Edward Green Balfour (1813–1889) and his contributions to Indian agriculture and forestry

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Edward Balfour sparkles in the history of science of Madras Presidency as a polymath. He also features prominently in different roles as an administrator. Starting as an army surgeon, he retired as the chief administrator of Madras Medical Department. In whichever work outfit he was, Balfour achieved the best outcome; his enthusiasm towards development of science is imminent. His profundity in meticulously documenting his observations on diverse aspects of science, medicine, biology, agriculture, forestry, anthropology and astronomy is stunning.

Life and work in India

Edward Balfour, who retired as the Surgeon General of Madras Presidency, was born in Scotland on 6 September 1813. He qualified for the licentiate of the Royal College of Surgeons of Edinburgh in 1833. Balfour joined the medical department of the Indian army in 1834 and was commissioned as an Assistant Surgeon in 1836 and became a full Surgeon in 1852. He was the acting government agent at Chepauk (note 1) and the paymaster of the Carnatic stipends in 1850. During the early years of his service, Balfour mastered Hindustani and Persian (note 2). He was the Deputy Inspector-General of Hospitals during 1862–1870. He also served as the Deputy Surgeon-General in Burma, the Straits Settlements, and Andamans, in the ceded districts, in the Mysore division, and in the Hyderabad subsidiary force and Hyderabad contingent. While displaying a sharp administrative acumen in these roles, he maintained a sustained interest in science and in its promotion. He was the brain behind the establishment of the Madras Museum (1851), Madras Zoo (1855), and Mysore Museum (1866). Balfour became the Surgeon General of Madras Presidency in 1871, which he held until 1876. In this role, he impressed the Government of Madras on the need for qualified women doctors, since local social customs restricted women from receiving treatment from male doctors and attending public hospitals. Consequently, the Madras Medical College opened its gates to women[1] in 1875. The Balfour Memorial Gold Medal (1891) at the University of Madras with the sole object of encouraging women studying medicine commemorates Balfour (note 3). He returned to Britain in 1876. He died in London on 8 December 1889. His portrait by Walter Barnard in 1880 (Figure 1) was placed in the Government Central Museum (the 'Chennai Museum' today). Balfour was a Fellow of the University of Madras and a corresponding member of the Imperial Royal Geological Institute of Vienna.

Balfour supported grant of independence to India, although it materialized only in 1947. His uncle Joseph Hume (1777–1855), a medical doctor and a radical British parliamentarian, probably influenced Balfour towards this thinking. Allan Octavian Hume (1829–1912), son of Joseph Hume, who served as an Indian Civil Servant (and an avid ornithologist and horticulturist) and who worked in the North-West Provinces of the Raj (presently Uttar Pradesh) was his first cousin. Many would recall that Allan Hume was a founding pillar of the Indian National Congress in 1885, the concept of which was conceived in a private meeting held during a Theosophists' convention in Madras in December 1884.

In this note, I write on Balfour's major contributions to Indian agriculture and forestry, after referring briefly to his contributions to Indian science in general.

Figure 1. Edward Balfour.

Contributions to Indian science

Balfour's adeptness in writing on a range of subjects is astonishing. More than 30 works of varying lengths are his contributions (Table 1).

His articles 'Statistical data for forming troops and maintaining them in health in different climates and localities' and 'Observations on the means of preserving the health of troops by selecting healthy localities for their cantonments', written early in his career, brought him into limelight. These publications induced the Government of Madras in establishing the military hospital at Wellington (The Nilgiris), which later became the Defence Services Staff College. He was passionately interested in the epidemiology of cholera. His report 'On the influence exercised by trees on the climate of a country' in 1849 and the 'Timber trees, timber, and fancy woods, as also the forests of India and of eastern and southern Asia' indicate his interest in weather and its then-strongly-emphasized role in health. Serving as the first officer-in-charge during 1850–1859 of the Museum in Madras, he published articles pertaining to special branches of scientific study (Table 1). His 'Barometrical survey of India' (1853) is an example of his versatility in climatology. He published 'Localities of India exempt from cholera' in 1857, characterizing the geography and spread of cholera.

Before leaving India in 1876, Balfour wrote 'Medical hints to the people of India', which included 'The Vydian and the Hakim, what do they know of medicine?' and 'Eminent medical men of Asia, Africa, Europe, and America, who have advanced medical science'. He translated J. T. Conquest's *Outlines of Midwifery* into Hindustani and had them printed in Tamil, Telugu, and Kannada. He also translated Tate's *Astronomy* into Hindustani; he prepared *Statistical Map of the World* (1854) in both Hindustani and English, which was reprinted in Tamil and Telugu.

