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## **Herpetology of an Antique Land: The History of Herpetological Explorations and Knowledge in India and South Asia**

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**Abstract.** The history of herpetological explorations in the Indian subcontinent is traced from Vedic times to present. The profound knowledge that the ancients of India had ca. 3,300 years before present, including the identification and classification of snakes, was remarkable, and probably stems from their deep interest in the natural world, besides the obvious utilitarian value of such knowledge. Medieval European knowledge of the regional herpetofauna consisted mostly of exaggerated accounts culled from bestiaries and colourful accounts by visitors writing primarily for the entertainment of a European audience. With the Mughal period came the age of natural history record keeping. Many of the rulers were keen natural historians and kept memoirs that often recorded specific information on amphibians and reptiles.

European merchants, and subsequently, the British colonial system, brought the best of western science to India. Although primarily motivated by profit to be made from botanical explorations (e.g., spices and tea) they also supported early herpetological explorations of the country. As a result, specimens from India, Nepal and Sri Lanka were made available for examination and description by museum curators in Europe. The enormous collections that were made also resulted, in the 1800s, in the foundation of local museums, some of which are the earliest existing systematic institutions in the world, including those in Calcutta and Bombay. Prominent naturalists of the time who were associated, as staff, society members and collectors of such museums include Edward BLYTH, Edward KELAART, John ANDERSON, William THEOBALD and Ferdinand STOLICZKA.

The final chapter in the history of south Asian herpetology began after the withdrawal of the colonial powers, at the end of World War II. Among the few local scientists who produced exceptional work was Paulus DERANIYAGALA of Sri Lanka. DERANIYAGALA explored his island nation and described a large number of new taxa in local journals in several volumes published by the Colombo Museum. At the beginning of the 21st Century, herpetological explorations, through a combination of lack of resources and political will, as well as new restrictive laws, face the threat of coming to a halt. The rapid disappearance of natural habitats and the inevitable extinction of species place an urgency on the resumption of inventories and the protection of the living resources of the region.

**Key words.** Sri Lanka, Asiatic Society of Bengal.

### **1. INTRODUCTION**

Southern Asia, comprising the Indian Subcontinent countries of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, has a distinctive and rich herpetofauna, as well as a long history of documented studies, commencing from the Vedic period, that date back perhaps as far as 10,000 years before Christ. The following essay traces the development of the science in the region, especially India, and also, her adjacent countries, to the present, enumerating the more important works, and authors and collectors, till 1970. A listing of geographic names as in former times, along with the modern-day equivalent is in the Appendix.

### **2. THE VEDIC PERIOD**

The ancestors of the people living in the region now called India did not have their own name for their land ("India" is derived from the Sindu, later, Indus River), nor their religion ("Hindu", also from the same source),

both having been given by invading armies from the west. The richness of her civilisation and of the land itself nurtured many regional scholars, not the least of these being the unknown authors of the great works, the Vedas, written, according to various sources, between 1,300–1,000 B.C. (BLOOMFIELD 1908), to around 10,000 B.C. (SIDHARTH 1999). The Vedas not only offer guidelines for code of conduct, hymns and incantations to various deities, but also discuss many more practical topics, such as health care, the treatment of illnesses and injury through medicine and surgery, and protocol for sacrifices. Thus, while Europe and, indeed, much of the rest of the world languished in the dark ages, Vedic scholars founded the world's first university (at Takshila, in 2,700 BP, with an attendance of over 10,500 students from all over the world), started a school of surgery (in 2,600 BP, that dealt with complicated cases such as caesarians, cataracts, artificial limbs, brain and plastic surgeries), worked on algebra, trigonometry, calculus and astronomy (including the helio-

centric notion of the solar system), discovered the decimal system, calculated the value of pi and resolved that atomism is the basis of all matter (TERESI 2002).

Of the Gita, one of the devotional works in Sanskrit, the language of ancient India and mother of all Indo-European languages, Warren HASTINGS, the Governor-General of East India Company, was to write: "...a performance of great originality, of a sublimity of conception, reasoning and diction almost unequalled; and a single exception, amongst all the known religions of mankind...I should not fear to place, in opposition to the best French versions of the most admired passages of the Iliad or Odyssey, or of the first and sixth books of our own MILTON.. " (KEAY 1981: 25). The earliest of the Vedas, the *Rigveda*, which is organised into 1,028 hymns (Suktas) that are divided into 10 books (KOCHHAR 2000) contains much information that is of interest to contemporary herpetologists. In this, arguably the oldest book in the library of man, is the following hymn sung in praise of the humble *Manduka* (frog):

"Remaining in deep slumber at other times of the year, *Manduka*, at the time of onset of the rains, speak in such terms that will endear itself to the God of the rumbling clouds...When the God of the clouds pour water onto the thirsty *Manduka*, they become filled with desire, one going eagerly after the other, like a toddler who runs to its beloved, uttering unintelligible sounds....The songs of different *Manduka* are different. A smoke-coloured *Manduka* has a deep note, while a green one produces a light note....It is clear that the *Manduka* include different species which are unlike each other in their appearance and in their songs" (Vasistha, *Rigveda*: Mandala VII, Sukta 103).

The early classification of animals, including amphibians and reptiles, during the Vedic period of India was based on form, medium occupied (earth, air or water), the presumed number of sensory powers possessed, and whether they were wild or domesticated (RAO 1957; GHILDIAL-SHARMA & SHARMA 1989). *Manu Smriti*, compiled between 200 B.C. and 200 A.D., on the other hand, classified animals on the basis of their reproductive modes. Thus, snakes, crocodiles and tortoises were classified along with birds and fish, for being (primarily) oviparous. The *Umasvati*, a Jain work written between 135–219 A.D., classified animals according to their sensory powers. Amphibians and reptiles, in this system, were grouped along with humans, for possessing the senses of sight, hearing, taste, smell and touch. The classification systems of Charak and Susruta, on the other hand, recognised differences based on habitats, and the eight categories identified include aquatic species that live in water, those in dry hills, amphibious species and animals living in marshy or water-logged areas. The *Susruta Nagarjuna* classified snakes into the

following groups (including both venomous and non-venomous). The venomous included:

- *Darvikaras* ("hooded, swift, diurnal, bearing hoods on bodies marks of chariot-wheels, ploughs, umbrellas, rhombs or cross-bands, gold, etc."). These are clearly cobras, including *Naja naja* (Linnaeus, 1758) and *Ophiophagus hannah* (Cantor, 1836).
- *Mandalins* ("bearing circles or rings on the body, hood reduced, thick, slow-moving, nocturnal"). These are the vipers, including *Daboia russelii* (Shaw & Nodder, 1797) and perhaps *Gloydius himalayanus* (Günther, 1864).
- *Rajimats* ("hoodless, nocturnal, bearing a series of dots or coloured markings on upper parts and flanks of body"). These are *Bungarus caeruleus* (Schneider, 1801) and *B. sindanus* Boulenger, 1897.

