



A formal swan with crest and curled plumes and a short neck. From a carving in wood on a doorway in Chingleput District, Madras.



Another form of the mythical Yali with lionine body, mane and tail, but with canine face and bovine horn and ear. From a panel of a 'mangani' at Madurantakan in Chingleput District, Madras.

Photos: M. Krishnan

known to Hindu religious tradition as *sāligrām*, is held in veneration as the favourite abode of Mahā Vishnu.

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#### I. ANIMAL WEALTH OF INDIA IN THE 3RD AND 4TH MILLENIUM B.C.

Evidence of animal life in the Indus Valley and the adjoining territories of Sind, Punjab, and Baluchistan has been brought together by a careful study of the actual animal remains found in Mohenjodaro, Harappa, Amri, Nal, Nundara, and Rupar, and of animal representations engraved on seal amulets, and in the figurines and engravings and paintings on pottery and other ware. Actual remains of 39 species of animals including 26 of Vertebrates and 13 of Invertebrates were found at various levels. These may be grouped as follows:—

1. Animals maintained in a state of domestication. Humped cattle, buffalo, elephant, camel, horse, goat, pig, and fowl.
2. Animals found near human habitations, some of them probably semi-domesticated. Dog, mongoose, shrew, rat, lizard, and tortoise.
3. Animals caught, probably for use as food. Pig, crocodile, turtles, tortoise (*Trionyx*, *Chitra*, *Damonia*, and *Batagur*), freshwater fishes (carps, cat fishes *Rita* and *Wallago*) and the marine cat fish *Arius*, probably imported for consumption from the coast.

4. Scutes of turtles, shells of snails, and the skeleton of corals imported for ornament or other uses.
  5. Animal remains imported probably for medicinal purposes.
  6. Wild animals.
  7. Animal remains occurring fortuitously.
- Batagur* among tortoises *Lamellidens* and *Area* among bivalve molluscs; *Cypraea* (Cowries), *Eburna*, *Fasciolaria*, and *Xanchus* (Chank) among gastropod molluscs; and *Favia* among corals.
- Horns of deer (*Cervus*, 4 species).
- Bear, monkey, jackal, wolf, squirrel, gharial, and parrot.
- The Clionid sponge, judging from bore holes on *Fasciolaria* shells, the Polyzoon colonies the markings of which are still to be seen on shells, and the Anatinid bivalves embedded in a mass of madreporean coral show that conditions in the sea were much the same as they are now.

The elephant (*Elephas maximus*) was probably wild as there is still evidence that in Malwa and Nimar it was so till 1600 A.D. The horse (*Equus caballus*) was the country-bred, while of the humped cattle (*Bos indicus*) there are wild and domesticated forms showing progressive and steady deterioration correlated with the size of teeth and skull. There were the buffalo, the camel, the goat, the sheep, the ass, and the boar. The Kashmir Stag, the Sambar or Rusa Deer, the Spotted Deer, and the Hog Deer which is still an inhabitant of Sind were common. The domesticated fowl was probably much larger in size than modern fowls, judging from the size of the femur and other bones.<sup>1</sup> The presence under fluviatile conditions of the freshwater bivalves, *Lamellidens marginalis* and *Parreysia favidens*, and of the freshwater gastropods, *Indoplanorbis exustus* and *Viviparus bengalensis*, and of the land-snail *Zooteus insularis*, the gharial *Garialis gangeticus*, the tortoises and turtles, the carps, and cat fishes shows that the faunal elements on land and in water were much the same then as they are now. The chank bangles and cores from which bangles have been sawn show that bangle-making and bangle-wearing were then as much in vogue in western India as now in Bengal and east India.

We may now turn to the representations of animals engraved or painted on seals and pottery and to the figurines. Owing to the bizarre and fanciful forms which have been given to them, the identification of these representations of animals is probably a little more difficult

<sup>1</sup> Herodotus, the Father of History, is said to have recorded twenty-three centuries ago that the animals of India, except the horse, were larger than those found elsewhere (Annandale, N. *Journ. Bombay Natural History Society* 29 : 633-642, 1923).

than that of the actual animal remains which rarely, if ever, give room for ambiguity. Apart from engravings of fabulous creatures on seal amulets, the recognisable animals are the cattle, the elephant, the rhinoceros, and the tiger<sup>1</sup> such as are commonly found in damp jungles. The lion which prefers a dry zone such as is now found in the Gir region of Kathiawar does not appear to have figured on seals. Amongst the cattle figure the water buffalo (*Bos bubalis*), the Gaur or bison (*Bos gaurus*), the humped bull or Zebu (*Bos indicus*), and a short-horned humpless bull. The ram, pig, dog, monkey, bear, hare, and squirrel amongst mammals, and the parrot and peacock among birds are found engraved on copper tablets or take the form of figurines, but are never represented on seals. The dog, represented with the collar round the neck, shows it to have been used as a domestic pet and a guard. The short-horned and the humped bulls, the ram, and the rhinoceros were amongst the most popular of the animal figurines, though curiously the cow is altogether omitted, as also the tiger which, according to Piggot (1952), still survives in Sind<sup>2</sup>. The elephant and the fish-eating crocodile (*Gharial*) of the great rivers of India are copied in figurines, though the common pig is omitted.

Lion, goat or ibex, birds of various types, and fishes, and even the scorpion are represented in the Sind and Baluchistan ware, the ibex being often used as a decorative motif. Some of the Kulli ware bears painted decorations in the form of a frieze of naturalistic representations of animals and plants. The animal representations include humped cattle, felines in grotesquely elongated forms (which appear to have been copied by modern advertisers of automobiles, motor oils, and lubricants), diminutive stylized goats, conventionalized birds, fish, and even a bloated stag-beetle. The humped cattle are shown as tethered to trees or posts indicating their domestication.