The logical and reliable methods Balfour used in either medicine or other disciplines are impressive. He relied on

Table 1. Science-related publications of E. G. Balfour, presumably complete, not referred to in the article

Anthropology
On the ethnology of Hyderabad in the Dekhan (3 parts). *The Madras Monthly Journal of Medical Science*, Madras, 1871.

Astronomy
Tate's Astronomy, Gleigs's School Series, translated into Hindustani (translation by EGB), Madras, 1858.

Biology, including economic biology
The Mollusca or the Classes, Families and Genera of Recent and Fossil Shells, Asylum Press, Madras, 1855.
Catalogue of the British shells in the museum, Central Museum, Madras, 1855.
Report on the woods and trees of the city of Madras, Madras, 1856.
Catalogue of the shells in the museum, Central Museum, Madras, 1856.
Remarks on the gutta percha of Southern India. Noticing also the history and manufacture of the gutta percha of commerce, Government Central Museum, Madras, 1856.
The commercial products of the Madras Presidency, as shown by its exports and imports, their quantities and values, for the four years: 1852–53 to 1855–56 (inclusive), Madras, 1857.

Geology, including economic geology
On the marbles of southern India, report from the Central Government Museum, Madras, 1854.
On the iron ores, the manufacture of iron and steel; with notices of the coals of the Madras Presidency, Madras, 1854.
Catalogue of aqueous rocks as mineral structures: palaeontology or the catalogues of aqueous rocks and their fossils in the order of their superposition. Madura, its rocks and minerals and geology of Tinnevelly, Madras (Central Museum), 1855.
Catalogue containing palaeontology, Part II, Madras, 1855.
Catalogue of the minerals in the museum; to illustrate the physical and chemical characters of minerals, Madras, 1855.
Appendix to the report on iron ores, the manufacture of iron and steel of southern India, Madras, 1856.
Report on the Elliot marbles, report on museum in the provinces and report on the mineral substances of southern India, useful as grinding, polishing, and sharpening materials, Madras, 1856.
Catalogue of the iron ore &c. of southern India, and samples of iron smelted and manufactured from them, Madras, 1856.
Catalogue containing palaeontology, Part III, Madras, 1857.
Catalogue of minerals, Part II, containing minerals used in metallurgy and the arts. Minerals entering into the composition of rocks, minerals used as gems, gems in their natural state, Madras, 1857.
Catalogue of the minerals, Part III, containing minerals in the Government Central Museum, Madras, arranged to illustrate systematic mineralogy, Madras, 1857.
Catalogue of the hypogene and volcanic rocks in the museum, Madras (date not known).

Museology
Government Central Museum: on its origin and objects, Report from the Government Central Museum, Madras, 1853.
Catalogue of the library of the museum, Madras, 1856.

Miscellaneous
Statistical map of the world (three Hindustani editions), Madras, 1849.
Statistical map of the world (one diglot Hindustani and English), Madras, 1850.
Statistical map of the world (one diglot English and Tamil edition), Madras, 1854.
Statistical map of the world (one diglot English and Teloogoo edition), Madras, 1854.

large samples and used right tools to analyse his findings. As one story goes, he 'assessed' human behaviour towards caged tiger and cheetah cubs displayed at the entrance of the Madras Museum, then located in the Oriental College precinct (note 4). The outcome of this assessment led to establishing the zoological garden in People's Park, near Madras Central Station (note 5).

Notes on the influence exercised by trees in inducing rain and preserving moisture

This essay was published in Madras[2], when Balfour was an Assistant Surgeon with the Madras army. Writing from Kurnool (now in Andhra Pradesh), Balfour explains the context for this essay in his cover letter to the Secretary of the Revenue Department of the Government of Madras (# 981, dated 31 March 1848). He explains why he pursued this subject in response to the call of the Government of Madras:

> 'A remark in one of Dr Priestly's [*spelt so in the original, for Joseph Priestley*] writings had directed my attention to the influence of trees on the health of man, and in the course of my inquiries, some years ago, I think in 1840, I arranged a few notes which I had collected on a collateral subject, viz., the influence of tress in inducing rain and preserving moisture.'

