physician of the English Governor (1687-89). He went on to become President of the Royal Society and ushered in the golden age of the Chelsea Physic Garden. Scotsman **James Cuninghame**, a surgeon with the East India Company, was the first European to collect plants in China (1698-1709) including the conifer *Cunninghamia*. He was elected a Fellow of the Royal Society. Another Scot, **William Houston**, was a ship's surgeon with the ill-fated South Sea Company and collected plants in the Caribbean and the Americas (1730-33). These plants were dispatched to Philip Miller at the Chelsea Physic Garden. **Isaac Lawson**, who was a pupil of the great Dutch botanist Herman Boerhaave and subsequently became an army doctor, deserves a mention for financing the first publication of Linnaeus' ground-breaking *Systema naturae* in 1735. Scottish physician **William Pitcairn** and Edinburgh-trained English physician, **John Fothergill**, both had renowned private botanic gardens – at Islington and Upton respectively. In 1775 they jointly employed Scottish gardener William Blaikie as probably the first professional collector of Alpine plants. Finally, **James Lind**, a cousin of the advocate of citrus juice, accompanied Joseph Banks as surgeon/naturalist on the latter's scientific exploration of Iceland in 1772.

Naval Surgeons

Naval surgeon is a misleading title since these officers served also as general physicians on board ship. The rank was a high one - generally only the captain was paid more than a full surgeon. At this time surgeons were more often than not Scots. The Scots novelist Tobias Smollet, himself a former naval surgeon, had one of his characters, Roderick Random, present himself for examination in London as a prospective ship's surgeon, only to be met with the wry comment: "We have scarce any other countrymen to examine here – you Scotchmen have overspread us of late as the locusts did Egypt!"^{vi} Most of the important voyages of exploration and other scientific expeditions in this period had Scottish or Scottish trained surgeons on board, and, because of their training, these doubled as botanists or naturalists (the latter collected animals as well as plants and were paid more). "The mental process is the same at the bed-side of the patient and in the cabinet of the naturalist ... correct observation leading to correct diagnosis [i.e. identification]" said the Manx naturalist **Edward Forbes** (Edinburgh trained)^{vii}. Kew usually got a share of their plant collections. From 1854, in fact, it became a requirement that Kew was the first destination for all collections made at government expense: for the Royal Navy this had been unofficially so since the early 1840's^{viii}. "These exploratory voyages of the 18th and 19th centuries, to which naturalists were attached ... constitute an almost unrecognised government subsidy to natural science as important as any more formal government subsidy to science in our own time."^{ix} The following are Scots unless otherwise stated.

William Anderson, a correspondent of Professor Hope and Joseph Banks, was surgeon on Captain Cook's second and third voyages (*HMS Resolution*, 1772-75, 1776-78). Banks had hoped to join the former voyage but could not get the facilities he wanted. The latter voyage, on which Anderson was the official naturalist, was primarily a search for a north-west passage between the Pacific and the Atlantic. Both Anderson and Cook died on that voyage – Anderson of tuberculosis and Cook killed

by unfriendly Hawaiians. As well as collecting plants, Anderson made important studies of Pacific island languages and culture.

Archibald Menzies, was a Professor Hope pupil, who served as surgeon/naturalist on Captain Vancouver's around-the-world voyage and survey of the Pacific Coast of North America (*HMS Discovery*, 1791-94). This was following Menzies' participation in the American War of Independence, including a British victory against the French in the Battle of the Saints (1782). He obtained seed of the Monkey Puzzle tree (*Araucaria araucana*) – a favourite ornamental of the Victorians – allegedly by picking them out of a dessert he had been offered. He sent back a plethora of other new plant species to Kew and Edinburgh, and described many more. The Hawaiians called him “the red-faced man who cut off the limbs of men and gathered grass”! Menzies' botanical work, his animal and ethnological collections and meteorological observations make this one of the important early scientific expeditions^x.

Robert Brown, a pupil of Professor Hope's successor Daniel Rutherford, served as naturalist/surgeon on Captain Flinders' expedition around Australia (*HMS Investigator*, 1801-05). He sent back a huge haul of seeds, most of them new to science, prompting Banks to write: “[the seeds] are all sown in Kew Gardens, and much hope is built on their success, which will create a new epoch in the prosperity of that magnificent establishment”^{xi}. Edinburgh also received some of his plants. In a career spanning sixty years Brown became the most eminent British botanist of his day. He became the Librarian (later President) of the Linnaean Society and championed the more natural system of plant classification that eventually replaced the Linnaean. He was also curator of Joseph Banks' incomparable herbarium collection (later the British Museum herbarium): Brown generally received dried plant specimens from collectors while Kew at that time received seeds, bulbs and any living plants^{xii}. He also advanced the use of microscopy in botany: he named the cell nucleus and was the first to observe the phenomenon that became known as “Brownian Motion”.

William “Gulielmo” Jameson, Edinburgh trained, joined a whaling ship as surgeon on a voyage to Baffin Bay in the Arctic in 1818 (the same year as John Ross's Royal Navy expedition to the same region). Jameson botanised on the local islands. On a later voyage to Peru, he decided to stay in that part of the world. He became Professor of Botany at Quito, Ecuador, and in 1846 was chosen to compile a flora of that country. Jameson corresponded with both William and Joseph Hooker, and plants collected from all over South America were sent to Kew.