## II. ANIMAL LIFE IN THE VEDIC PERIOD (2000 TO 600 B.C.)<sup>3</sup>

For a knowledge of the classification of animal life in the period up to 600 B.C. one has to turn to recorded evidence of such knowledge in the Upanishads, Susruta Samhita, and other works. The Chāndogya Upanishad has classified animals on the broad basis of their ovum or seed (*bija*) into three groups: (1) born of eggs (*andua*), (2) born fully developed or viviparous (*jivaja*), (3) born of plant-like organisms (*udvijja*). The birds, which belong to the first group, and mammals, which belong to the second group, both of which are used as food by man, appear to have been divided into the following 8 classes depending on their habitat and feeding habits:

1. Carnivorous land quadrupeds and birds such as fall upon their prey with force (*prasaha*).
2. Animals living in marsh or water-logged lands or graze on river banks (*anripa*).

<sup>1</sup> The tiger has curiously left no traces of its bones amongst the animal remains excavated in Sind and Baluchistan.

<sup>2</sup> We can trace no authentic record in support of this either for the past or the present. E.g.

<sup>3</sup> Including the age of the Rig Veda (2000 to 1500 B.C.), the age of the Samhitas and Brahmanas (1500 to 800 B.C.), and the age of the old Upanishads (900 to 600 B.C.).

3. Animals living in underground holes or burrows (Rodents and Insectivores—*bhūsaya* or *vileśaya*).
4. Animals living in freshwater or seawater (*vārisaya*).
5. Animals living both on land and in water—amphibians (*jalachara*).
6. Animals living on dry and elevated hilly or jungle land, such as deer, etc. (*jangala*).
7. Birds that scatter their food in picking it up (*viskira*), e.g. crow, bulbul, thrush, pigeon, and other perching birds.
8. Birds that pierce, tear their food (fruits), or torment their prey (worms) with their beak [Birds of prey—vulture, eagle, kite, etc. (*pratudda*)].

The second class *anūpa* appears to have been deemed an important class as it is further divided into the following groups:—

1. *kulēchara*—herbivorous quadrupeds frequenting banks of rivers and ponds, including the elephant, the rhinoceros, the buffalo, and the deer.
2. *plava*—floating on water, such as geese, ducks, cranes, etc.
3. *kōsastha*—living in shells (mollusca), including the large gastropods, the Chank (*sankha*) and the smaller gastropods (*sankhānā*), the mussels, and pearl-oysters (*sūkti* and *jalasūkti*), the various types of spiral-shelled land gastropods or snails (*sambhuka*, *valluka*, *rādika*, etc.).
4. *pādīna*—aquatic animals with long drawn appendages including the tortoise and turtles (*kūrmā*), the crocodile (*kumbhīra*), the crab (*karkata*), the whale or dolphin (*simsūmā*) with a protruding snout and breathing through a blow-hole out of water.
5. *matsya*—the fishes of seawater and freshwater, amongst which are included the whales (*timi* and *timingila*) and the sharks (*makara*).

The *jangala* were similarly broken up further into arboreal animals [*parnamriga*—ape, monkey, sloth, squirrel, tree cat (*putighasa*), and other similar carnivores], domesticated animals (*grāmya*—horse, mule, ass, camel, goat, sheep, etc.—all non-carnivorous quadrupeds or *akravyāda*), cave-dwelling animals (*guhāsaya*—lion, tiger, panther, bear, wolf, hyena, jackal, wild cat—all carnivorous quadrupeds).

More or less similar notions seem to have prevailed in the classifications of the animal kingdom enunciated by Susrūta, Pātanjali, Prasastapāda, and Chāraka. Susrūta has recognised oviparity, viviparity, and spontaneous generation amongst animals. He put man and the carnivorous (*vijala*) and herbivorous (*pasu*) quadrupeds amongst the viviparous; birds, snakes, turtles, crocodiles, and fish amongst the oviparous; worms, insects (*krīni*, *kīta*, *pīplīka*) amongst those born of moist heat; and frogs and mealy bugs amongst those that are born after metamorphosis. Pātanjali seemed to have been aware of a group of small or minute animals without blood or bones which he classed among the *kshudrajanū*, but as asexually generated. Prasastapāda recognised the asexually generated (*ayōnīja*) from those sexually generated by the union of sperm and a germ element (*yōnīja*), and amongst the latter the placental viviparous

(*jarāyuja*) from the non-placental egg-born (*andaja*) birds, reptiles, fishes, and insects. Chāraka recognised four primary divisions of animals: (1) the viviparous placental quadrupeds and man (*jarāyuja*), (2) the oviparous birds, reptiles, and fish (*andaja*); (3) the asexually or spontaneously generated worms, mosquitoes, etc., born of moist heat (*svēdaja* or *usmaja*) and (4) those born of rotting vegetation (*udvijja*).

There is some evidence of a more precise classification in the *Susruta Nāgārjuna*, as in the case of snakes, which are divided into 5 different genera or families, one non-venomous and four venomous including one hybrid and three pure families. The venomous are (1) the hooded cobras (*Nāga tripudians* and *N. bungarus*) the *darvīkāra*, diurnal, swift, and bearing marks of chariot-wheels, plough, umbrella, goad, or thrombus on the hood; (2) the non-hooded thick-set, slow, nocturnal Vipers (*mandali*) bearing circles or rings on the body; (3) the non-hooded nocturnal Krait (?) bearing coloured markings or dots on the upper parts and sides; and (4) the hybrid *raikaranya*. The non-venomous (*nirvisha*) family includes the Boidae or python (*ajagara*), and the arboreal colubrine *Dendrophis* (*vrishkshēsaya*). The poison of cobras was believed to be most deadly when they were young, and of *mandali* or vipers when middle-aged, and of *rajmata* when aged. The differential action of the venom on animals in the different venomous snakes appears to have been known and is elaborately described.