Non-venomous snakes were also known by the ancient Indians, and the list includes 12 species, including *Vrkasesaya* (*Ahaetulla nasuta* [Lacépède, 1789]) and *Ajagara*, literally, "goat-swallower" (*Python molurus* [Linnaeus, 1758]). The action of the venom on different animals was apparently understood, and was described in detail. Importance was given to the study of snakes ("Sarpa Vidya"), and much was written about snakes, some of which was fanciful, and some of which has been verified by modern science. For instance, written in these works is information that the *Swaja* (viper) is sometimes attacked and killed by the *Harina* (deer or antelope), or that cobras mate during the summer months of Jyesththa and Ashadha (approximately, May/June and June/July, respectively).

Although the primary purpose of indigenous names has been thought to be utilitarian (DIAMOND 1966; GOULD 1979), the complex classification and naming process (= folk taxonomy and nomenclature) seen here tends to support BERLIN's (1992) theory that humans are innately curious about the natural world, and that names are supplied to species that may not always have a direct utilitarian value. Southern Asia offers a rich source for ethnozoology, given the large number (ca. 200) languages and dialects spoken, an ancient (> 3,500 years) civilization, and over 1,700 names of amphibians and reptiles have been documented (DAS 1998).

### 3. ANCIENT AND MEDIAEVAL EUROPEAN KNOWLEDGE OF SOUTH ASIA

The impenetrable Himalayan mountain chain that encircles the land across the northern border of India has contributed to the northern parts of the country being isolated for centuries. Only a handful of travellers were able to traverse these barriers in their quest to "discover" the subcontinent, and were most impressed with the fauna. The writings of these early travellers or those reporting on the fauna based on accounts they heard

provide early knowledge of the herpetofauna of this great landmass.

The Greek philosopher HERODOTUS of Halicarnassus (484?–425? B.C.) wrote: “It seems as if the extreme regions of the Earth were blessed by nature with the most excellent productions.... In India, which, as I observed lately, is the furthest region of the inhabited world towards the East, all the four-footed beasts and the birds are very much bigger than those found elsewhere, except only the horses”.

In his landmark work in 37 volumes, *Natural History* (the first 10 volumes published in 77 A.D., the remainder after his death), the Roman encyclopaedist, PLINY THE ELDER (23–79 A.D.) wrote that the snakes of India were large enough to swallow elephants and some grew to 80 and 140 cubits (1 cubit = 18–22 inches) in length (RACKHAM et al. 1967–1971; HUGHES 1998). The early Greek natural history literature was probably written for effect, primarily to entertain a Greek audience, although PLINY, a Roman, wanted fellow Romans to return to a simpler and more austere life (FRENCH 1994). Other European travellers of the same period brought back tales from India that would help provide material for mediaeval bestiaries than disseminated knowledge of natural history. Noteworthy among mediaeval visitors from the west are the Italian explorer Marco POLO (1254–1324) and the Arab traveller Ibn BATUTA (1304?–1378?).

#### 4. THE MUGHAL PERIOD

The Mughal conquest of India, after the Battle of Panipat in 1526 A.D., led to a period of general political stability for the next several centuries. Fine architectural monuments and gardens (some of which survive to this day) were built by the Mughal Emperors, many of them patrons of art and culture. It also brought about the first written memoirs that included detailed natural history notes. Emperor ZEHIR-ED-DIN BABUR, also spelt Zahiruddin Muhammed BABUR MIRZA (1483–1530), the founder of the Mughal Empire, was a keen natural historian, and coming as he did from the arid country of Kirghistan, in central Asia, was greatly impressed with the bountiful flora and fauna of his newly acquired kingdom. Many of these observations were made under adverse conditions (such as during long marches against enemies). Wrote BABUR in his Memoirs (ZEHIR-ED-DIN BABUR ca. 1530; translation 1921: 224–225): “The frogs of Hindustan are worthy of notice. Though of the same species as our own, they will run six or seven gaz (approximately, one feet to a gaz) on the face of the water”. In this case, it is obvious that the intriguing animal is none other than the Indian skipping frog, *Euphlyctis cyanophlyctis* (Schneider, 1799). Reptiles feature too in BABUR’s memoirs. Of the gharial, *Gavialis gangeticus* (Gmelin, 1789),

BABUR wrote, “...the *gharial*...is a large fish. Many of the army saw it in the Saru River. It carries off men. During the time that we remained on the Saru River, one or two slave boys were seized by it and carried away”. Also recorded was the *Sherabi*, literally, “water lion”, and suspected to be the marsh crocodile, *Crocodilus palustris* Lesson, 1831, which dwells in standing waters, such as lagoons on banks of rivers after inundation. It was reported to carry off men and even buffaloes.

BABUR’s great grandson, Emperor JAHANGIR (1569–1627), whose notes on natural history were detailed (JAHANGIR 1626), recorded the swallowing of a cobra (probably a *Naja* species) by another cobra (almost certainly *Ophiophagus hannah*), around 1624 A.D. It is said that Jahangir, given his great love for both nature and the arts, would have been a happier man if he were to become a museum curator, rather than the ruler of all of Hindustan (ALI 1927).