Balfour stopped in Mauritius on his way from Scotland to Madras in the 1830s. He read the writings on vegetation conservation in Mauritius by Jacques-Henri Bernardin de Saint-Pierre[3] (1737–1814). He was inspired by the writings of Jean-Baptiste Boussingault[4] (1802–1887). Their thoughts influenced Balfour. Joseph Priestley was another key motivational factor for Balfour. Priestley's words are inspirational in the context of trees and their role in preserving moisture[5]:

> 'These proofs of a partial restoration of air by plants in a state of vegetation, though is a confined and unnatural situation, cannot but render it highly probable, that the injury which is continually done to the atmosphere

by the respiration of such a number of animals, and the putrefaction of such masses by both vegetable and animal matter, is, in part at least, repaired by the vegetable creation. And, notwithstanding the prodigious mass of air that is corrupted daily by the above mentioned causes; yet, if we consider the immense profusion of vegetables upon the face of the earth, giving in places suited to their nature and consequently at full liberty to exert all their powers, both inhaling and exhaling, it can hardly be thought, but that it may be a sufficiently counterbalance to it, and that the remedy is adequate to the evil.'

Towards the end of his essay, Balfour[2] says that

- extensive clearing of trees of a country diminishes the quantity of running water, which flows over its surface;
- it is impossible to determine what influences the diminution: whether it is the lack of rainfall or it is the enhanced evaporation of surface water;
- greater level of moisture accumulates in wooded land than in denuded land;
- mountains covered by forests influence cloud gathering;
- forest trees at the mountain summits are specially adapted to receive (and store) more moisture;
- denuded lands encourage more rapid evaporation;
- forests store water and regulate its flow;
- temperature within forests are nearly the same throughout the year;
- forests regulate wind flow;
- trees restrict dissipation and loss of water;
- the clayey-soil in southern Indian forests preserves surface and subsoil waters;
- the power of trees to gather moisture from fogs varies with species.

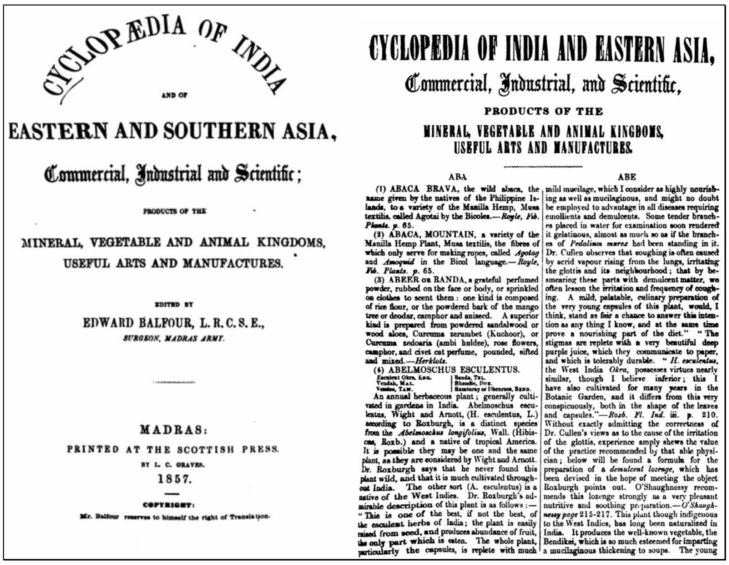
He concludes his commentary, saying:

> 'If the facts (*listed above*) detailed warrant deductions it may be confidently asserted that Southern India would be greatly enriched and its climate ameliorated by the introduction of arboriculture.'

The series of famines in India in the 19th century[6] triggered the Madras Government to make this call. Balfour refers to recurrences of famines in India due to denudation of forests by Indians in the earlier periods[2]. In this essay, Balfour urges that trees be extensively planted to obtain a more abundant and regular rain for the country and to prevent famine occurrence in southern India.

The Cyclopædia of India and of Eastern and Southern Asia

The first edition of Balfour's three-volume work[7], the *Cyclopædia of India and of Eastern and Southern Asia, Commercial, Industrial, and Scientific Products of the Mineral, Vegetable and Animal Kingdoms, Useful Arts and Manufactures* appeared in Madras in 1857 (Figure 2). This encyclopædia embodied profound experience, extensive reading and indefatigable effort. A second edition was published in India in 1873. Between 1877 and 1884, Balfour revised this book further. The last edition, published in London in 1885, is superior to the earlier editions on several scores, with a lavish and ungrudging outlay. The usefulness of the work was soon and well recognized; the whole expendi-


CYCLOPÆDIA OF INDIA AND OF EASTERN AND SOUTHERN ASIA, Commercial, Industrial and Scientific; PRODUCTS OF THE MINERAL, VEGETABLE AND ANIMAL KINGDOMS, USEFUL ARTS AND MANUFACTURES. EDITED BY EDWARD BALFOUR, L. R. C. S. E., SURGEON, MADRAS ARMY. MADRAS: PRINTED AT THE SCOTTISH PRESS. BY L. C. GRAVES. 1857. COPYRIGHT: Mr. Balfour reserves to himself the right of Translation.