The Agni and Bhavishya puranas have a number of observations on the structure and habits of snakes, some of which approximate to modern verified and recorded facts while others appear to be fanciful as yet. The latter states that Nāgāda (*nāgās*) copulate in the summer months of May and June (*Jyēṣṭha* and *Āshādha*), gestate during rainy months and bring forth about two hundred and forty eggs in November (*Kārtik*), the majority of which are devoured by the parents, but those that are left break forth from the shell in about two months. Eggs of a golden hue like that of the red *arka* (*Calotropis gigantea*) produce males, those somewhat paler and of an elongate ovoid shape bring forth females, and those of the hue of *Sīrīśā* blossom hermaphrodites. The young snakes turn dark on the 7th day, and in a fortnight to three weeks the teeth appear. Poison is formed in the fangs in three weeks and becomes deadly on the 25th night. In six months more they shed the skin. Their crawling on the ground is associated with the folds of the skin on the undersurface expanding and contracting alternately, and appearing as though they had fine filament-like legs. The joints on the skin (scales and scutae) are stated to be 240 in number (sub-caudals excluded). Human beings, oxen, mongooses, boars, cats, peacocks, partridges (*chakrā*), and even a scorpion are stated to be their enemies. The cobras (*nāga*) may live for 120 years, and the non-venomous snakes for 75 years, estimates which are only twice as much as the modern ones ranging from 13 to 30 years or more for all types of snakes as a whole.

<sup>1</sup> Flower, S. S. Contributions to our knowledge of the duration of life in Vertebrate animals, Parts I to IV. *Proc. Zool. Soc. London*, I and II Fish and Batrachians pp. 247-289 (1925), III and IV Reptiles pp. 911-981, Birds pp. 1365-1472, Mammals *P.Z.S.* I, pp. 115-231. Same author in *P.Z.S.* I (1935), CVII (1937), CVIII (1938).

According to Agnipurana the total number of teeth in a cobra is 32 of which four, two on either side, are venomous and have distinct names (*kalarātri* and *yanadātika*). The non-grooved hard maxillary teeth accompanying the fangs also seem to have distinct names (*karāli* and *makari*).

The understanding of the classification of animals seems to become more precise and scientific at the beginning of the 1st century A.D. In the Jaina work *Tattvārthadhigama*, Umasvati (ca. 40 A.D.) has attempted a classification of the animal kingdom on the number of senses, from the simple to the complex, as follows:—

Invertebrata:

- (i) Animals with *two* senses, of *touch* and *taste*, involved in the selection or rejection of food.
- (ii) Animals with *three* senses, of *touch*, *taste*, and *smell*, involving the contraction of tissues and appropriation of food.
- (iii) Animals with *four* senses, of *touch*, *taste*, *smell*, and *sight*.

Vertebrata:

- (iv) Animals with *five* well-developed senses of *touch*, *taste*, *smell*, *sight*, and *hearing*.

Invertebrata:

- (i) Worms without appendages (earthworms, round worms, etc.), and the leeches (*jalāka*), Annelida (*apādika*), and those with unsegmented lateral appendages (*nāpuraka*), the joint-legged arthropods (*gandupāda*), the top-shaped molluscs (*sankha*) and the Helicoid gastropods (*sambuka*), the bivalve molluscs such as pearl-oysters and mussels (*sūktika*) are put under the first group.
- (ii) The ants (*pipilika*) and the Formicid red ants (*rōhinika*), the bugs and fleas (*upāchika*, *kunthu* and *tuburuka*), the weevils and lice (*trapusabija* and *karapāstikha*), the centipedes and spring-tails (*salapādi* and *utpātuka*), the plant-lice (*trinapatra*), the white-ants or termites (*kāshṭahāraka*) are among those of the second group.
- (iii) The bees, wasps and hornets (*bhranara*, *varata* and *sāranga*), the flies, gnats, gad-flies, and mosquitoes (*makshika*, *puttika*, *dansa*, and *mashaka*), the scorpions and spiders (*vischika* and *nandyāvara*), the butterflies and moths (*kīta*), the grass-hoppers and locusts (*patanga*) are amongst those of the third group.

Vertebrata:

- (iv) The fish (*matsya*), the oviparous, limbed amphibians and reptiles (*bhujanga*), the oviparous apodal caecilians and reptiles (*urago*), the birds (*pakshi*), and the quadrupeds (*chatuspāda* and *tiryakyōni*), and the biped or man (*dvipāda*) are among those of the fourth group.

The fourth group is sub-divided according to the mode of production as follows: (1) *andaja* (pisees, Batrachia and Reptilia), (2) *jarāyuja* (mammals born with non-deciduous placenta), (3) *pōtaja* (mammals with deciduous placenta).

1. *Andaja* includes *sarpa* (serpents), *godha* (giant lizard-like monitor, etc.), *krikatāsa* (chameleon), *grītagōliku* (house lizard), *matsya* (fish), *kārma* (tortoise and turtle), *nakra* (crocodile), *sīnsūmāra* (porpoise or dolphin), and the *lōmapaksha pakshi* (birds with feathers).

2. *Jarāyuja* includes man, ape, cattle, horse, camel, deer, hog, lion, tiger, bear, dog, and cat.