(Sir) John Richardson, naturalist/surgeon on Sir John Franklin's first two Arctic expeditions (1819-22, 1825-27). He returned from the first to face accusations of murder and cannibalism, but the matter was not pursued. His many finds were the basis for the *Flora Boreali-Americana* and the *Fauna Boreali-Americana*, the former compiled by William Hooker at Glasgow. When Franklin's third expedition went missing, Richardson joined another eminent medically trained Scots Arctic explorer, **John Rae**, in an unsuccessful rescue attempt. Rae was noted for his ability to live off the land. Richardson excelled in several fields: a 20th century tribute to him stated that “it is not every day that we meet in one person surgeon, physician, sailor, soldier, administrator, explorer, naturalist, author and scholar.”^{xiii}

John Scouler, naturalist/surgeon on a Hudson Bay Company ship bound for the north-west coast of America via the Galapagos (*William & Ann*, 1824-26). His

colleague was the great Scottish plant collector David Douglas who had been recruited to collect on behalf of the (Royal) Horticultural Society (both were protégés of William Hooker – see below). They were the first naturalists to explore the Oregon region: Douglas stayed behind to complete what would be his greatest haul of new plants. Scouler later collected plants in South Africa and the Indian Ocean and went on to have a distinguished academic career in Scotland and Ireland.

Alexander Collie, naturalist/surgeon on the voyage of *HMS Blossom*, captained by Frederick Beechey (1825-28), collected plants in such diverse places as Africa, South America, California and Taiwan. Although he was subordinate to an ailing English surgeon, it was acknowledged by William Hooker that Collie had done most of the work (Hooker had sponsored Collie's membership of the Linnaean Society and later worked on his plant collection). Collie subsequently settled in Western Australia where, as well as collecting more plants, he became one of the important early explorers of that region.^{xiv}

Charles Darwin was an Englishman who functioned only as a naturalist, not a surgeon, on the *HMS Beagle* expedition (1831-36), but his two years at Edinburgh University Medical School were the only formal scientific training he received. He was also introduced to Lamarckian evolutionary theory there – by his mentor, Robert Grant, a zoologist who would become the first Professor of Comparative Anatomy in Britain^{xv}. Being too squeamish to dissect corpses or amputate limbs, Darwin did not complete the course (unlike his father Robert and grandfather Erasmus, the eminent natural philosopher, who were both practising doctors trained at Edinburgh University). Kew received plants from the *Beagle* expedition.

Andrew Sinclair served as naturalist/surgeon with Richard Brinsley Hinds on Sir Edward Belcher's survey of the Pacific coast of South America (*HMS Sulphur*, 1834-37). He later collected plants in Central America, Brazil, Australia and New Zealand, which he sent to Kew. His final post, before dying in a drowning accident, was colonial secretary in New Zealand under Vice-Admiral Robert Fitzroy (formerly Captain of *HMS Beagle*).

David Lyall and **(Sir) Joseph Hooker** (the latter an Englishman educated at Glasgow High School and Glasgow University Medical School) on Scotsman Sir James Clark Ross's Antarctic expedition (*HMS Erebus & HMS Terror*, 1839-42). The two surgeons collected many new land and sea plants, notably cryptogams (lichens, mosses, algae, etc.) Lyall subsequently served as naturalist/surgeon on Captain Stokes' exploration around New Zealand (*HMS Acheron*, 1847-51), then on one of numerous searches for Sir John Franklin, then in the Crimean War (he was present at the bombardment of the mighty fortress of Sveaborg) and finally (c.1858) on a survey of the Canada-USA border. "Back home again, and awash with plants, Lyall enjoyed a few happy years completing his report at Kew."^{xvi} Despite the plethora of plants that he collected from around the world (6,700 specimens), he is largely overlooked. Hooker, on the other hand, went on to become one of the most celebrated botanists of his day (see below) and an important collaborator with Charles Darwin.

Thomas Edmonston was a Shetlander and a remarkably precocious botanist. At the age of fifteen he contributed material to the *Annals & Magazine of Natural History*, and after his medical training at Edinburgh he was offered, at the age of nineteen, a professorship in Glasgow. However, he first elected to serve as naturalist on *HMS Herald* (1845-46) exploring the Pacific and the coast of California along with two

assistant botanists from Kew Gardens. Tragically, less than a year into the voyage, Edmonston was killed by the accidental discharge of a rifle.

John Macgillivray and **T.H. Huxley**: MacGillivray, like Darwin, did not complete his medical training at Edinburgh. He served as a naturalist on *HMS Fly* (1842-46) surveying the south-western Pacific and the Great Barrier Reef; on *HMS Rattlesnake* (1846-50) off the north-eastern coast of Australia with the English naturalist/surgeon, and Darwin's future "bulldog", T.H. Huxley (London trained and subordinate to MacGillivray); and finally on *HMS Herald* (1852-56) around Fiji and the Pacific. After twelve years spent on cramped Royal Navy ships, MacGillivray descended into alcoholism and died in obscurity in Australia. "He is remembered for his integrity and diligence as a naturalist and collector, enduring uncomfortable, often dangerous, conditions to send back specimens on which other men made their reputations"^{xvii}.

Robert Oliver Cunningham interrupted an academic career to serve as naturalist on Captain Mayne's survey of the Magellan Straits and western Patagonia (*HMS Nassau*, 1866-69). He was appointed on the recommendation of Joseph Hooker and collected plants for Kew. He went on to have a successful academic career in Belfast.

(Sir) Charles Wyville Thomson and **(Sir) John Murray**, on the *HMS Challenger* expedition (1872-76), founded the science of oceanography. Thomson, though the son of an East India Company surgeon, did not practise as a doctor following his medical training at Edinburgh, but Murray did serve as a ship's surgeon. Prior to this expedition the ocean bed was very much *terra incognita*. By trawling and sounding all the major oceans other than the Indian, they discovered 4,700 new species of marine plant and animal and made a host of important scientific measurements. Murray immodestly but fairly described the consequent report as "the greatest advance in the knowledge of our planet since the celebrated discoveries of the 15th and 16th centuries"^{xviii}.

William Speirs Bruce studied medicine at Edinburgh and in his spare time worked as a volunteer on some of the *Challenger* collection. Inspired by this, he became a naturalist/surgeon on a whaling expedition in the Antarctic, and then participated in various expeditions in the Arctic regions before organising his own expedition to the Antarctic (*Scotia* 1902-04) with a personnel that was almost exclusively Scottish. This was a huge success. New coastline was discovered, the first weather station in the Antarctic was established (which is said to have "laid the foundation of modern climate change studies"^{xix}) and their extensive scientific collections, which included plant specimens, provided the basis for the Scottish Oceanographic Institute in Edinburgh. Bruce kept up a correspondence with the aging Joseph Hooker – himself a former Antarctic explorer.