#### 5. THE PRE-COLONIAL PERIOD

Following the great Portuguese navigator, Vasco DA GAMA’s (ca. 1469–1524) arrival on the west coast of India in 1498, the country became like a “candleflame to moths in the minds of the imaginative Europeans” (WHITTLE 1970). The commencement of European contact and trade virtually brought to an end indigenous knowledge of the natural history, and its dissemination. It also brought in Western science, to be performed for the next 200 years exclusively by hand-picked scientific personnel of the Honourable East India Company (which traced its descent from 1600, and was active till 1857, when its army was dissolved in the Sepoy Mutiny; see KEAY 1991 for an account of the history of the Company and COWAN 1975, for details of the natural history catalogues of the Company), and subsequently, the government of British India – medical doctors or military engineers, and also professional botanists and zoologists educated in the leading universities of Europe at the time. The agenda grew out of commercial pressure from both at home and in the colonies, to supply botanical gardens and discover herbs with medicinal properties (GROVE 1998), and one of the earlier directives to the Danish botanist, Nathaniel WALLICH (1785–1854), who was later rewarded with the position of Director of the Calcutta Botanical Gardens, was to “explore the unknown productions in Botany, as well as Zoology and Mineralogy” in the territory of the East India Company (BASTIN 1981). Pioneering naturalists of the time more often than not looked well beyond the mandate provided by their superiors, and large numbers of zoological specimens were collected, and frequently documented pictorially through coloured sketches prepared by local artists. Little technical information, however, flowed from Britain to India, and a conscious ef-

fort was made to keep scientific information from reaching the home country (GADGIL & GUHA 1995).

European naturalists were quick to discover what is now known as a global biodiversity hotspot—the Sahyadri (in Sanskrit) or the Sahyadri Kandala of the Skanda Purana, the hill range that runs along the west coast of the Indian peninsula, also known as the Western Ghats. The first published natural history account of the region was on medicinal plants by Garcia DE ORTA (ca. 1490 – ca. 1570). His 1563 work, in Portuguese, entitled *Coloquios dos simples e drogas e cousas medicinaes da India*, was published from Goa and went through several editions. This was followed by the ambitious *Hortus Indicus Malabaricus*, which describes nearly a thousand plant species in 12 volumes, and was authored by the then Dutch Governor of Cochin, Hendrik Adriaan VAN RHEEDE TOT DRAKENSTEIN (1636–1691), assisted by four Indian scholars and an Italian Carmelite monk.

Regions around colonial settlements were to be the first to be explored: Calcutta and Vizagapatam and their environs were the type localities of many herpetological species from the early 1800s. The few pioneering herpetologists who collected in bordering areas of the North-West Frontier, North East Frontier Agency, and the Khasi Hills were associated with either the East India Company's Army or the British Imperial Government of India. A majority of the early naturalists were medical doctors.

One of the first Europeans to collect in India was the Lithuanian-born physician, Johan Gerhard KOENIG (1728–1785), a student of Carl LINNAEUS (1707–1778), who arrived in India in 1767, remaining there until his death in 1785 (BURKILL 1953). KOENIG, who was educated in Denmark and Sweden, made a collection mainly of plants and insects that were sent to Copenhagen. The most celebrated student of KOENIG was Patrick RUSSELL (1727–1805), who was also the first Western herpetologist in India, and a medical doctor by training. RUSSELL was employed as a naturalist by the British East India Company at Vizagapatam (at present Visakhapatnam). RUSSELL is best known for a two volume folio of water colours mainly of snakes (the limbless scincid, *Barkudia melanosticta* (Schneider, 1801) was also illustrated, this being the only lizard species covered – see DAS 2000), published in 1796 and 1801–1802 (the second volume was completed posthumously between 1807 and 1809 or 1810; ADLER 1989). A unique aspect of the work was the use of local vernacular names, but not their English or scientific names (perhaps because the Linnean system of classification was new at the time). A number of European herpetologists (including DAUDIN 1803; MERREM 1820; SCHNEIDER 1801; and SHAW 1802) applied Linnean names to species illustrated in RUSSELL's magnificent folios. The Latin name

of the RUSSELL's Viper (RUSSELL's 'Katuka Rekula Poda'), *Daboia russelii* (Shaw & Nodder, 1797), honours the man. Besides descriptions of the local snake species, RUSSELL was also able to discover the differences between venomous and harmless snakes (HAWGOOD 1994), which was accomplished through an examination of their teeth as well as observations on the effect of their bite on various small animals.

In the latter part of the 1700s, Christoph Samuel JOHN (1747–1813), a Danish missionary based at the Protestant mission in Tranquebar, on the Coromandel coast, started sending specimens of fish, as well as amphibians and reptiles, to a fellow member of the Gessellschaft für Naturforschender Freunde zu Berlin, Marcus (Markus) Elieser (Elisar) BLOCH (1723–1799). Although a physician by training, BLOCH was a great collector of natural history specimens, and authored numerous papers in ichthyology (PAEPKE 1993). BLOCH's herpetological output did not match his fish work (BAUER 1998), but his specimens from India were worked on by Johann Gottlob SCHNEIDER (1750–1822), resulting in the monumental *Historia Amphibiorum*, published by SCHNEIDER in two parts (1799 and 1801). Among the species described by SCHNEIDER from the BLOCH collection were the amphibians *Euphlyctis cyanophlyctis* (Schneider, 1799), *Bufo melanostictus* Schneider, 1799, and *Crocodylus porosus* Schneider, 1801. The type series of many of these taxa are extant in the collection of the Museum für Naturkunde, in Berlin (BAUER et al. 1995).