3. *Potaja* includes elephants, insectivores, hare, squirrel, mongoose, mice, and bats.

Knowledge of animal life in India amongst the Vedic Indians appears to have been comprehensive and widespread, judging from references to over 250 species of animals in the Rig, Yajur, and Atharva Vedas spread over the more important classes of the animal Kingdom, particularly those of the phylum Vertebrata. A broad classification of animals based on their habits, such as *vāyārya* (living on air), *āranya* (wild), and *grāmya* (tame or domestic), seems to have been in vogue. Amongst the Invertebrates, the relatively fewer references are to the terrestrial Insects, though a few marine organisms like pearl-shells and the chank or *sankha* find a mention in the Vedic texts, which indicates that the Vedic civilization came into very little contact with maritime states and civilizations. Amongst the Vertebrata, by far the most numerous references are to the mammals and birds, though reptiles, amphibians, and fish find a place in the repertory of knowledge in the Vedic period.

The herbivorous ruminant and non-ruminant ungulates, and the elephant (*gaja* or *mrigahasti*), the ape (*kāpi*, *kimpurusha*, *purusha mriga*), and the flying fox (*manthāvala*), the graminivorous or omnivorous Rodents, hare (*susa*), mouse (*niśhika*), rat (*ākhu*) and mole, and the carnivorous lion (*pītra* or *simha*), tiger (*vyāghra*, *sārdāla*), panther (*drīpin*), polecat and cat (*vrīsha*, *damsa*), hyena (*śāla-śrīka*), wolf (*vrīka*), jackal (*śrigāla*), and dog (*śrāna*, *kukura*), the ichneumon or mongoose (*nakula*), and the omnivorous bear (*raksha*), and the fabulous eight-legged beast or bird of the snowy regions referred to as *Sarabha*, and the dolphin (*mukara*) amongst the aquatic inhabitants appear to be the mammals known in the Vedic age. There is also reference to the capture of lions in pitfalls (*paripad*). The bat (*jatu*) seems to have been treated separately, neither as a beast nor as a bird. We shall have occasion to revert to the herbivorous class of animals in greater detail further on.

A great variety of birds finds mention in the Vedic texts: the carrion-eating vulture (*gridhra*), the hunting eagle (*syēna* or *suparna*), the falcon (*kshipra-syēna*) and other birds of prey, the carnivorous night-prowler owl (*ulāka*), the omnivorous crow (*śayasa*, *lōpa* or *smasara* *kukum*), the graminivorous pigeon (*kapōta*), and sparrow (*kalavinka*), the insectivorous cock (*kukkuta*), Cuckoo (referred to

<sup>1</sup> The sacrificial altar in the Asvamedhakāya sites discovered near Dehra Dun is said to have the shape of a *syēna* in the act of flying with outspread wings (vide Ramachandran, T. N., in *A.I.R. Selections*, II, No. 2, pp. 46-48, 1946).

under a variety of names such as *kōka*, *kōkila*, *chakravāka* ?, *pika*, Curlew or snipe (*krauncha*), Quail (*laba*), partridge (or lapwing?) (*tittiri*), peacock (*mayūra*), thrush (*rōpanaka*), woodpecker (*cāsha*), wagtail and the Cattle Egret (*gō-shadi*), the smaller honey-sucking or flower-visiting sunbird (*palanga* or *sakunta*), the aquatic group of birds, goose or duck (*chakravāka*), swan (*ati* or *hamsa*), diver (*madgu*), pelican (*plava*), crane (*hālaka*), and heron (*kanku*). Amongst the birds mentioned as being capable of separating milk from a mixture of milk and water are the eagle (*suparna*), the curlew (*krauncha*), and the swan or goose (*hamsa*). The last named is said to be capable of separating *soma* from a mixture of it with water.

Amongst the reptiles, the snakes were very well known, each by its own special features of coloration, structure, or habits. The goat-eating python (*ajagara*), the boa-constrictor (*asita* or *vāhasa*), the crawler (*ahi* or *sariśripa*), the red coloured *lohitaki*, the speckle-necked *kalmasagrica*, the cross-striped *tiraska-rājī*, the valuable-skinned *prādāku*, the viper (*svāja*) which is said to be attacked and killed by the deer or gazelle (*harina*) constitute the serpent tribes known to Vedic Indians. Great importance was attached to the study of serpents (*sarpa* *vidya*). The chameleon (*krikalasa*) and the house-lizard (*kundranācī*, *kumbhīnasa*), amongst the smaller land reptiles, the crocodile (*nakra*, also known as *ajagara*), the alligator (*sintsumāra*), and the tortoise (*kucchapa* or *hārma*) amongst the aquatic reptiles appear to be well known.

The only amphibian *sensu stricto* known was the frog (*mandūka* or *varshā-bhī*), which is supposed to have cooling properties and to call in the rains. The *mandūka* amongst the amphibians and the *tittiri* amongst the birds appear to have been used to designate two of the Upanishads, the *Māndākyōpanishad* and the *Taittiriyōpanishad*.

It is curious that although a few references to fish and fishermen are found in the Vedic texts, they refer to a later period in Vedic age rather than the earlier. Angling of fish by hooks and the drying of fish and its sale appear to have been prevalent. The terms *purikāya*, *jasu*, *matsya*, and *sakula* appear to refer to some genera of fish, and the terms *kaivarta*, *dāsa*, *dhaivra*, and *sauškala* to fishermen or their profession and trade.