Land Explorers

"A competent and capable botanist may do more to open up the country than a dozen mining engineers, for the discovery of a single plant useful to commerce may be of greater value to Africa than many gold mines" [Pall Mall Gazette, 1891].^{xx} "I have heard the celebrated traveller Mungo Park ... rather gave the preference to travelling as a discoverer in Africa than to wandering by night and day the wilds of his native land in the capacity of a country medical practitioner" [Sir Walter Scott, 1827].^{xxi}

Some of the most important explorers of Africa and elsewhere were Scots botanist physicians. In the middle of the 19th century, one of the great movers and shakers in the field of imperial science, along with William and Joseph Hooker, was the eminent Scots geologist, Sir Roderick Murchison. As President, and one of the founders, of the Royal Geographical Society and concurrently Director-General of the Geological Survey, he organised many scientific expeditions around the world, and “while his countrymen [i.e. Scots] played prominent roles in imperial administration, defence, medicine and science, Murchison acted as an important metropolitan connection in their network for mutual advancement.”^{xxii} All of the following, except Joseph Hooker, Augustine Henry and Arthur Kerr, were Scots.

Mungo Park, “the jewel in the crown of the African Association”, was an able botanist. He collected plants for Joseph Banks on his first expedition to Sumatra in 1793. Edinburgh also received some plants. His two subsequent explorations of the Niger region (1795-97, 1805-06 – he died on the latter following an attack by natives) opened up a huge area of West Africa for trade and colonisation. His autobiographical *Travels* was an instant bestseller and remains a classic of the genre.

Dugald Carmichael: After qualifying in medicine at Edinburgh University, Carmichael’s first position was as an assistant surgeon with the Argyllshire Fencibles. His colleague was none other than the young Robert Brown, who would go on to become the leading British botanist of his day. Carmichael, on the other hand, became a full time military surgeon, seeing action in 1805 against the Dutch in South Africa. In his travels around the world with his regiment he found time to collect plants in Tristan da Cunha, Reunion, Mauritius and India. His main interest was in fungi and cryptogams, especially algae. A pioneer in this field, he has been called the “father of marine botany”. Back in Scotland as a civilian, he published his research, which was later acknowledged by Darwin, and he was elected a Fellow of the Linnaean Society. He became a friend of William Hooker (who was Professor of Botany at Glasgow University at that time) and botanised with the young Joseph Hooker.^{xxiii}

William Jack was the son of the Principal of Aberdeen University. He served as an army surgeon in India and saw action in the Anglo-Nepal War in 1814-15 (this war resulted in the creation of the British Gurkhas). He corresponded with Nathaniel Wallich at Calcutta Botanic Garden and in 1818 he accompanied Sir Stamford Raffles on an expedition to Sumatra. He collected plants in India and Malaya as well as Sumatra (sent to Kew and Edinburgh) and compiled a flora of Malayan plants before his untimely death from malaria at the age of twenty-seven. (N.B. Another gifted medically trained polymath, **John Leyden**, died from malaria during Raffles’ invasion of Java in 1811.)

Francis Buchanan-Hamilton: After graduating from Edinburgh University he joined the East India Company as a medical officer in the hope of becoming a botanist, but he had to serve ten years as a naval surgeon before he got a land posting in Bengal. He accompanied Capt. Michael Symes on the latter’s diplomatic mission to Burma (1795); he was appointed by Lord Wellesley to survey the newly conquered Kingdom of Mysore (c. 1800); he accompanied Capt. William Knox on his mission to Katmandu (1802-03); and in 1807 he was appointed to carry out a topical survey of Bengal, which occupied the remainder of his time in India. In each of these activities he collected a huge herbarium of plants, earning himself the title “the father of Nepalese botany”. His surveys, additionally, included social, economic and archaeological information. In 1814 he achieved his long-time ambition to become

Superintendent of Calcutta Botanic Garden, but by then he was ready to retire. He spent the rest of his days in Scotland, writing pieces on natural history. He was a fellow of the Royal Society and, following his brother's death, he established his claim as chief of clan Buchanan.

John Crawford and George Finlayson: Crawford was an Edinburgh trained army surgeon who rose to become a distinguished colonial administrator in South-East Asia. He led two diplomatic missions – the first to what is now Thailand and Viet-Nam (1821-22) and the second to the Burmese court (1826-27). On the former he was accompanied by another able Scots army surgeon, George Finlayson, in the capacity of naturalist/surgeon. Many botanical and geological specimens were collected in the course of these missions. Perhaps Crawford's most famous discovery was the strikingly beautiful flowering tree, *Amherstia nobilis* (Pride of Burma) – just one species among the 18,000 botanical specimens collected on the Burma mission. Apart from his geological findings, Crawford is noted for his writings on the languages, geography and ethnology of South-East Asia. (N.B. On earlier occasions, Scots physicians had been employed as naturalists on other historic diplomatic missions: **Alexander Hamilton** on fellow Scot George Bogle's mission to Tibet and Bhutan, 1773-75; **Robert Saunders** on Samuel Turner's mission to Lhasa, 1783-84; and **Hugh Gillan** on Lord Macartney's famous mission to China, 1792-94 – although, in the latter case, most of the botanical work seems to have been left to two gardeners^{xxiv}.)