Nearly contemporary with RUSSELL and JOHN was Major-General Thomas HARDWICKE (1756–1835). HARDWICKE served in the Bengal Artillery of the East India Company, but his real interest was in the collection of objects of natural history and coloured sketches of plants and animals (in some 32 folio volumes, that included over 2,000 drawings, of which 366 were of amphibians and reptiles), made by local (SAWYER 1971) or both English and local (GRAY 1830) artists. These were bequeathed to the British Museum in London (DAWSON 1946), and the specimens themselves were distributed between the British Museum, the Museum of the East India Company, as well as those of the Linnean and Zoological Societies (KINNEAR 1925). HARDWICKE's areas of activity were essentially around places he was posted- Bengal, including Dum-Dum and Calcutta, and the United Provinces, including Fatehgarh and Cawnpur, although he also went on a short expedition to Srinagar. HARDWICKE's most famous herpetological contribution was in a work in which he collaborated with John GRAY (1800–1875) at the British Museum, entitled *Illustrations of Indian Zoology* (GRAY 1830–1835), and distributed through subscription. The dates of publication of this work have been discussed by SAWYER (1953) and WHEELER (1998). Although the volume was

the result of labour of both GRAY and HARDWICKE, names of all new taxa (except for turtles, which were after an unpublished manuscript by the English naturalist, Thomas BELL, 1792–1880), were formally created by Gray alone (WHEELER 1998). These volumes included some of HARDWICKE's collection of illustrations; the text was never published, owing to HARDWICKE's premature death and the legal dispute that followed. Biographies of HARDWICKE are in KINNEAR (1925) and DAWSON (1946).

Sea voyages, embarked upon by the European powers at the height of their military power in the early to middle part of the 1800s, led to the exploration of many remote islands. The archipelago system of the Nicobars, situated about 120 km to the north-west of Sumatra but politically a part of the Republic of India, was visited by the Austrian frigate *Novara*, which cruised the world between 1857–59. The *Novara* anchored off several islands of the Nicobars, and naturalists on board made collections, apparently from the interior of these islands. The results were written in two volumes (1867a, 1867b), authored by Franz STEINDACHNER (1834–1919) in 1867, although some of the descriptions were formally authored by Leopold Joseph Franz Johann FITZINGER (1802–1884), both staff of the Naturhistorisches Museum Wien, Vienna. The itinerary of the voyage of the *Novara* was provided by GANS (1955), who listed sites visited in the Nicobars. Significant species described based on the voyage include "*Scincella*" *macrotis* (Steindachner, 1867), *Dibamus nicobaricum* (Steindachner, 1867) and *Trimeresurus labialis* Steindachner, 1867.

## 6. THE COLONIAL PERIOD

That the Museum of the Asiatic Society of Bengal, in Calcutta, came into being was in no way deliberate. Its founder, the noted Orientalist, Sir William JONES (1746–1794; see CANNON 1960, for a biographic sketch), who arrived in Bengal as a Puisne Judge of the Supreme Court at Fort William, Calcutta, was a distinguished scholar and linguist (FERMOR 1935). The elite of Calcutta, comprising 30 members of the European community, met on 15 January, 1784, for the first congregation of the Asiatic Society, whose original intention was, in the words of JONES, among other things, to "...investigate whatever is rare in the stupendous fabric of nature..." and "...to correct the geography of Asia by new observations and discoveries...". To the credit of the Asiatic Society of Calcutta, it inspired the establishment of various branches, such as those in London, Bombay, Madras, Colombo, Singapore, and Shanghai, most with transient lives, and none a serious rival of the one in Calcutta (FERMOR 1935).

William JONES was personally opposed to the collection of zoological specimens (BOSE 1885). However, specimens of plants and animals did start to arrive at the Society, collected from the remotest parts of the Indian Empire by the members of the Society. One of the earliest members of the Society, and also arguably the first scientific worker of vertebrates, was Brian Houghton HODGSON (1800–1894). HODGSON originally came to India in 1818 as a Writer in the East India Company, eventually becoming the Resident at the Court of Nepal until 1843. His extensive collections of mammals, birds and reptiles from Nepal, made by several local collectors in his employ, included many new species, and Hodgson wrote no less than 127 papers on the subject of vertebrate zoology (BOSE 1885; SWAN & LEVITON 1962). Apart from the zoological collections, Hodgson, in the manner of biologists of the time, also commissioned local artists to prepare water colours of many of the specimens from life, and 11 of these are at present in the library of The Natural History Museum, London. Theodore Edward CANTOR (1809–1860), a Danish naturalist with the East India Company described some of the species depicted in the HODGSON paintings as new. The snake *Orthriophis hodgsonii* (Günther, 1860), honours Brian Houghton HODGSON.

A need for a formal museum was felt by the Society, as the honorary office bearers could not cope with the steady stream of specimens that were arriving. Finally, in 1840, the Society applied for and received a grant from the Directors of the East India Company for the salary of a permanent Curator. Edward BLYTH (1810–1873), a gifted English naturalist, was hired for the position as the Museum's first Curator, and he was to remain in Calcutta for the next 22 years (ARCHER 1962). BLYTH himself was not a field person, perhaps for want of opportunity, and apart for excursions in the vicinity of Calcutta, and trips to the North West Province (including Lucknow, Kanpur, Allahabad and Benaras), Khulna and several to Burma, essentially remained based in Calcutta and built up a large network of contacts through correspondence. These included British Residents or other administrators based in Kathmandu (Hodgson), Burma (Arthur Purves PHAYRE, 1812–1885), Ceylon (Edward Fredric KELAART, 1819–1860), and the Andaman Islands (Robert Francis TYTLER, ?–1916). Major herpetological contributions of BLYTH included his monthly notes that were published nearly uninterrupted for 20 long years in the Proceedings of the Society, that contained species descriptions. Given the fact that he did not have access to the types of many of the species then being described by GRAY and GÜNTHER in London, it is remarkable that many of BLYTH's novelties are still valid. Biographies of BLYTH can be found in ARCHER (1962), GROTE (1875) and GELDART (1884). Grote (1875) wrote an introduction to BLYTH in

the latter's posthumously published monograph on the Burmese mammals and birds that carries a rare hand-coloured portrait of the author.

Edward BLYTH's influence on Charles DARWIN (1809–1882) is well documented (EISELEY 1959; BEDDALL 1972; 1973), and DARWIN frequently quoted the Calcutta curator as an "excellent authority", as did other leading biologists of the day, including Richard OWEN (1804–1892) and John Edward GRAY (1800–1875), who exploited Blyth to further their own research (BRANDON-JONES 1995). In 1835, when only 25 years old, BLYTH wrote a paper in the *Magazine of Natural History* that discusses natural selection and evolution, nine years before DARWIN read his manuscript to Joseph Dalton HOOKER (1809–1882) (GELDART 1884).