Amongst the Invertebrates the class Insecta is more frequently alluded to than the Crustacea and the Arachnida. The crab (*karkata* or *udra*) in the former, the spider (*śūra* *nābhi*) and the scorpion (*vrishchika* or *ajakava*) in the latter appear to have been most commonly noticed. The misleading general term 'worm' appears to have been applied to a varied assortment of earthworms, round worms, millipedes and centipedes, and grubs of insects, referred to under the terms *krimi*, *adrishta*, *alāndu*, *avaskaza*, *kaskusa*, *kīta*, *kapana*, *nilangu*, etc. The caterpillar or worm-like larval forms of insects were probably the *trīna* *jālayāka*, and any crawling worm-like form was also referred to as *tsaru*. Among Insects, the biting, the piercing or stinging, the boring, and the cutting forms seem to have been recognised. *Alapāsaya* and *palanga* were the generic terms for insects, the *prahankata* and *plusi* being the noxious ones. The locust (*salabha*), the bee (*pushkarasada*, *arangāra*, *sāra*, *bhringa*, *madhukriti*),

the cochineal (*indragopa*), the termite (*upajīhvaka*) which builds the ant hill (*vapa*, *valmīka*), the ants which eat the flesh of the dead (*pīpila* and *pīplika*), and the grain-destroying (*jabhya*) and boring (*tarda*) beetles seem to have been distinguished, as also the different kinds of flies. The unwelcome and annoying house-fly termed *makshi* or *ādmasad*, the small biting fly or gadfly (*damsa*), the large biting fly (*mashaka*) which is said to be capable of biting even the thick-skinned elephant, the stinging wasp or other similar insects (*suechika*), and the sky-illuminating fire-fly (*khadyōtā*) are referred to in a number of places in the Vedic texts. The flies, mosquitoes, lice, and bugs are classed generally amongst the sweat-born (*svēdāja*) in *Mānava Dharma Sāstra*. A theory of spread of diseases by an unseen (*adrishta*), probably microscopic, worm (*krimi*) seems also to have been prevalent.

The horse, the cow, the sheep and goats, and man, collectively termed *pasu*, have received frequent mention in the Vedic texts.

The cattle, more particularly the bull, the cow, and the ox, and their calves, have been treated in great detail as may be seen from the innumerable terms used to differentiate them at various ages and conditions. Thus, the oxen employed for drawing carts were *anadvaha*, the bull (*usra*, *rishabha*, *garaya*, *gaura*) separated from the cows was *maryaka*, the castrated ox was *nirasta* (applied to the castrated horse as well), the cow ceased to give milk was *dhīnushtari*, and the cattle having a spleen-shaped mark branded on the ear were *plīhakarna*, the young cow which has calved only once was *grishti*, the cow desiring the bull was *vasita*, the cow that miscarried was *vehat*, and the barren cow was *vasā*. Similarly, the calves of various ages were distinguished, e.g. the new-born calf (*ātmada*), the sucking calf (*dhāruna*), the 18-month old calf (*tryavi*), the 3-year old *trivatsa*, the 4-year old *turyanti* or *turyavaha*, and the young calf *vatsa* intended to induce the cow to give milk. Milk (*kshīra* or *pāyas*) played a large part in the economy of Vedic Indians. It was taken warm from the udder or made into *ādāna* with grain (*kshīraādāna*), *Ajā-kshīra* (goat's milk) is also mentioned.

The cow was the chief source of wealth of the Vedic Indians. Milk was drunk fresh or made into butter or curds, mixed with *soma* or cooked with grain. Cows were milked thrice a day and grazed thrice. The milking cows were in the *gosala* at night, others were in the open pasture, but in the heat of the day all were in the cattle-shed. Cows were also used for drawing carts.

A similar distinction of horses as in the cows above seems to have also been in vogue. The side horse (of the four horses yoked to the chariot) on the right or in front was *prastī-prastya*, the stalled horse not allowed to graze was *marya* or *pastyāvānt*; even the wild ass (*parasvānt*) was distinguished from the domesticated *khara* or *gārdhaba*. The mule was known to be of mixed parentage (*Asvatara* ♂ or *asvatari* ♀, or *dwirētās*) born of the horse and the ass or the mare and the ass. There are references to racing (*āji*) and a semi-circular race-course (*saptya* or *kastha*), and presumably the stalled horses were carefully maintained for the races or for being yoked to chariots which took part in the races. The race course had definite dimensions. Prizes were offered and eagerly competed for. The steeds used for the races were often washed and adorned.

Horses of various colours were known. A white horse with black ears mentioned in the *Atharva Veda* is said to be of special value.<sup>1</sup> Mares were preferred for drawing chariots, because of their swiftness and sureness, and also for drawing carts. Reins, halters, and whips were used to control horses.

The common and uncommon animals known in Vedic times were intelligently classified according to some peculiarities in structure or habits. Thus the dreaded beasts of the jungles were *mriga bhima*, the animals of the forest were *āranya*, the small herbivores, sheep, goat, and ox, were *kshndra* and *anyatdanta* (incisors in one jaw), and the larger whole-hoofed herbivorous horse and the ass the *eka-sapha* and *ubhayadanta*. There was even some reference to the embryonic membranes (*jarāyu*), the chorion as opposed to the amnion. The elephant was *hastin* by the use of its trunk for grasping things, and man was *ubhayadanta* (with incisors in both jaws) and *hastādana* by his habits of eating. The apes and monkeys which grasped their food by the mouth were *mukhādana*. It is evident that in Vedic times there were different kinds of stags (*rṣya*), deer (*truru*), antelopes (*ēni*, *krishna*), Gazelle (*prshtha*, *harina*), and also sheep (*avi*, *aja*) and goats (*chāga*), the buffalo (*mahiṣa*), the great bull (*mahoksha*), the rhinoceros (*khadga* or *vardhra nasa* in reference to its horn), the boar (*varāha* or *stūkara*), and the porcupine (*sra-vidh* or *salat*) whose quills were used for parting the hair and anointing the eyes.