Robert Lyall, early in his medical career, showed a talent for botany: he had a paper read at the Linnaean society in 1811 and had six others published elsewhere. In 1815, like a number of Scottish physicians, he sought his fortune in Russia, but eight years later he had to leave the country hurriedly after publishing the first of several books and articles criticising aspects of Russian Society. However, he delivered a large number of Russian plant seeds to Kew. In 1826 he was appointed the resident British agent in Madagascar, but soon found himself banished as a suspected sorcerer after being discovered collecting plants and reptiles! The plants he collected in Madagascar, Mauritius and St. Helena were dispatched to Kew and other botanical institutions. The final episode in his tragi-comical life was his death in 1831 from malarial fever – a disease he had contracted during his brief stay in Madagascar. A member of the Linnaean and Royal Asiatic Societies, he had fourteen Madagascan plants named after him.

Walter Oudney served as a naval surgeon in the East Indies. He had hopes of an academic career, but instead, on the recommendation of an Edinburgh University botanist, he agreed to serve as naturalist in the company of Major Denham and Lieutenant Clapperton on what proved to be an important expedition in search of the upper reaches of the Niger (1821-25). They were the first Europeans to make a north-south crossing of the Sahara and they greatly advanced the state of geographical knowledge of sub-Saharan Africa. Oudney collected hundreds of natural history specimens before his untimely death from malaria in 1824.

William Tolmie, a pupil of William Hooker at Glasgow, was employed by the Hudson Bay Company on Hooker's recommendation. He travelled to the Pacific North West on the *Gannymede* in 1832. A polymath, he collected plants and animals and kept detailed notes. He was involved in the Canadian Geological Survey. In later life he held administrative posts and got involved in the politics of the region. His life-long interests were natural history and the study of Native American languages.

John Imray was not an explorer as such, but his four decades of botanical, agricultural and humanitarian work on the island of Dominica is worthy of note. He was sent by the British Colonial Office to Dominica as a government surgeon in 1832. During his lengthy tenure he introduced public health legislation, founded hospitals and alms-houses, and researched tropical diseases. In addition, he corresponded with Joseph Hooker, collected plants (Kew received some), contributed to the Flora of the British West Indies, created his own botanic garden, and initiated lime and Liberian coffee production on the island. He was also a fervent spokesman for small peasant farmers and emancipated slaves (the emancipation of slaves in British colonies took effect in 1834). His good work was continued by his successor, **Henry A. A. Nicholls**, an Aberdeen educated physician.^{xxv}

David Livingstone kept up a lengthy correspondence with William and Joseph Hooker and sent many “useful vegetables” and artefacts made from plants to Kew during his long sojourn in Africa (1841-52, 1852-56, 1858-64, 1866-73)^{xxvi}. The famous missionary was interested in economically important plants because he believed that the “two pioneers of civilisation – Christianity *and* commerce – should ever be inseparable”.^{xxvii} As an explorer he opened up and mapped a vast area of Central Africa, and, as a missionary he was a passionate opponent of slavery and an advocate of education, pointing the way towards a relatively more ethical style of colonisation (see also John Kirk below).

(Sir) Joseph Hooker (1848-51): see next section.

William Balfour Baikie also started out as a naval surgeon. He then became naturalist/surgeon, later leader, on two expeditions up the Niger by steam boat (1854-55, 1857-59). He proved the navigability of the river and, incidentally, the effectiveness of quinine in preventing malaria. Many dried specimens of plant were sent back to Kew. He later founded the city of Lokoja (Nigeria), built roads and studied African languages. Among his many writings was a natural history of his native Orkneys.

Peter Sutherland served as naval surgeon on the first of several unsuccessful searches for Sir John Franklin. Like many of the botanist physicians his skills were multidisciplinary. When he moved to South Africa it was his geological skills, and the support of Roderick Murchison, that earned him the post of Surveyor-General (1855-87) in the recently acquired British province of Natal. In the course of his travels in South Africa he collected many plants, which were sent to Kew.

(Sir) James Hector, another Murchison protégé, was naturalist/geologist/physician on Captain Palliser’s exploration of western Canada (1857-60). He later settled in New Zealand where he became that country’s leading scientist. Among his multitude of activities he founded and managed New Zealand’s first botanic garden (at Wellington). It was Murchison and William Hooker who jointly facilitated his election to the Royal Society.

(Sir) John Kirk, volunteered for service as a surgeon in the Crimean War in 1855 and was stationed in the Dardanelles. He spent his spare time studying the local flora. He was appointed botanist/physician on Livingstone’s second Zambezi expedition (1858-64). Livingstone wrote: “I take ... an economic botanist [Kirk] to give a full report of the vegetable productions – fibrous, gummy and medicinal substances

together with dye stuffs – everything which may be useful in commerce”^{xxviii}. Kirk too corresponded at length with both Hookers, and the plethora of plants he collected formed the basis of the *Flora of Tropical Africa*. He later became British Consul in Zanzibar and negotiated the ending of the slave trade in the region, thereby fulfilling one of Livingstone’s greatest aspirations. He continued to be interested in economically important plants: he fostered the copal and rubber industries in East Africa, in the latter case using a native African vine, Kirk’s Landolphia.

James E. T. Aitchison, an Indian born Scot, trained in medicine at Edinburgh University and joined the Bengal Medical Service. He subsequently became the British Commissioner to the strategically important region of Ladakh and accompanied General (Lord) Roberts throughout the Second Anglo-Afghanistan War (1878-80). This, from a British perspective, was considerably more successful than the First. He combined his military duties with botanical work, although he complained to Joseph Hooker during the war: “We go on to Allykke. I will try to do my best but fighting and botany do not amalgamate.” Nevertheless, in six years he collected c.10,000 specimens (c.800 species) in Afghanistan alone. He collected many more in India. His writings include various articles on the flora and fauna of the region and a Handbook of the Trade Products of Ladakh. In retirement he took up residence near Kew with a view to writing up a Flora based on his plant collections, but he died before he could carry out the project.^{xxix}

Henry Ogg Forbes, between 1878 and 1887, after plant collecting in Portugal, explored and collected plants in the Moluccas and New Guinea, the latter on behalf of the Royal Geographical Society. Both Edinburgh and Kew received plants from Forbes, but because of friction at the time between Kew Gardens and the Natural History Museum, the latter did not share the New Guinea plants with Kew^{xxx}.