Local naturalists at the time published in the *Asiatick Researches* and the *Calcutta Journal of Natural History*, which were to be superseded by two regular publications of the Society – the *Journal* (started in March 1832, the old series continuing until 1904; CHAUDHURI 1956), and the *Proceedings* in January 1865 (which were issued monthly till December 1904). Numerous new taxa were described, some in the form of brief notes within monthly meeting notices. Collections came to the Museum not only from members, but also various Boundary Commissions, with which naturalists were invariably attached. Thus, naturalists from the Asiatic Society of Bengal or the Indian Museum, visited such far off places such as the Pamirs, the Afghan-Baluch border, and Persia. ALCOCK (1898); ALCOCK & FINN (1897) and BLANFORD (1876), reported on the herpetological works resulting from such Commissions. Expeditions to many remote regions in tropical and temperate regions of Asia (Yarkand, Abor Hills, Yunnan and the Mergui Archipelago), were also sources of material, and were reported on by ANDERSON (1879, 1889) and ANNANDALE (1912a, 1912b). The life and works of several prominent naturalists of the time who were associated with the Museum of the Asiatic Society of Bengal, or its successor, the Indian Museum, as either staff or Society members, are described below.

Colonel Richard Henry BEDDOME (1830–1911) entered the Indian Army in 1848. His primary interest was, however, in natural history, and in 1857, when the Madras Forestry Service was established, he became Chief Assistant to the Conservator, whom he succeeded in 1867. Besides his major botanical treatises, BEDDOME wrote lengthy papers on the herpetofauna of both the Western and Eastern Ghats of peninsular India, describing many new species, especially of uropeltids and lizards (e.g., BEDDOME 1862, 1863, 1867, 1870a, 1870b, 1886). Biographies of Beddome can be found in SMITH (1931, 1940).

Already well known for his two volumes on the Indian mammals and birds, Thomas Claverhill JERDON (1811–1872), a member of the Asiatic Society, was an important contributor to herpetology. JERDON made collections from all over India, the most important being made on expeditions to the Himalayas and the Khasi Hills of what was then Assam. JERDON's important works include a series of two papers that deal with his extensive collections from India, published in the *Journal of the Asiatic Society* in 1853 (1853a, 1853b), and an 1870 paper describing many new species of amphibians and reptiles, most presumably collected personally, and hence natural history information on many were provided. The major synthesis on reptiles, planned in collaboration with Albert GÜNTHER of the British Museum, where most of JERDON's specimens are deposited, proceeded as far as the genus *Tropidonotus* Kuhl, 1824, and was discontinued after JERDON's untimely death. It was left to GÜNTHER to describe the new species from JERDON's last expedition, including a new crotalid, *Trimeresurus* (now *Protobothrops* Hoge & Romano-Hoge, 1983) *jerdonii* (Günther, 1875). GÜNTHER (1875), however, commented that JERDON trusted his memory regarding collection localities, and did not always label his specimens, which left many without locality data.

Lieutenant-Colonel Edward Fredrick KELAART (1819–1860), Army Staff Surgeon, an important worker in Sri Lankan herpetology, was born of Dutch extraction in Colombo. KELAART studied medicine in England. Between 1852–1854, he produced *Prodromus Faunae Zeylanicae*, in two parts, which are now scarce volumes (the first was reprinted by the Wildlife Heritage Trust of Sri Lanka in 1998), that described the fauna of the island nation. Some of KELAART's herpetological specimens are in the Natural History Museum, London, others in the Zoological Survey of India. However, the types of a number of his new species are at present unlocated. Kelaart was in contact with BLYTH and Andrew SMITH (1797–1872), among others, but his full time commitment to the Army probably left him with little time to visit museums and compare specimens. Nonetheless, his *Prodromus* was to remain essential reading on Sri Lankan vertebrates for many decades. An essay on the life and work of Kelaart can be found in PETHIYAGODA & MANAMENDRA-ARACHCHI (1997).

The passing of the Museum Act in 1866 made possible the transfer of the Museum of the Asiatic Society to the hands of the British India Government (FERMOR 1936), thereby ensuring the preservation of its holdings for posterity. The responsibility of the collections maintained by Blyth fell on John ANDERSON (1833–1900), who was hired from England to be the first Supervisor of the Indian Museum. ANDERSON's first publication after joining the Museum was in 1871. It listed the reptile

accessions of the Indian Museum between 1865–1870, and contained the descriptions of numerous new species. ANDERSON was an indefatigable field worker and museum curator and administrator, which is reflected by his published output and the large number of long distance expeditions he took part in. One of his remarkable discoveries was made in the flooded ricefields above Nantin and the subtemperate valleys of Momien and Hotha, during one of the two expeditions to Yunnan in south-western China (where he was the official naturalist as well as Medical Officer) – a new genus (*Tylototriton* Anderson, 1871) and a new species (*T. verrucosus* Anderson, 1871) of newt. The two Yunnan Expeditions (1868–1869 and 1874–1875), despite their logistic and political problems, led to ANDERSON's finest work – the 1878 (published in 1879) monograph on the vertebrate fauna of the Upper Burma-Yunnan region, including fine water colors of turtles. ANDERSON's life and work have been traced by LEVITON & ALDRICH (1982) and BOULENGER (1905).

William THEOBALD (1829–1908), a staff member of the Geological Survey of India, is remembered for his work in both herpetology and malacology of India and Burma. While on an official visit to Calcutta from Rangoon, THEOBALD offered his services to John ANDERSON, to compile a catalogue of the herpetological holdings of the Museum in Calcutta. The manuscript was published as an extra number of the *Journal of the Society* in 1868. While THEOBALD followed the then recent work of GÜNTHER (1864), he made several radical changes in the higher level classification, such as placing Xenopeltidae with the booids, and establishing the Family Geoemydidae. Theobald described numerous novelties, including the genus *Blythia* Theobald, 1868. Eight years later, THEOBALD (1876) published an expanded version of his catalogue. His access to the Indian Museum material (which had by that time become a major repository for material from all over Asia) and a first hand knowledge of a partially-shared fauna (that of Burma), permitted a greater understanding of the fauna than that of many of his predecessors. This is readily evident from the identification keys that he devised (the first in the history of south Asian herpetology), using simple characteristics, such as colour, scale counts and gross morphology. Acutely aware of the shortcomings of his work, due, in part, to the non-availability of critical literature, THEOBALD's monograph was written, by his own admission, "at odd hours snatched from other duties, whilst waiting may be for a break in the weather to march, or whilst better men are busy saying their prayers". In Burma, THEOBALD's enthusiasm to catch the king cobra, *Ophiophagus hannah*, was not shared by the locals, and in retrospect, he admitted to being foolhardy, but that "one does not stop to weigh consequences when a fine specimen is to be secured".