CYCLOPEDIA OF INDIA AND EASTERN ASIA, Commercial, Industrial, and Scientific, PRODUCTS OF THE MINERAL, VEGETABLE AND ANIMAL KINGDOMS, USEFUL ARTS AND MANUFACTURES.

Figure 2. (Left) Cover page of vol. I of Balfour's *Cyclopædia of India*. (Right) First page from the same volume.

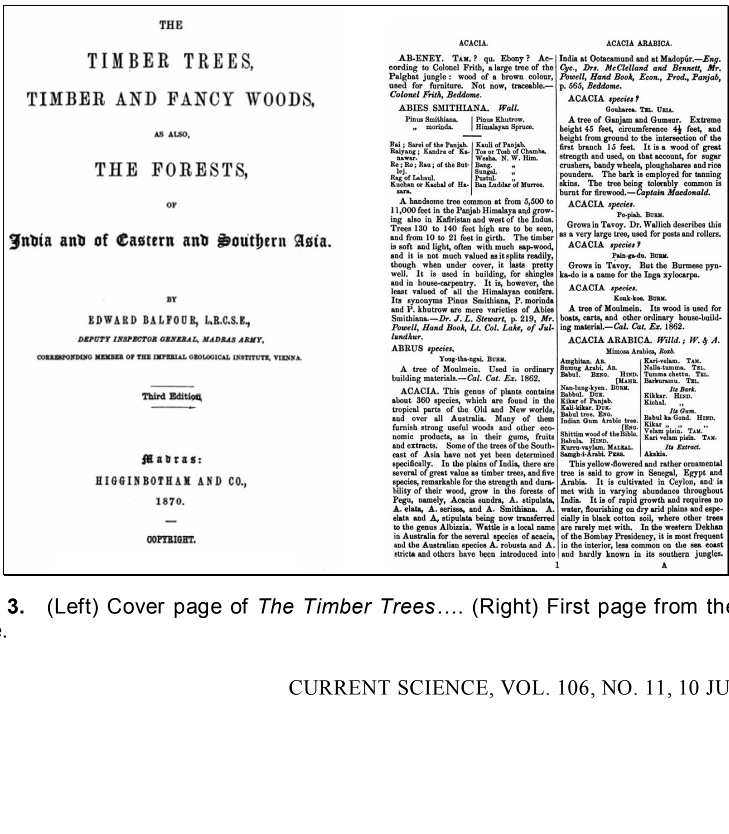

THE TIMBER TREES, TIMBER AND FANCY WOODS, AS ALSO, THE FORESTS, OF India and of Eastern and Southern Asia. BY EDWARD BALFOUR, L.R.C.S.E., DEPUTY INSPECTOR GENERAL, MADRAS ARMY, CORRESPONDING MEMBER OF THE IMPERIAL GEOLOGICAL INSTITUTE, VIENNA. Third Edition. Madras: HIGGINBOTHAM AND CO., 1870. COPYRIGHT.

Figure 3. (Left) Cover page of *The Timber Trees*…. (Right) First page from the same volume.

ture was recouped in two years. The third edition of this work, which he published with Bernard Quaritch, London in 1885, includes 35,000 articles, 16,000 index headings pertaining to 70 million people from an area of 0.3 million square km.

Balfour justifies the production of these massive tomes, each running to several hundred pages, as an effort to fill knowledge gaps in the eastern nations, including India and to provide a quick and ready source for getting summary information on every object of interest. To achieve the best outcomes, he gathered information on India and other South Asian and southeast Asian nations. Moreover, his roles as the Secretary to the Madras Central Committees for the Great Exhibition (1851) (note 6), the Madras Exhibition (1855), the Universal Exhibition held in Paris (1855), and the Madras Exhibition (1857) facilitated him to assemble information in this volume. His role as the officer-in-charge of the Government Central Museum of Madras also enabled him to know about and obtain several products of economic relevance.

He rationalizes the purpose and scope of this volume saying,

> 'The Cyclopædia is not intended to comprise the whole science of Botany nor that of Medicine, or Zoology; nor to instruct in all matters useful in Commerce or the Arts; but whether examined for information or amusement, the botanist, the medical practitioner, the naturalist, and the merchant, may perhaps each find something in it, which, from his engagements, he did not know before, or though once known he may have forgotten.'