Augustine Henry, born in Scotland of Irish parents, studied medicine at Belfast and Edinburgh. In 1882 he took up a post in Shanghai with the Chinese Imperial Maritime Customs Service, which was an arm of the Chinese government but which was staffed at senior levels by mainly British personnel. He became a noted Sinologist and achieved, remarkably, the rank of Mandarin. In 1884 he began collecting plants as a hobby and he wrote to Kew offering to collect specimens for them. Following the Opium Wars, the Yangtze River had been opened up to foreigners, allowing access to vast areas previously unexplored by Westerners. Henry became one of the most important collectors of plants in Central China, sending 15,000 plants, seeds and dried specimens to Kew, including 500 new species and 25 new genera. He spent 1901/02 at Kew sorting his plant collection.

Arthur Kerr, born in Ireland and trained in medicine in Dublin, pioneered plant collecting in Siam (Thailand) where he worked, initially as a medical officer, from 1902. He did this on behalf of William G. Craib, Professor of Botany at Aberdeen University, who used them to compile his *Florae Siamensis Enumeratio*. After he died, Kerr’s personal herbarium collection of 21,500 specimens was received by the British Museum “A century later [his collections] are still among the best materials available to describe the plants [of Thailand] and map their distributions” [Royal Botanic Gardens Kew website].

Sir Joseph Hooker & Friends

Joseph Hooker's father Sir William, though English, was Professor of Botany at Glasgow University Medical School for 20 years (i.e. throughout the period of Kew's temporary decline following Joseph Banks' death). Murchison said of him: "Numbers [of his students] entered the army, navy and Indian Medical Service or sought other positions in foreign countries. To all Sir William was ready to lend a helping hand, guiding their studies when pupils, and furthering their interests afterwards, well satisfied to be repaid by a share of their [plant] collections"^{xxxii}. Any dried plant specimens provided by these former medical students would have been added to Hooker's private herbarium, which eventually grew to surpass even Robert Brown's at the British Museum. In 1841, Sir William became the first official Director of the Royal Botanic Garden at Kew after Queen Victoria had donated it to the nation. He brought his collection of dried plants with him from Glasgow and this became the foundation of Kew's first on-site herbarium, in Hunter House, in 1852.^{xxxiii}

Under Hooker's Directorship at Kew, the original small botanic garden expanded to absorb around 100 hectares of the surrounding royal pleasure grounds, a magnificent new Palm House was built and a Temperate House partly built. The funding that Sir William and his successors received from the government was largely predicated on Kew's usefulness to British commerce and Empire.^{xxxiii} Joseph described his father as "the projector and able assistant of those efforts on the part of our Home and Colonial Governments that have led to the formation of botanical and horticultural establishments in so many of our colonies, in India and in our foreign possessions, [and] as the liberal and disinterested patron of private scientific enterprise everywhere, especially among the officers of the army, navy and civil services."^{xxxiv}

As mentioned above, Joseph had been a student at Glasgow University Medical School and had been botanist/surgeon on Captain Ross's Antarctic expedition. His next plant collecting expedition, in 1848, was on land – in the Himalayan region of India. This expedition was on behalf of Kew and was facilitated by the energetic Scots Governor-General of India, Lord Dalhousie^{xxxv}. Hooker's first companion on this expedition was **Archibald Campbell**, a Scottish medical doctor who had become the British agent in Darjeeling. While botanising in Sikkim, which was an independent state, they were both arrested by a Sikkimese government official and Campbell was badly beaten up. Although they were subsequently released, the British used this as an excuse to annex a large part of Sikkim around the district of Darjeeling. Campbell experimented with tea planting there, demonstrating that conditions were ideal for producing the finest tea^{xxxvi}. The rest, as they say, is history.

Hooker's next companion was **Thomas Thomson**, an old school and university friend of Hooker from his Glasgow days (another fellow pupil had been the future Lord Kelvin, the great physicist). Thomson had become an army surgeon and had been part of the British force that occupied Afghanistan in 1839-42. He was one of the few who came out alive following wholesale massacres of the occupying force. Hooker and Thomson collected many new plants in the eastern Himalayas and Thomson went on to become Superintendent of the Calcutta Botanic Garden.

The 25 new species of Rhododendron brought back to Kew from these Himalayan expeditions created a Rhododendron craze in Victorian Britain. More significantly, Hooker's growing knowledge of the geographical distribution of plant species, based on his own and others' collections was to be of indispensable use to his friend Darwin.

East India Company Surgeons & Botanic Garden Superintendents

“We continue to have a false idea of the Industrial Revolution, and to recognise its meaning only in coal, pig iron, factories and in the remade landscapes and demography of northern England ... But the rise in cities and the Industrial Revolution in the West was inseparably connected to plantation farming, ranching and forestry economies in every other human community. Machines did not run merely on coal: they consumed cotton, wool, dyes, vegetable oils and the strength of the peripheral populations which provided these. Wheat, beef, tea and sugar allowed operatives to meet the brutal pace of work. Shiploads of timber and rubber went to absorb shocks, and indeed electricity, which steel would not have contained. Without plant fibres twined into rope, woven into sacking, and crushed into paper, no administration and commerce could take place, and a whole civilization which depended on commodities being moved and recorded would have collapsed. Only within the lifetime of our parents did the synthetic magic of organic chemists limit industry’s utter dependence on plants and on agricultural labour.” [Drayton, 2000]

Between 1784 and 1858 British India was governed by the East India Company on behalf of the British government. Sir Walter Scott said that the East India Company was “the corn chest for Scotland where we poor gentry must send our youngest sons as we send our black cattle to the south.”^{xxxvii} And not just the gentry. Botanic gardens were springing up all over the Empire (in the Victorian era 80% of all colonial botanic gardens in the world were British^{xxxviii}), the most prestigious ones being in the Indian subcontinent. With Kew as the central scientific authority, a huge amount of plant collecting, flora compilation, and experimenting with the propagation and cultivation of plants was carried out in and around these gardens. They were the first to receive economically important plants from often distant parts of the world and their task was to determine whether they were suitable for growing in the soil and climatic conditions in their area. This process was known as “plant transfer”.