The Czech geologist-natural historian, Ferdinand STOLICZKA (1838–1874), was appointed palaeontologist with the Geological Survey of India in 1863. An energetic field worker, he collected vertebrates and molluscs extensively, from Simla to Rupshu and the Indus Valley, including Spiti, Cutch, Darjeeling, and while on holiday, visited the then remote Andaman and Nicobar Islands. Stoliczka also collected from Akyab, Moulmein and Rangoon in Burma, Penang and Singapore in Malaya, and was the official Naturalist with the Second Mission to Yarkand, in central Asia. These truly remote regions offered great challenges ("Hunger, thirst, and cold are daily companions", wrote Stoliczka in a letter in 1864; KOLMAS 1982: 7), and it is thus not surprising that several of the species described by him have not been found since their original discovery. STOLICZKA's numerous papers were published in the *Proceedings* and *Journal of the Asiatic Society* (1871a, 1871b, 1872a, 1872b, 1872c, 1872d, 1873). The great explorer passed away from overexhaustion on the return leg of the journey from Yarkand, and was buried in Leh, in Ladakh. A biography and a list of published works and reports of Stoliczka can be found in KOLMAS (1982).

William Thomas BLANFORD (1832–1905) was an active collector, writing major works not only vertebrates, but also on molluscs. Natural history, however, was not his profession: BLANFORD joined the Geological Survey of India in 1845, and wrote several important works on his special subject. Besides India, Burma, and the Tibet Frontier, he also collected in Africa, and in fact, spend so much of his time in the field away from Calcutta that he could accept the offer of Vice-President of the Asiatic Society only in 1877, and between 1878–1879, was the President of the Society. As a field biologist, BLANFORD's papers were full of natural history trivia. Because of the passing away of Ferdinand STOLICZKA during the Second Yarkand Expedition, it was left to BLANFORD to compile the report of the expedition, which he did in the *Proceedings* and *Journal of the Asiatic Society* in 1875 and 1876. He also authored the zoological and geological results of the Persian Boundary Commission, 1870–1872, and was instrumental in convincing the Secretary of State for India of the need to start a series of volumes known as the *Fauna of India*, of which he was editor of the first four volumes (KINNEAR 1953).

Anderson was succeeded as Supervisor of the Indian Museum by Lieutenant-Colonel Alfred William ALCOCK (1859–1933), whose primary interest in the natural sciences was marine biology, although he also reported on the zoology of the Pamir Boundary Commission and on the reptiles of the Afghan-Baluch Commission of 1895 (ALCOCK 1897, 1898).

Various other collectors visited the region in the middle to latter part of the 1800s, for the purpose of acquiring zoological specimens for museums in Europe and the US. Prominent among them is William Temple HORNADAY (1854–1937), who spent time collecting in India and Sri Lanka in 1876, before proceeding to the Malay Peninsula and Borneo (HORNADAY 1885). HORNADAY'S collection was sold to various museums in the United States. For instance, gharials, *Gavialis gangeticus*, collected by him from the "Jumna River" are now with the United States National Museum (USNM 211272) and the Museum of Comparative Zoology at Harvard University (MCZ 161013 and 33950). An account of the life of this animal-collector-turned-conservationist is in GULLICK (1993). Another American collector at the time was Reverend M. M. CARLETON (?–?), whose herpetological activities were apparently confined to the Punjab region of northern India, between 1871–1880. CARLETON'S significant collection, comprising 230 specimens representing 39 species, also came to the Museum of Comparative Zoology, and was worked on by Thomas BARBOUR (1908), who described *Glaucania carltoni* Barbour, 1908, at present synonymous with *Leptotyphlops blanfordii* (Boulenger, 1890), and especially by CONSTABLE (1949).

Between 1854–1858, the brothers Hermann Alfred Rudolph (1826–1882), Adolphe (1829–1857) and Robert (?–?) VON SCHLAGINTWEIT conducted a scientific expedition to "India and High Asia". Their herpetological collection, numbering 118 specimens was donated to the British Museum, London, and was worked on by GÜNTHER (1860), who reported several new species from Simla, Garhwal, Ladak and Sikkim. Also in India (1816–1820) and Sri Lanka (1820–1821) was Jean-Baptiste-Louis-Claude-Théodore LESCHENAULT (1773–1826), who collected many new species of reptiles that were to be described by workers at the Muséum National d'Histoire Naturelle, Paris. A list of LESCHENAULT'S writing is in JEANDET (1883), and he appears not to have described any new herpetological taxa himself. The manuscripts of this early French naturalist, two of which contain substantial accounts of herpetological observations made in India and Sri Lanka, are extant in the Bibliothèque Centrale, of the Muséum national d'Histoire Naturelle, Paris. Another Frenchman who collected in India was Jean-Jacques DUSSUMIER (1792–1883), a trader-shipowner in the French mercantile marine, who collected specimens from many ports of call, all of which were eventually donated to the museum in Paris (KINNEAR 1953). *Draco dussumieri* Duméril & Bibron, 1837, honours the man, about whom little else is known.

A major contribution to the study of snakes in India was made by Joseph FAYRER (1824–1907), an army physician with the British East India Company, who saw ac-

tion during the Sepoy Mutiny, the first uprising by nationalist Indians against the British, in 1857. FAYRER was responsible for the folio volume *Thanatophidia of India*, published in two editions in 1872 and 1874. FAYRER'S careful study of the venom apparatus of snakes and his experiments with their venom helped improve treatment of snake-bite, and he was the first to draw attention to the differences in the nature of bites between elapids and vipers.