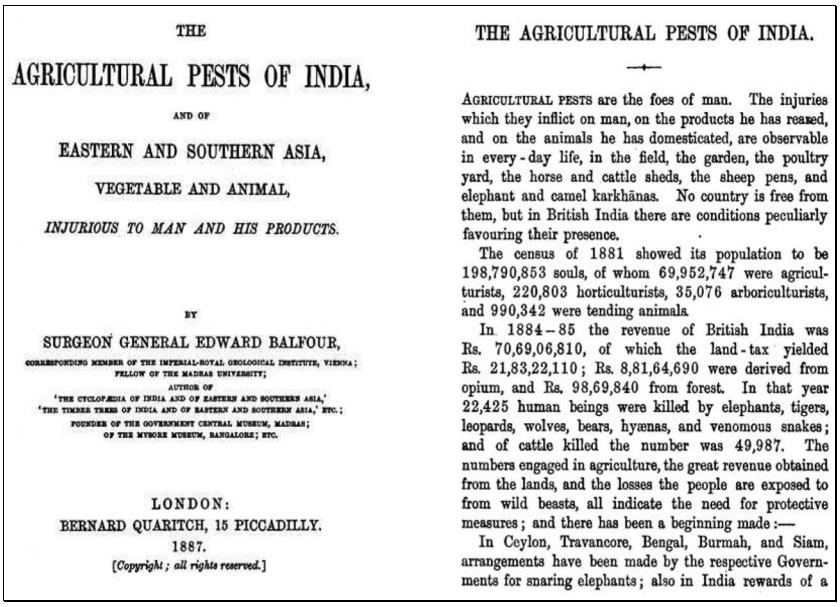
The Timber Trees, Timber and Fancy Woods as also the Forests of India and of Eastern and Southern Asia

Three editions of *The Timber Trees, Timber and Fancy Woods as also the Forests of India and of Eastern and Southern Asia* were published by Balfour[8] in Madras in 1858, 1862, and 1870 (Figure 3). The 1858 edition clarifies the purpose and scope of this volume as follows: 'that it is a handbook, which provides botanical names and matching local names of useful timbers; it outlines the characters of different woods and their other economic products and it explains the nature of vegetations in which they grow with remarks on how these plants could be better raised'. In the 1862 edition, Balfour carried out significant revisions – obviously based on the extensive feedback he got from users. The 1862 edition bears a thoroughly revised format with the names of useful woods and timbers arranged alphabetically according to their biological names, wherever available, and vernacular names. Understandably, Balfour experienced difficulty with biological names and their synonyms and he provides a lengthy explanatory footnote referring to the history of scientific botany in India citing extensively from Wight and Walker-Arnott[9]. Balfour clarifies that he relied on Roxburgh[10] for determining individual trees. The 1870 edition published in England includes a substantial revision with information added on different Indian forest trees with supplementary notes he received from H. Cleghorn, J. L Stewart, A. Gibson, R. H. Beddome, R. Thompson, and G. Bidie in India. He also made efforts to update information on the trees from beyond South Asia, using information from Bennett[11] on the trees of New South Wales, Australia.

The Agricultural Pests of India and of Eastern and Southern Asia, Vegetable and Animal, Injurious to Man and his Products

Balfour published this book[12] in London in 1887 (Figure 4). In the first 15 pages, he talks about the status of agriculture in India providing staggering number-based details, starting from the human population of India and its relation to domesticated animals and birds. In the following pages, he talks of crop rotation, mixing of annual-crop plants with perennials and the reason he provides offers an exciting reading, which I will reproduce here as such (pp. 16–17):

> 'One of the protective measures against insect ravages, which [*is*] strongly urged on cultivators in all countries, is to change the cops in successive years. Each insect species has its own particular plants on which alone it lives, and deprived of food by a change in cultivation, they die. The cucumbers, the rice, and cotton plants, the tea and coffee shrubs, the bamboo, the sāl, pine, and fir trees, have each their own enemies; and on land where a rotation of crops is followed, the parasites (*sic.* pestiferous arthropods) have to seek fresh marauding ground once a twelve-month of [*or?*] oftener, and are frequently kept away entirely or for a considerable period by an absence of their special food. … A large percentage of them would thus be destroyed from season to season, before they reached their particular food-stuff.'



THE

AGRICULTURAL PESTS OF INDIA,

AND OF

EASTERN AND SOUTHERN ASIA,

VEGETABLE AND ANIMAL,

INJURIOUS TO MAN AND HIS PRODUCTS.

BY

SURGEON GENERAL EDWARD BALFOUR,

CORRESPONDING MEMBER OF THE IMPERIAL-ROYAL GEOLOGICAL INSTITUTE, VIENNA; FELLOW OF THE MADRAS UNIVERSITY; AUTHOR OF 'THE CYCLOPÆDIA OF INDIA AND OF EASTERN AND SOUTHERN ASIA,' 'THE TIMBER TREES OF INDIA AND OF EASTERN AND SOUTHERN ASIA,' ETC.; FOUNDER OF THE GOVERNMENT CENTRAL MUSEUM, MADRAS; OF THE MYSORE MUSEUM, BANGALORE; ETC.