In this period the notorious breadfruit, intended to feed slaves, was transferred from the South Pacific to St. Vincent in the West Indies (by Captain Bligh on his second attempt – his first attempt was on *HMS Bounty*!); tea was transferred from China to India and Africa; rubber from South America to Malaya; mahogany from the West Indies to India; cocoa from the West Indies to Africa; the oil palm from Africa to Malaya; quinine from South America to India (this, as a treatment for malaria, facilitated British exploration and colonisation of the tropics^{xxxix}); and the American pineapple to all the tropical regions of the Empire. Many more such transfers continued up to the end of the Empire and this has had huge economic consequences around the world. Ray Desmond lists some of the useful plants, native and exotic, handled by just one botanic garden superintendent in late 18th/early 19th century India (William Roxburgh – see below): black pepper, nutmeg, cinnamon, clove, allspice, sugar-cane, coffee, breadfruit, olive, teak, mahogany, mulberry (for silk), flax, jute, sisal, various hems, indigo and prickly pear (for cochineal dye)^{xl}.

Medical Doctors were now routinely being appointed as superintendents of botanic gardens and to other senior posts in the colonies. The sheer number of Scottish doctors in such posts from the late 18th to the late 19th century tells the story. Most of the following have entries in the Oxford Dictionary of National Biography:-

Canton (East India Company): brothers **John and Alexander Duncan** and **John Livingstone**, 1782-1829 (plant collecting only, notably for Joseph Banks)^{xli}.

St Vincent (the first imperial botanic garden, founded by the Scots governor, Gen. Robert Melville in 1765): **George Young**^{xlii}, **Alexander Anderson**, **William Lochhead**.

Jamaica: **William Wright**, **Thomas Clarke**^{xliii}, **Thomas Dancer**, **James Macfadyen**. (Dancer and two Kew gardeners had accompanied Cpt. Bligh when the latter delivered the above-mentioned breadfruit plants to Alexander Anderson on St. Vincent in 1793.)

Madras: **William Roxburgh** (founder of botanic garden, c.1781), **Patrick Russell**, **James Anderson**, **Robert Wight**, **Edward Balfour**, **Hugh F.C. Cleghorn**, **George Bidie**, **Andrew Berry**^{xliiv}.

Saharanpur: **George Govan**, **John Forbes Royle** (Scottish mother and Scottish education^{xlv}, subsequently Professor of Materia Medica at Kings College, London), **Hugh Falconer**, **William Jameson**, **John Lindsay Stewart**, **Sir George King**.

Calcutta: (botanic garden founded by Scotsman Col. Robert Kyd, 1787) **John Fleming**, William Roxburgh (transferred from Madras), Francis Buchanan-Hamilton (see Land Explorers above: the latter three were Professor Hope pupils), **John McClelland** (an Ulster Scot^{xlvi}), Hugh Falconer (transferred from Saharanpur), Thomas Thomson, brothers **Thomas and John Anderson**, Sir George King (also from Saharanpur), **Sir David Prain**, **Andrew Thomas Gage**, **Sir George Watt**, **Arthur Barclay** (mycologist).

Bombay (botanic garden founded by the Scots governor, Sir John Malcolm, 1828): **Alexander Gibson**, **Nicol Dalzell**, **John Forbes Watson** (subsequently Director of the India Museum, London).

Dacca: **James Kerr** (EIC surgeon/botanist).

Punjab: John Lindsay Stewart (Conservator of Forests).

Burma: John McClelland (Superintendent of Forests).

Ceylon: **George Gardner** (previously a plant collector in Brazil).

Penang: **William Hunter**

Singapore: **William Montgomerie**

Wellington (NZ): Sir James Hector (see above under Land Explorers).

N.B. There, were, of course, botanic gardens in other parts of the Empire:-

Ontario: **George Lawson**, Edinburgh educated, founded the Botanical Society of Canada at Kingston, Ontario.

Sydney, Melbourne, Brisbane: these gardens were managed at this time by gardeners, mostly Scots who had been trained at Edinburgh Botanic Garden and/or Kew Gardens.

British Africa: ditto.^{xlvi}

The historian of Indian botany, Isaac Burkill, assessing the various categories of botanist who had operated in the sub-continent, concluded that “the surgeons did the most for the advancement of the subject” (he also acknowledged the importance of Edinburgh University and its succession of notable botany professors: John Hope, Robert Graham and John Hutton Balfour)^{xlvi}. Calcutta, the capital of British India from 1772 to 1912 – India being the “Jewel in the Crown” of the British Empire – was a particular stronghold of the Scots surgeons. Joseph Hooker said of its botanic garden, which was known as the “Kew of India”, that it had “contributed more useful and ornamental tropical plants to the public and private gardens of the world than any other establishment before or since”^{xlvi}. Calcutta also had a Medical School where several of the surgeons served as Professors of Botany, an Indian Museum that was curated for 21 years by another surgeon (John Anderson), and a *Journal of Natural History* founded and edited by yet another (McClelland).

Of the Calcutta botanists listed above, William Roxburgh, who is recognised as the “father of Indian botany”, initiated the *Flora Indica*, was one of the most prolific suppliers of plants to Kew¹, and was an early environmentalist (see below); Hugh Falconer received Robert Fortune’s tea plants from China as part of the momentous tea transfer, played an important part in conserving teak forests in Burma, and, from studies of animal fossils, was the first to suggest the evolutionary theory that is today known as “punctuated equilibrium” (a century before Stephen Jay Gould!); Sir George King, following two disastrous cyclones, re-built the Botanic Garden to an even higher standard than before, was the first Director of the Botanical Survey of India (still in existence), and pioneered affordable quinine for the masses; and Sir George Watt compiled a massive ten-volume *Dictionary of the Commercial Products of India* that is probably the greatest compilation of commercial plants in India ever produced.