Although he never collected or otherwise worked in the region, Malcolm Arthur SMITH (1875–1958) is an important contributor to the herpetology of south Asia. Between 1914 and 1957, Smith published 128 papers and monographs, besides a number of reviews and obituary notices, many of which were relevant to the herpetology of this region (see bibliography in AHRENFELDT 1959). His three volume *Fauna of British India* series on Reptilia and Batrachia (published between 1931 and 1943), covering "Testudines and Crocodylia" (Volume I; 1931), "Sauria" (Volume II; 1935) and "Serpentes" (Volume III; 1943) is still essential reading in herpetology. The Amphibia was not dealt with. SMITH examined the collection of the British Museum and the entire collection of types belonging to the Indian Museum and that of the Bombay Natural History Society were sent to him on loan. SMITH'S knowledge of the Indian herpetofauna was thus based on museum study, and he expanded the geographic coverage of the *Fauna* to cover the entire Indo-Chinese region, areas he was most familiar with, on account of his long professional stint as a physician in Thailand (see SMITH 1957). SMITH (1952) also wrote the history of herpetology in India, from the time of Patrick RUSSELL to his own.

Frank WALL (1868–1950), a member of the Indian Medical Service, serving in India as well as Ceylon and Burma, distinguished himself in the study of snakes. WALL'S remarkable herpetological career included a large number of papers, starting with a note in 1898 on the water snake, *Enhydris sieboldii* Schlegel, 1837. His most significant works were a monograph of the sea-snakes (1909), one on the snakes of Sri Lanka (1921), and a semi-popular account of the venomous land snakes of British India and Sri Lanka (1928). In all, WALL wrote 219 papers, pamphlets and books during his long service in India (listed by CAMPDEN-MAIN 1969). Ever a populariser, he published, between 1905 and 1919, a series of 29 papers on the common Indian snakes in the *Journal of the Bombay Natural History Society*, with valuable notes on the natural history, and illustrated with fine coloured plates. Most of WALL'S snake types are extant in the Natural History Museum, London, the Museum of the Bombay Natural History Society and the Zoological Survey of India (SMITH 1931: 13; DAS & CHATURVEDI 1998; DAS et al. 1998).

The contributions of Western herpetologists, other than the British or those working with the Imperial Institutions, to the herpetology of southern Asia during this period can only be briefly described. The French contribution in the region did not match their efforts in the French colonies in Indo-China, but deserves mention. Paul CHABANAUD (1876–1959), a Correspondant of the Muséum National d'Histoire Naturelle, Paris, produced a 13 page report in 1922 of a collection of amphibians and reptiles made by the French collector Guy BABAULT (?–?) in 1914 in the Central Province of India and the eastern Himalayas. The work included 128 species, comprising 21 amphibians and 107 reptiles. In 1928, the Swiss herpetologist, Jean ROUX (1876–1939) reported on a herpetological collection made by the Muséum d'Histoire Naturelle, Geneva, between 1926–27 that included the rare microhylid frog endemic to the Western Ghats, *Melanobatrachus indicus* BEDDOME, 1878 (see ROUX 1928).

Directly instrumental in the founding of the Zoological Survey of India in 1916 (see SEWELL 1932, for a history of its founding) was Thomas Nelson ANNANDALE (1876–1924), who came to India in 1904 as Deputy Superintendent of the Indian Museum. ANNANDALE helped initiate both the Records and Memoirs of the Indian Museum. Perhaps the region's first limnologist, ANNANDALE did extensive work on the ecology of Asian lakes, such as the Chilka and Logtak in India, Inle in Burma, the Sea of Galilee in Jordan, Hamun-i-Helmand in Seistan (at the Baluchistan-Persia border), and others in Peninsular Malaysia, China and Japan. He also described numerous taxa of amphibians and reptiles from all over India, besides Kuwait, Bangladesh, Nepal, Pakistan, Burma, China, Borneo and Java. The heavy work of administration of his new organisation (in addition to the Anthropological Survey of India, which he also helped found), which he was responsible in placing as an Imperial Department, at par with the long-established Geological Survey of India, did not stop his field work, and ANNANDALE participated in expeditions in the Malay Peninsula, Java, Palestine, China, Morocco and Japan. He died of malaria at the age of 48. Accounts of the life and works of ANNANDALE can be found in KEMP (1925) and SEWELL (1950).

## 7. POST-WORLD WAR II

The post-independence era marked the beginning of a period of great decline in field research in general. Countries in south Asia had the daunting task of nation-building, and resources for development of natural science were limited. Contributions to the subject for the next half a century failed to match those made earlier in their importance, and many were isolated descriptions, miscellaneous observations on natural history of the more abundant species, and basic studies of morphology

and physiology. For reptiles, workers continue to use the *Fauna of British India* series by Malcolm SMITH, published between 1931–1943, while the only comprehensive volume for the amphibians is the one in the earlier series by George BOULENGER in 1890.

Despite these constraints, individuals of several institutions, such as the Zoological Survey of India, the Pakistan Museum of Natural History and the Bombay Natural History Society explored some of the remotest parts of the region, including the Nicobar Archipelago, eastern Arunachal Pradesh, at its border with Myanmar, the forested hill range of the Western Ghats, and the remote Balochistan region, turning up new species or new records of what were considered extralimital species.

Substantial work was conducted in Sri Lanka (then Ceylon) after World War II by one man- Paulus Edward Pieris DERANIYAGALA (1900–1973), the country's most well respected zoologist and a product of both Cambridge and Harvard. DERANIYAGALA was Director of the National Museum at Colombo between 1939–1963, and published extensively on such subjects as anthropology, archaeology, sociology and palaeontology. Perhaps his most important herpetological work is on the crocodylians and turtles of Sri Lanka, entitled *The tetrapod reptiles of Ceylon*. Vol. 1, published in 1939. His set of two volumes on herpetology in the *Colored Atlas* series (Vol. 1: fish; Vol. 2: Tetrapod reptiles, including crocodylians, turtles and lizards; and Vol. 3: Snakes), published between 1953–1955 by the Colombo Museum, are landmarks in the history of natural history of Sri Lanka. Each volume was profusely illustrated with the author's own water colours (although some would argue that these are more artistic renderings than reliable aids to identification). DERANIYAGALA described a total of 51 species and subspecies of reptiles, both living and fossil. An account of the life and herpetological publications of the Sri Lankan naturalist is in DAS & DE SILVA (1996).