LONDON:
BERNARD QUARITCH, 15 PICCADILLY.
1887.
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THE AGRICULTURAL PESTS OF INDIA.

AGRICULTURAL PESTS are the foes of man. The injuries which they inflict on man, on the products he has reared, and on the animals he has domesticated, are observable in every-day life, in the field, the garden, the poultry yard, the horse and cattle sheds, the sheep pens, and elephant and camel karkhānas. No country is free from them, but in British India there are conditions peculiarly favouring their presence.

The census of 1881 showed its population to be 198,790,853 souls, of whom 69,952,747 were agriculturists, 220,803 horticulturists, 35,076 arboriculturists, and 990,342 were tending animals.

In 1884–85 the revenue of British India was Rs. 70,69,06,810, of which the land-tax yielded Rs. 21,83,22,110; Rs. 8,81,64,690 were derived from opium, and Rs. 98,69,840 from forest. In that year 22,425 human beings were killed by elephants, tigers, leopards, wolves, bears, hyænas, and venomous snakes; and of cattle killed the number was 49,987. The numbers engaged in agriculture, the great revenue obtained from the lands, and the losses the people are exposed to from wild beasts, all indicate the need for protective measures; and there has been a beginning made:—

In Ceylon, Travancore, Bengal, Burmah, and Siam, arrangements have been made by the respective Governments for snaring elephants; also in India rewards of a

Figure 4. (Left) Cover page of *The Agricultural Pests of India*…. (Right) First page from the same volume.

He talks of parasitic species belonging to the Acari and the Ichneumonidae (Hymenoptera) that eventually kill larval forms of the Lepidoptera and Coleoptera, the Coccinellidae that predate on aphids, use of *Quassia* extract (Simaroubaceae), and the use of light traps to catch insects. He also refers to the chemical properties of certain plants that are today recognized as botanicals. He cites several species of Apiaceae such as *Anethum sowa* (*Anethum graveoeloens* var. *sowa*), *Coriandrum sativum*, *Foeniculum panmori* (= *F. vulgare*), *F. vulgaris* (= *F. vulgare*), *Petroselinum sativum* (= *P. crispum*), and *Ptychotis ajowan* (= *Trachyspermum ammi*) as examples that are generally free from insects and recommends using them along with crop plants. Several other fascinating remarks occur on pages 18–20. Pages 21–118 include an alphabetical treatment of agriculturally relevant organisms – not only those of crop relevance, but also those of veterinary importance – starting with Acarina. Wherever relevant, Balfour includes vernacular names transliterated in Roman alphabets. I provide here an example pertaining to *Eucheirus longimanus* (Coleoptera: Scarabaeideae) from pp. 53:

> '**Eucheirus longimanus**, a chafer that attack the palms. It is known in the Moluccas as the grand sagueir feeding beetles, because they perish in thousands during the night by dropping into the palm wine collecting buckets. It is one of the Lamellicorn Coleoptera.'

Remarks

Today we know with certainty that forests and large human-made woodlands influence water quality and abundance; also that they influence water flows and the availability of water resources[13]. Because forest catchments provide water to meet diverse human needs, the challenge faced by land managers is maximizing the range of multi-sectoral forest benefits without detriment to water resources and ecosystem functions[14,15]. We know that forests influence temperature regimens and other vital climate factors.

The science of relation between water and trees was recognized formally first in France (note 7), because a royal ordinance on waters and forests existed in France as early as AD 1219 (ref. 16). French governments, since then, employed officers in charge of *Eaux et Forêts*[17]. In the context of post-renaissance period hydrology, Bernard Palissy (16th century) blazed new trails proposing the concept of infiltration in water movement, which later evolved into the hydrologic cycle theory. Pierre Perrault (17th century) polished Palissy's proposal[18]. Kircher (1602—1680) first used the term 'hydrologic cycle'[19] in his *Mundus Subterraneus*. Bécher[20] (1635–1682) explained that the earth functioned similar to a distillation apparatus: seawater vaporized to the earth; on its way to the surface, it entered the interior of snow-clad mountains, which condensed the vapour into water, which sprang down mountain slopes and ran back into the sea. The next noteworthy explanation was by Antonio Vallisnieri[21] (1661–1730), who established infiltration. By the mid-18th century, we got a comprehensive clarity of the hydrologic cycle. A little before the French Revolution, French naturalists were already proposing romantic views on the possible influence of forests on climate and water flow. The best among them are the remarks of de Saint Pierre in his monumental *Études de la Nature*[3], which outlined the role and impact of forests on rain and stream flow in Mauritius. The words of de Saint Pierre (see quote below) take us back to Balfour:

> 'This attractive force of the forests on this island is such that a field in an uncovered situation close to them often suffers a lack of rain whereas it rains almost all year long in woods that are situated within gunshot. It is by destroying part of the trees crowning the heights of this island that one has caused most of the streams that watered it to dry up. I attribute to the same lack of foresight the notable diminishing of the streams and rivers in a large part of Europe.'