It is an indication of the prestige of the Calcutta Botanic Garden, and of Scots botanists, that its tenth Scottish manager (by then the post had been upgraded to Director), Sir David Prain, became the first official Director of the Royal Botanic Gardens Kew who was not a member of the Hooker family. This was in 1905 following 20 years’ service in India. He also became President of the Linnaean Society. Prain was the last of the major botanist physicians: by his time botany had become an academic subject in its own right and a career independent of medicine.

The Conservationists

According to his entry in the Oxford Dictionary of National Biography, Alexander Anderson (who had served as an army surgeon in the American War of Independence before becoming the Superintendent of the St. Vincent Botanic Garden in 1785) “was the first of a long line of Scottish colonial experts concerned with the relationships between deforestation, climate change, and the extinction of plants and animals as well as indigenous people”^{li}. This early example of environmentalism would

culminate in what has been called “Scottish Hippocratic responses to ecological crises”^{liii} (Scottish doctors were trained in the environmental causes of disease).

According to the Cambridge historian Richard Grove: “In India, William Roxburgh [Calcutta], Edward Balfour [Madras], Alexander Gibson [Bombay] and Hugh [F. C.] Cleghorn [Madras], all Scottish medical scientists, wrote alarmist narratives relating deforestation to the danger of climate change ... The writings of Edward Balfour and Hugh Cleghorn in the late 1840’s in particular illustrate the extent of the permeation of a global environmental consciousness and could be said to constitute some of the first writings on world environmental history.”^{liii} Edward Balfour was the nephew of Joseph Hume, the Scottish leader of the Radicals in the House of Commons and the cousin of Allan Octavian Hume. The latter was medically trained and a gifted naturalist and was the leading founder of the Indian National Congress – the political party that would eventually achieve Indian independence. Balfour and the rest of his colleagues in India espoused such radical causes as social reform, feminism (Madras Medical College was opened to women in 1875) and even outright anti-imperialism, as well as environmental issues^{liv}.

With the support of both Hookers, they mounted a campaign that culminated in the creation in 1861 of an all-India Forest Department under Hugh Cleghorn. Lord Dalhousie, during his governorship, initiated a vigorous conservation policy, very much against the wishes of the private capitalists, based on controlled felling, re-planting and the provision of tree nurseries. Grove sees this achievement as an important development in the early history of the conservation movement that provided a model for later schemes throughout the world from the USA to Australia^{lv}.

Conclusion

There were English, French, German, Dutch, Swedish, etc. botanist physicians, but in terms of sheer numbers at least, the Scots and Scots trained ones must surely take the prize. In the century or so during which the botanist physicians flourished, botany became a respected professional career rather than the domain of gardeners and amateurs, plant collecting and cataloguing reached its zenith, Kew became arguably the most prestigious botanic garden in the world at the centre of an international network of co-operating gardens, and the inter-continental transfer of economically important plants transformed the world economy for ever. The early example of practical conservation mentioned above was a foreshadowing of Kew’s current role in the world. Today the movement of plants between countries is highly regulated, and Kew is actively involved in this regulation. The promotion of sustainable agriculture and the conservation of plants and habitats throughout the world, rather than serving the needs of the British Empire, has become Kew’s principle role. The following is a balanced modern assessment of the botanist physicians (by botanist Henry Noltie of the Royal Botanic Garden Edinburgh):-

“The great period of establishment [of Indian botanic gardens] was from the late 18th to the late 19th centuries, initially by the East India Company. This arose as a result of two major factors: as part of the process of economic/imperialistic expansion, and in the pursuit of scientific knowledge for its own sake in the wake of the European Enlightenment. These factors, driven by figures such as Sir Joseph Banks and Sir William Hooker in England, cannot be separated and there has been much debate over their relative importance and the use of science as an instrument of imperialist control.

... That from the start the running of these establishments was entrusted to men with a scientific training – the Company's surgeons, who had studied botany as part of their medical courses, notably at Scottish universities – led to a diversity of motivation and potential conflicts of interest with their employers. The Company's agenda was to a large extent, though not quite exclusively, commercial – investigating indigenous plants for potential exploitation, and introducing exotic species to be grown either as cash crops or as sources of food, medicine, dyestuffs, etc. The surgeons, while supporting the aims of their paymasters, often had additional motives ranging from the philanthropic, such as investigating local and imported crops that might withstand droughts and alleviate famine, to taxonomic investigation of the Indian flora (not merely its economic species), using gardens to raise trees for re-forestation schemes, and as a base for wider scientific investigations such as the climatic effects of deforestation.”^{lvi}

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ⁱ Carter, 1988.

ⁱⁱ Statistic quoted in E. Wills, *Scottish firsts*, 2002.

ⁱⁱⁱ Harvie, 2002.

^{iv} Noltie, 2011.

^v Brockway, 1979.

^{vi} Smollett, *The adventures of Roderick Random*, 1748.

^{vii} Forbes 1843 quoted in J. Endersby, *Imperial nature*, 2008.

^{viii} Drayton, 2000.

^{ix} Brockway, 1979.

^x McCarthy, 2010.

^{xi} Desmond, 1995.

^{xii} Desmond, 1995.

^{xiii} *ODNB* entry for Richardson.

^{xiv} Friends of Cruikshank Botanic Garden, *Newsletter*, February 2011.

^{xv} Dempster

^{xvi} Lindsay, 2005.

^{xvii} *ODNB* entry for MacGillivray.

^{xviii} *Wikipedia* entry for “Challenger expedition”.

^{xix} *Wikipedia* entry for Bruce.

^{xx} *Pall Mall Gazette*, 23 March 1891.

^{xxi} Scott, *The surgeon's daughter*, 1827.

^{xxii} Stafford, 1989.