The contribution of overseas specialists to the growth of the subject in the subcontinent in the last few decades have been significant. The list includes Edward Harrison TAYLOR (1889–1978), whose contributions to the herpetology of Ceylon were mostly published in a series of large papers in the *University of Kansas Science Bulletin* (e.g., TAYLOR 1947; 1950a; 1950b; 1953), and included many new species. For instance, from a single site, "12 miles north of Trincomalee", TAYLOR collected five new species of the genus *Typhlops* Oppel, 1811 (*Typhlops lankaensis* Taylor, 1947, *T. malcolmi* Taylor, 1947, *T. tenebrarum* Taylor, 1947, *T. veddae* Taylor, 1947 and *T. violaceus* Taylor, 1947), all of which are considered valid at present (MCDIARMID et al. 1999). Among other more recent European contributors is Robert Friedrich Wilhelm MERTENS (1894–1975), Cu-

rator of the Senckenberg Museum in Frankfurt am Main. Mertens produced a long series of papers on the herpetology of Pakistan, including important ones published in 1969, and supplemented with those in 1970, 1971 and 1974 describing many new taxa, based on field work conducted in 1952. The sole Hungarian contributor to the herpetology of south Asia is Lajos (= Ludwig) MÉHELY (1862–1952/53), who, in 1897, published an important 16 page paper in *Természetrajzi Füzetek* on the herpetofauna of Sri Lanka. Sherman MINTON's (1919–1999) most important work on the region includes an illustrated key published in 1962 and a 1966 monograph that formed an issue of the *Bulletin of the American Museum of Natural History*, in which he gave an account of the herpetofauna of Pakistan. Since the 1970s, a number of workers, local and foreign, have worked in several countries of south Asia, particularly Pakistan, Sri Lanka and Nepal.

Explorations of the remaining wilderness areas of southern Asia are at present under threat of cessation, as systematic research and museum collections are not actively supported by local governments, as a result of a combination of a lethargic bureaucracy, scarcity of resources, scientific mediocrity, and restrictive legislation regulating access to natural resources. As the world enters the new millennium, human needs are greater than ever before, and probably never in the history of south Asia has the need to understand and protect its living resources been greater.

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## Appendix

In the preceding essay, I have used geographical names as they existed at the time. In this appendix is a list of place names cited in the text (in bold) and their modern-day equivalents.

**Akyab:** Sittwe, Myanmar. **Assam:** Although there is a modern Indian state by this name, historically, it included what are now the states of Manipur, Meghalaya, Mizoram, Nagaland and Tripura (which, along with Assam and Arunachal Pradesh, are collectively referred to as 'Seven Sisters'). **Bombay:** Mumbai, in Maharashtra State, western India. In historic times, the Bombay Presidency included the State of Baluchistán, Punjab, the princely State of Rájputána, besides the modern state of Maharashtra. **Burma:** Myanmar. **Calcutta:** Kolkata, in West Bengal State, eastern India. **Cawnpur:** Kanpur, in Uttar Pradesh State, northern India. **Central Province:** Madhya Pradesh, in central India. **Ceylon:** Sri Lanka. **Coromandel Coast:** Situated east of the Eastern Ghats, a loose chain of hills, the coast stretches from the mouth of the Krishna River, south to Point Calimere, at the southern point of peninsular India. **Cutch:** Kachchh, in Gujarat State, western India. **Hotha:** Husa (Longchuan Xian), in Yunnan Province, south-eastern China. **Jumna River:** Yamuna River, in Uttar Pradesh, northern India. **Khasi Hills:** A mountain range in the central part of Meghalaya State, north-eastern India. **Ladak:** Ladakh, referred to as 'Kiachha' by the traveller Fa Hien and as 'Mao-lo-Pho' by Hieun Tsang, lies north-east of the Indus River, and comprise the mountain ranges of Ladakh and Karakorum, and also valleys of the upper Indus, in

northern of India and extreme north-eastern Pakistan. Since the cease-fire agreement between India and Pakistan in 1949, southern Ladakh has been a part of Jammu and Kashmir State of northern India, the rest administered by Pakistan. **Madras:** Chennai, in Tamil Nadu State, south-eastern India. Historically, Madras Presidency included the modern day Tamil Nadu State, in addition to five politically dependent states- Travancore, Cochin, Pudukottah, Banganapalli and Sandhúr, and extended from Cape Comorin (Kanyakumari) to Chilka Lake bordering the Bay of Bengal; the western borders touched the Arabian Sea. Also included in the Madras Presidency was the Laccadive (Lakshadweep) Islands. **Malaya:** At present, West (or Peninsular) Malaysia and Republic of Singapore. **Momien:** Tengchong Xian, in Yunnan Province, south-eastern China. **Moulmein:** Mawlamyine, in southern Myanmar. **North East Frontier Agency:** Arunachal Pradesh, in north-eastern India. **Penang:** Pulau Pinang, West (or Peninsular) Malaysia. **Persia:** Iran. **Rangoon:** Yangon, in southern Myanmar. **Saru River:** Saryu River, in north-western India. **Simla:** Shimla, in Himachal Pradesh, northern India. **Tibet:** Xizang Autonomous Region, China. **Tranquebar:** Tarangambadi, in Tamil Nadu State, south-eastern India. **United Provinces:** Uttar Pradesh, in northern India. This is the region of much of India's pre-Muslim and pre-British history, including the epics Ramayana and Mahabharata, and the cradle of the great kingdoms of Ashoka and the Guptas. The United Provinces of Agra and Oudh was formed in 1902, and made an autonomous government in 1937. **Vizagapatam:** Visakhapatnam, in Andhra Pradesh State, south-eastern India. **Yarkand:** Shache, southern Xinjiang Uygur Autonomous Region, western China.