There were innumerable economic uses for various animal products. The skins (*ajina*) of animals (goat, gazelle, antelope and tiger) used as clothing (*ajina-visi*), and the furrier's trade were well known. Sheep's wool (*āmarati*) was used for making clothing and for filtering soma juice. The boar skin appears to have been used as material for making shoes or sandals (*upānah-sathapatha brahmaṇa*), and the rhinoceros hide as a covering for the chariot (*sankhyāyana srauta sutra*). Flesh of both oxen and cows which were sacrificed was eaten always cooked, never raw. Hunting was also practised for recreation as well as for food and for the protection of cattle. The bow and arrow were used for hunting, but nets and pitfalls mostly for capture. Birds were caught in nets and snares. Pits were used for catching antelopes and lions. Elephants were captured with tame females. The boar was hunted with dogs in chase, and the buffalo was captured by ropes or lasso.<sup>2</sup> Fish were caught by netting, by hook, and by hands, by damming streams, and baiting with poisons.

<sup>1</sup> In a recent work entitled '*Āvastāstra*' by Nakula (Edited by S. Gopalan, V. Swaminatha Atreya, and K. S. Subramania Sastry of the T. M. S. S. M. Library, Tanjore, S. India), the considerable knowledge developed in ancient India on horse-lore is referred to. A large mass of practical knowledge concerning the marks of good and bad horses, qualities of different breeds from various countries, the treatment of horse's ailments is ascribed partly to mythological and partly to historical authors.

<sup>2</sup> Owing probably to the military needs of the age, the knowledge of horses and elephants reached a high standard. There is thus a treatise on the elephant's health (*Hastayurveda*) of great antiquity. That a knowledge of animals in general was cultivated as a scientific pursuit is evident from the systematic treatment cows, dogs, goats, horses, and even cocks and turtles, receive in separate sections of *Varāhīmīra's Brihat Samhitā* (R. C. Mazumdar on 'Growth of Scientific spirit in Ancient India' in *Science and Culture*, XVIII pp. 463-472 (1953)).

Leather was used as material for making bow-string, sling, thong, rein, whip, bag, percussion instrument, and *bhastra* (bottle). The art of tanning hides appears to have been well known. The wetting of hides and its stretching over pegs are mentioned in the Vedic texts. Animal skins (*trac* in Rig Veda) were also used in the process of extracting soma juice from the plant.

The sacrifice of a great variety of animals in *astamēdha* (horse-sacrifice) and *purushamēdha* (human sacrifice) appears to have been common in Vedic times. Over 50 species of animals of all classes, big and small, are mentioned in the Vedic texts as being fit for such sacrifice. It is not clear whether all of them were eaten after the sacrificial ceremony. Amongst these are included serpents and other reptiles, frogs, birds, bats, carnivorous and herbivorous mammals including monkeys, even bees and other kinds of insects. Among human beings, the *hastipa* (elephant-keeper), the *kaiyarta* (fisherman), the *dundubhi* (drum-beater), the *saushkala* (fish-catcher or angler) are classed as fit for sacrifice at *purushamēdha*.

### III. ANIMAL LIFE KNOWN IN THE PERIOD OF SANGAM LITERATURE IN THE TAMIL COUNTRY<sup>1</sup>

A great variety of mammals and birds, and a few species of reptiles and fish, and of arthropods are referred to in the Tamil Sangam literature of South India. Both the wild and the domesticated species are mentioned, not in special treatises dealing with their natural history, but only incidentally in the course of descriptive accounts in verse or prose of town and country, of crowns and kingdoms, and of wars and conquests. The sources of such references to animal life in the Tamil country are not only the well-known and ancient works like *Tholkappiam*, *Silappadhikaram*, etc., but also other forms of literature like *Kurinjipāttu*, *Padittrupathu*, *Pattinapāllai*, *Kurunthōgai*, *Aingurūnūru*, *Malaipadukadām*, *Kural*, *Nāladiar*, *Nānmaṇikkadigai*, *Nattrimai*.

Amongst the mammals are mentioned the wild beasts including the lion and tiger, the wild cat, the bear and the boar, the porcupine, the elephant, the monkey, and the deer, the wild cow or bull, the jackal and the mongoose, the rabbit, squirrel and rat, and the domesticated ones including the goat, sheep and pig, the cow, bull and buffalo, the beasts of burden such as the ass, mule and horse, the elephant and the camel, and the dog and the bitch. The mythological *yāli* is also referred to.<sup>2</sup>

Amongst the reptiles, the cobra and the python, the tortoise and the

<sup>1</sup> The Tamil Sangam literature is almost certainly spread over a long period, but there seems to be considerable difference of opinion in regard to its length. Prof. K. A. Nilakanta Sastry is of the view that it is spread over four centuries commencing with the 4th century A.D. On the contrary Sri A. Chidambaranār mentions at least thirteen sangams between 3000 B.C. and 1915 A.D. in his work, *Tamizh Changalai Varatram* (S. India Salva Siddhanta Works Publishing Society, Tineevelly Ltd., Madras-1, 174 pp., 1948).

<sup>2</sup> The recent discoveries of examples of live animals in the sea of some of the weirdest species believed to have been extinct for millions of years must caution us against continued suspicion of oft-repeated statements of observed phenomena in so-called mythology.

turtle, the crocodile, and the lizard and the iguana find mention. The mythical or the freak five-headed cobra is also referred to.