The later French authors, such as Rougier de la Bergerie (1800), talk of denudation of forests in France and the consequent irregularity in water flows as either trickles or floods. A few other further explanations followed, which can be read in Adams[22].

Returning to Balfour's essay on the importance of conserving trees and forests in regulating water cycle and rainfall, it is not surprising that sufficient intelligent thinking had already developed in Continental Europe based on the experiences of thinkers who had travelled to tropical colonies of their respective nations. When Balfour arrived in Madras, the semi-arid nature of the eastern peninsular India 'surprised' him[2], stimulating him to reflect on the relationship between the limited water availability and the sparseness of trees. The sparseness of the vegetation is further influenced by a weak northeast monsoon, which brings low rainfall to the inland segments of Madras presidency. Based on these observations, Balfour wrote his essay on the importance of improving tree abundance in this part of India, and how it can be worked to perform better. He extensively compares his observations to those he had known in the highlands of Scotland and the tropical island of Mauritius that receive abundant rain annually. Correlation between forest cover and rainfall has been shown with more emphatic evidences by Meher-Homji[23,24], nearly 100 years later in peninsular India. It would be appropriate here to recall the work of Hugh Cleghorn, a Madras-born Scot. After a few stints with Madras-Medical Service, Cleghorn became the Conservator of Forests in Madras in 1856. In this role Cleghorn made substantial contributions to forestry and forest management in the Madras Presidency and later as a deputy to Dietrich Brandis in Dehra Dun, he enabled the scientific management of Indian forests. In Cleghorn's volume on the forests of southern India[25], he refers to Balfour's *Cyclopædia*[7], but not his 1849 paper[2].

It is not an exaggeration to say that the Indian forest conservation and management schemes, in principle, developed out of Balfour's thinking. Those schemes indeed formed the model for most of the forest management projects in other British and French colonies[26]. During Balfour's study at Edinburgh, Scottish medical training emphasized the role and importance of water in human health, and in high probability, this training prompted Balfour to recognize the finiteness of water and to study the role played by forests in recycling water[27]. Balfour found it both logical and expedient to consider the forest problem as being fundamentally a public-health issue, demanding an interventionist solution in the countryside[26].

The Indian subcontinent was popular across the world for its rich natural variety

and legacy, favoured by its diversity in landscape, climate, orientation, seas and rivers, and mountains. This diversity attracted foreigners from the time of Alexander the Great (*c*. 4 century BC), who saw India as a terminus for trade and entrepreneurship. The East India Companies of different European nations in the 16th and 17th centuries had entrepreneurship in full view, which after a chequered range of geopolitical events, culminated in the subcontinent becoming a British dependency. Most of the British bureaucrats of the 19th century India saw the country's natural materials as the property of Britain for the economic development Britain. In this context Balfour stands tall with nobler objectives. His perception of the natural materials of India as India's wealth led him to document their details scientifically and use them judiciously. He added value to them. His *Cyclopædia of India and of Eastern and Southern Asia* is a remarkable effort that celebrates the natural wealth of India. While browsing through Balfour's *Cyclopædia*[7], I remembered the *Wealth of India* [*WoI*] volumes[28]. The similarity in the style of presentation and details of contents prompted me to think so. The CSIR website referring to the evolution of *WoI* series[28] indicates that the series builds on George Watt's *A Dictionary of the Economic Products of India* (1885). I checked the bibliography in Watt[29], which, unfortunately, does not refer to Balfour's *Cyclopædia*[7], the first Madras edition of which pre-dates Watt's dictionary by 28 years. Why Watt did not refer to Balfour's *Cyclopædia* and why the *WoI* history page too does not allude to the remarkable labour of Balfour leave me baffled!

The *Timber Trees, Timber and Fancy woods …*[8] and his A*gricultural pests of India…*[12] are technically the expanded notes on trees and agricultural pests from his *Cyclopædia*. Of particular interest to me are his references to parasitic wasps and predatory beetles and bugs in regulating populations of pestiferous arthropods in agriculture in his volume on agricultural pests[12]. Only in the 1880s, the 'classical' concept of biological control was established with trials made to regulate populations of *Icerya purchasi* (Insecta: Hemiptera) infesting citrus orchards using the predatory *Rodolia cardinalis* (Insecta: Coleoptera)[30], although Darwin[31] had earlier casually remarked on the interactions between moth populations (Insecta: Lepidoptera) and parasitic wasps, Ichneumonidae (Insecta: Hymenoptera). More exciting to me, are Balfour's notes on using different Apiaceae in crop husbandry, which can either deter or repel arthropods because of their strong volatiles. Such applications are being intensely explored presently to manage the pestiferous arthropods ecologically in agroecosystems[32,33].