^{xxiii} Joseph Hooker, *A sketch of the life and labours of Sir William Jackson Hooker*, 1903.

^{xxiv} Alastair Lamb (ed.), *Bhutan and Tibet: Bogle and Hamilton Letters, Journals and Memoranda*, 2002. Macartney (ed. Cranmer-Byng), *An embassy to China*, 1962, Appendix.

^{xxv} Lennox Edward Honychurch, *The Dominica story: a history of the island*, 1995.

^{xxvi} <http://www.kew.org/news/kew-blogs/library-art-archives/david-livingstone-bicentenary.htm>

^{xxvii} Livingstone in lecture at Cambridge University, 4 December 1857, quoted in Niall Ferguson, *Empire*, 2003.

^{xxviii} Livingstone in letter to Adam Sedgwick and 8th Duke of Argyll, quoted in Niall Ferguson, *ibid*.

^{xxix} <http://www.kew.org/news/kew-blogs/library-art-archives/aitchison-and-asia.htm>.

^{xxx} Drayton, 2000.

^{xxxi} *Journal of the Royal Geographical Society*, vol. 36, 1866, p.128.

http://books.google.co.uk/books/about/The_Journal_of_the_Royal_Geographical_So.html?id=pEM9A_AAYAAJ&redir_esc=y

^{xxxii} Allan, 1967.

^{xxxiii} Drayton, 2000.

^{xxxiv} *Kew Report*, 1865.

^{xxxv} Desmond, 1999.

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- xxxvi Moxham, 2003.
- xxxvii Quoted in J. G. Lockhart, *Memoirs of the life of Sir Walter Scott, bart.*, 1837.
https://openlibrary.org/works/OL4903041W/Memoirs_of_the_life_of_Sir_Walter_Scott_bart
- xxxviii McCracken, 1997.
- xxxix Brockway, 1979.
- xl Desmond, 1992.
- xli Kilpatrick, 2007.
- xlii Hamilton, 2005. Probably related to Scots colonial administrator, Sir William Young, 1st baronet.
- xliii Hamilton, 2005.
- xliv Nephew of James Anderson and son of an Edinburgh engraver.
- xlvi Indian Medical Service records (British Library).
- xlvii Nationality established from Indian Medical Service records (British Library).
- xlviii For an article on Scottish gardeners as plant collectors, proprietors of specialist plant nurseries and managers of botanic gardens in the U.K. and around the British Empire, see: Ron McEwen, "The northern lads" in *Sibbaldia*, vol.11, 2013. <https://journals.rbge.org.uk/rbgesib/issue/view/5>
- xlix Burkill, 1965.
- l Quoted in M. Hoyles, *The story of gardening*, 1991.
- li Desmond, 1995.
- lii ODNB entry for Anderson.
<http://www.oxforddnb.com/view/article/465?docPos=2>
- liii Grove, 1995.
- liiii Grove, 2006.
- liv Grove, 1995.
- lv Grove, 1995.
- lvi "Indian Botanic Gardens" in P. Taylor (ed.), *Oxford companion to the garden*, 2006, pp. 234–6.

Sources:-

- Allan, Mea, *The Hookers of Kew, 1758-1911*, 1967
- Brockway, Lucille, *Science and colonial expansion: the role of the British royal botanic gardens*, 1979.
- Burkill, Isaac, *Chapters on the history of botany in India*, 1965.
- Carter, Harold B., *Sir Joseph Banks*, 1988.
- Dempster, W.J., *The illustrious Hunter and the Darwins*, 2005.
- Desmond, Ray, *Dictionary of British and Irish botanists and horticulturalists*, 1994.
- Desmond, Ray, *The European discovery of Indian flora*, 1992.
- Desmond, Ray, *The History of the Royal Botanic Gardens Kew*, 1995.
- Desmond, Ray, *Sir Joseph Dalton Hooker: Traveller and Plant Collector*, 1999.
- Drayton, Richard, *Nature's government: science, imperial Britain, and the improvement of the world*, 2000.
- Gascoigne, John, *Joseph Banks and the English Enlightenment*, 1994.
- Grove, Richard H., *Green imperialism: colonial expansion, tropical island paradises and the origins of environmentalism*, 1995.
- Grove, R. & Damodaran, V., "Imperialism, intellectual networks and environmental change" in *Economic & Political Weekly*, 2006.
<http://ricardo.ecn.wfu.edu/~cottrell/ope/archive/0610/att-0215/01-grove-damadaran.pt1.pdf>
- Hamilton, Douglas J., *Scotland, the Caribbean and the Atlantic world, 1750-1820*, 2005.
- Harvie, David I., *Limeys: the conquest of scurvy*, 2000.
- Kilpatrick, Jane, *Gifts from the Gardens of China*, 2007.
- Lindsay, Ann, *Seeds of blood and beauty: Scottish plant hunters*, 2005.
- McCarthy, James, *Monkey Puzzle man*, 2010.
- McCracken, Donal, *Gardens of Empire: botanical institutions of the Victorian British Empire*, 1997.
- Moxham, Roy, *Tea: addiction, exploitation and Empire*, 2003.
- Noltie, Henry, "Robert Wight and the illustration of Indian botany", Linnean Society, 2005
<http://www.linnean.org/Resources/LinneanSociety/Documents/Publications/Other/Special%20Issue%2006%20-%20Robert%20Wight%20and%20the%20Illustration%20of%20Indian%20Botany.pdf>
- Noltie, Henry, "Indian botanic gardens" in Taylor, P., *Oxford companion to the garden*, 2006.
- Noltie, Henry, *John Hope: Alan G. Morton's memoir of a Scottish botanist*, 2011.
- Robinson, T.F., *William Roxburgh: founding father of Indian botany*, 2008.
- Royal Botanic Gardens Kew archives
- Smith, Edward, *The life of Sir Joseph Banks*, 1911.
- Stafford, Robert A., *Scientist of Empire: Sir Roderick Murchison, scientific exploration and Victorian imperialism*, 1989