The soaring birds, such as the kite (including the white-necked *garuda*) and the vulture, the domestic and jungle fowl, the crow, the sparrow and the pigeon, the peacock, parrot, koel, sky-lark and king-fisher, various kinds of owls, and the swan, crane and sea-fowl are mentioned. The rarity of the white crow and the white swan had probably evoked many descriptive chapters in Sangam literature. A more detailed account of the birds referred to in Tamil literature of the Sangam period is given below.

There are singularly few references to fish although some inferior kinds like *ayirai*, *iravu*, *irāl*, *suyal* and the shark (*suraru*) are mentioned. The only known crustacean is the crab.

Amongst the insects, the ant, bee and wasp, the dragon-fly and the winged Isoptera (easal), the white-ant or termite, the louse and the scorpion are referred to.

A few references to the descriptive accounts of animals in the Sangam Tamil period such as are given below will show that they are a mixture of observed facts, imagination, and poetic fancy, not a serious study in natural history.

In *Nedundārādai* reference is made to the chill northern wind called *vādai* which affects animals in various ways, preventing cattle from grazing in the fields, and cows from suckling their calves, making monkeys shiver in cold, and birds to fall from trees.

The work called *Pattiyappalai*, apart from its being a descriptive account of the ancient sea-coast city of Kaverippattinam, contains references to many domestic and wild animals known then. The temple in the city is compared to an elephant smeared with sacred ashes. Cowsheds, cows and buffaloes, deer, pigs, goats, and cocks, and an unidentifiable animal called *ōri* are referred to. The dog is described as frisking over bags of paddy, pepper, and other merchandise like the hill-goat, which jumps from rock to rock. An anchored ship in the harbour is compared to a tethered elephant in swinging motion. Amongst the many imports are horses from across the sea. King Karikāla Chōla in prison is compared to a caged tiger, and he is said to have escaped from prison like the male elephant caught in a pit which loosens the mud on the sides and fills in the pit to climb out. His success over the Pāndyās and Chéras in the battlefield of Koilivenni is compared to that of a lion cub in killing an elephant in a single, pouncing charge.

In *Purānāooru*, and in the tenth song of *Pattuppāttu*, are mentioned several interesting facts of natural history. Donkeys are said to have been employed to plough the ground after the conquering king has razed to the ground the palaces and fortresses, and elephants let loose into the tanks and ponds to render them unusable by the vanquished. The male elephant wounded in battle is said to shun the company of the female, cease having ablutions in the tank, and to brood over its injuries and defeat, taking the form of a thunderous call. Elephants are stated to be so tame as to allow children to wash them. The abundance of tigers in the country and their encounter with elephants which often succeed in crushing them to death are referred to, as well as a tiger missing an elephant as its prey not

caring to hunt a rat even when hungry. An indiscriminate collection of taxes by the king is compared to the wanton grazing of a corn-field by the tame elephant. A female deer which has lost its way in the hill-forests finds its way back to the herd by the peculiar call of the male, which is often taken advantage of by the tigers in the near-by caves. A hunting dog is said to be ferocious and fast enough to kill a herd of deer. The social habits of monkeys in sharing their finds in the forest are referred to, as for instance the male monkey which plucks a jack fruit inviting its mate to share it with him.

In another work called Kurumthögai there are more references to the elephant, monkey, crow and other birds, bat, frog, crocodile, and fish. The male elephant of the desert region is said to peel the bark of a tree called *yam* (*வை* or *வைா*) to squeeze the water out of it for the female to drink. The attack of a big elephant on a tiger and resting later in a garden, and the injured tiger waiting for an opportunity to catch the green-eyed red dog in the forest are referred to. A species of grass called the *korukkānthattai* is said to be a delicacy for elephants. The young of black monkeys playing with peacock eggs laid on firm ground in the forest is mentioned. The bereaved female monkey with young ones under its care would rather commit suicide by jumping into a mountain crevasse than see the young tormented by its relations. A black monkey with white face (probably the Langur) with its young ones shivers in the cold rainy season. The owner of a jack-fruit garden catches the fruit-stealing monkey with the help of a net spread under the tree. The call of the ubiquitous crow near a human dwelling is said to herald the arrival of guests, a well-known current belief in many parts of South India. Among other birds are mentioned the crane, the peacock, the parrot, the cock, and the dove. The crane known as *nārai* lying in wait for the fish (*āral*) is picturesquely referred to as the only witness to a promise made by a lover to his lady love. The crane known as *maraiyan* is said to eat the Indian gooseberry (*Phyllanthus emblica*) and to quench its thirst with water from mountain springs. It is a common experience that water of the worst kind tastes sweet if drunk after eating the gooseberry. The parrot is said to eat the neem fruit in the desert region, a habit common amongst crows. Cock-fighting was apparently a well-known sport in the Sangam period. The call of the dove in the forest is said to be that of a female while the male is away gathering food for the brood. There is frequent reference to the red-headed bird called *anril*, the male and female of which are inseparable and protest loudly with a cry when separated, which builds its beautiful golden-coloured nests on the ground.

The ominous cluck of the lizard (called *ondi*), the structure and colour of the inflorescence of the sugar-cane while enclosed in its spathe resembling those of a gravid green tree-snake, the death of snakes caused by noise of thunder, the flying foxes or fruit-eating bats going in search of fruit trees at dusk, the call of the tree-frog (*thérai*) resembling the sound of a drum called *thattai* beaten to scare away parrots from corn-fields, the danger of getting into water where the bow-legged male crocodile is known to live, the water-dog (probably the otter) eating the fish known as *valai*, which is said to devour a sweet mango dropping from a tree into the pond near the field in

which it lives, and crabs scuttling away into their holes at the sight of a crane are just a few instances of close observation of the world of animal life. The persistent reference to the eight-legged mountain goat known as *varudai*, which is probably identical with the *sarabha* in Sanskrit literature, makes it probable, if not certain, that a freak goat such as we see exhibited in village fairs and festivals with extra legs hanging from its back is meant, not a mythical beast as is often supposed. In the Kurunthogai the reference is to such a goat sucking its mother.