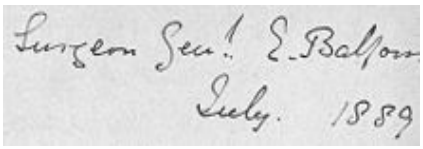

Figure 5. His signature of July 1889 that includes his title held in Madras until 1876.

The most notable element in these volumes is that Balfour revised them periodically adding the latest information; he publicly acknowledges the support and counsel he received from many of his contemporaries. That enthusiasm of seeking new information and nobility to accept suggestions, speak well of Balfour's personality. His signature (Figure 5) makes me wonder whether he had a touch of vanity about himself (a 'Balfourian' manner'? (note 8)).

Conclusion

Many British bureaucrats have functioned in Madras. Balfour outshines them. He came to Madras to serve as a surgeon in the Madras army; his innate acumen seems to have guided him to accept tasks that would generally be formidable to a person trained minimally as a surgeon. He was empathetic to the people of India, as apparent from his passion to learn local languages, in informing science to Indian people in those languages, and in supporting independence to India. He was also deeply concerned with women empowerment. His particular effort in throwing open the gates of Madras Medical College for women to enter medical training is commendable[1]. I will not say that he was superbly successful in every effort he made. And not all of his efforts were laced by altruism. But the efforts he made are laudable. He impresses as a genuine person and as one who worked at a plane that was different and superior, compared with many of his contemporaries. This versatile Scottish–Madras resident linked science, science administration and human values amazingly. Quite appropriately, this Briton is remembered today in Madras in Balfour Road, Kilpauk.

Notes

1. Chepauk is a suburb in Madras city, close to the Marina beach. The Nawab of Arcot's palace exists in Chepauk. Possibly Chepauk is the corruption of the Urdu term 'Ché Bagh', meaning six gardens. The Nawab's past household spoke Urdu and the present Prince's household speaks Urdu.
2. Balfour translated *Gul-dastah-i-Sukhan* (extracts from Persian and Hindustani poets) and published it as *The Bunch of Roses* in 1851. He established the Mohammedan Public Library in Madras, an institution that included books in English and Oriental languages. This service to Muslim literature and culture in India, on his departure, was gratefully acknowledged through a Persian Address presented to him by the leading Muslim residents of Madras.
3. The 'gold' Balfour Medal today survives as a 'silver' medal in the Tamil Nadu Dr M.G.R. Medical University, Madras.
4. Today, the Directorate of Public Instruction on College Road.
5. The Madras Zoo started in 1855 was seeded by a gift of a few mammals and birds by the Nawab of Arcot to Balfour. It functioned in People's Park (1855–1976).
6. The Great Exhibition was held at the Crystal Palace, Knightsbridge, London, in the summer of 1851. Holding this exhibition was a cherished dream of Prince Albert, husband of Queen Victoria, to display the wonders of industry and manufacturing from around the modern world. India contributed an elaborate throne of carved ivory, a coat embroidered with pearls, emeralds and rubies, and a magnificent howdah and other decorations that go on a royal elephant, and the priceless 'koh-i-noor' diamond. Following the Great Exhibition of 1851, George Harris (Governor of Madras) mooted the Madras Exhibition to improve the Presidency's agricultural and manufacturing industries. The Executive Organizing Committee was chaired by Harris with Balfour, its Secretary. It was held at the Banqueting Hall, Madras in February–April 1855. The 1857 Madras Exhibition too was held keeping the same theme that was enshrined for the 1855 exhibition and was held from February to April in 1857, with Lord Harris as the chair and Balfour as the secretary[34].

7. The connection between trees and rain has been recognized in India from ancient days (e.g. *Vriksãyurvéda* by Parãsarã, *c*. AD 1000).
8. Arthur Balfour, Prime Minister of England (1902–1905) displayed a manner dominated by self-obsession, which was recognized by his friends as the 'Balfourian manner'. Edward Harold Bagbie (1871–1929) in *Mirrors of Downing Street – Some Political Reflections* [G. P. Putnam's & Sons, New York, p. 171], written under the pseudonym '*a gentleman with a duster*' criticised Arthur Balfour for his manner. I would not know whether Arthur Balfour and Edward Balfour were, in any way, related!

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