There are further detailed references to bird life in Tamil literature both in respect of their habits and their ecological distribution. In Tholkappiamarabu the class Aves is alluded to as creatures with five senses. The excellence of the swan (*vellankurugu*), which is said to have a wide distribution in other countries in lotus tanks, its white colour, and its supposed capacity to separate milk from a mixture of it with water are referred to in a work called Chintamani. As in the case of the *avil*, there are innumerable references to a bird called *asunam* in Tamil literature. The *chataka*, *chakora*, *chakravaka* and *kinnaramithunam* are also birds which find frequent reference both in Sanskrit and Tamil literature. The first-named, with its bright and shining eyes resembling the scintillating precious stone padmaragam, lives on mountain tops and is believed to quench its thirst with rain drops. It is also referred to as *vānambadi* or *mēghappul* (sky-lark). In the lexicon called Pingalanighantu, the *chakora* is referred to as *nīlāmugipul* or the bird which drinks in the moonlight with its eyes. The beautiful golden-crested *chakravākam* or *nēmippul* is said to have the sky as its home and its eggs hatched by the heat of the sun's rays even before they reach the ground, so that the just-hatched birds take to the wing immediately. The flapping of the wings of *kinnaramithunam* is said to produce a musical sound akin to that produced by the stringed instrument known as the *yazh* or *yal*.

A great variety of fowls appears to have been recognised including the wild junglefowl (*kānakkōzhī*), the turkey (*vānkōzhī*), and the domestic fowl (*sēvarkōzhī*), and their greatest enemy is said to be the wild cat, known as *verugu*. Similarly among doves, the *manāvāchpura*, *mādappurā*, and *manipurā*. Their gregarious habit in seeking food, which has given rise to the aphorism *kapōtanyāyam*, their use as a homing bird to carry messages, their timid habits which make them fly away at loud noises, and their inability to fly against a strong breeze are all recorded. Three or four species or varieties of sparrow are recognised. Amongst these are the house-sparrow and probably the weaver-bird (*thookanānkurni*), which builds long pendulous nests from branches of trees and flies in groups in search of food. The external features and habits of the egret and the king-fisher have been accurately observed. The milk-white colour of the feathers of the egret (*kurugu* or *nārai*), its red mouth and webbed feet [?] resembling the roots of the palmyra palm, its cleverness in catching fish and crabs, the sharp needle-like golden-coloured beak of the king-fisher (*meenkothukuruci*), and the rapid flapping motion of its wings in the act of watching the fish in water, resembling the motion of the hands of the mridangam-player, are picturesquely alluded to. The beauty of form and gait of the peacock, comparable only to that of a

young maiden, and the resemblance of the crest on its head to the flower of a *vāgai* tree (*Pithecolobium saman*) are referred to. The first male progeny of the peacock is said to have a big and beautiful head-crest somewhat characteristic of the peacocks of the Kēkāya country where the poet Kamban in his Ramayana records the custom of crowning the first-born in Kēkāya. The *koel* or the *kuil*, stated to be only slightly different from the peacock [?] and to have a preference for the mango-tree, visits, like many other birds of its kind, such regions as have the *rasanta* (early summer) season on, and lays its eggs in the crow's nest where they are hatched by the crow until the fledglings show by their voice their real identity.

Several varieties of parrots are recognised, some noted for imitative speech, some for carrying messages, and some others as ornamental pets carried on the hand or on the breast. They are said to prefer the fruit of the Neem tree. The differences among the owls both in their habitat and in their characteristic cries are recognised, like those which live in holes of trees or on hills. Tirukkural mentions the crow as the bird that will beat the owl in day-time. Vultures are mentioned as forest-dwellers, and one of them, *āndilappul*, is said to live near burial grounds and feed on the brain of the human carcass. The superstitious beliefs regarding the crow and its varieties, such as the sea-shore crow, the white-plumed and red-mouthed (*siruvegakkai*), the wave-crow (*alaikkakkai*) which is probably a sea-gull or petrel, and the forest crow (*kānakkakkai*) with plumes of the colours of *vīruvākshi* flowers (probably a species of jasmine), are mentioned. The distinctions among the bats, which are presumably classed as birds, have been well drawn. The flying-fox or fruit bat (*rauvaat* or *vāvāl*) which hangs head downwards from the *āmbal* tree with its wings resembling its leaves, the insectivorous bat (*turiñjal*), which lives in dark places hanging from the roof of deserted houses and feeds on insects while on the wing, and the vampire bat, which is stated to suck the blood from the toe of a sleeping person without his being aware of it, are among such examples. Among the soaring birds which are said to fly very high and to build nests on high rocks among mountain tops are the kites (*parundu*, *poguval*, *garudan*, *sakuntam*) and the vultures (*kazhugu*). The long-lived *jatāya* and *sampāthi* mentioned in the Rāmayana are probably the *garuda*-kind of kites.

The eight-legged *simbul* or *egkalparavi* or *sarabham*, which is so strong as to strike terror among lions, the *yanairanji* which is capable of attacking the elephant and eating its brain, the big bird *chari* which is mentioned in the Mahābhārata as being capable of moving rocks (like the huge birds referred to in the Arabian Nights as Roe) are presumably to be classed among the legendary animals. The *ziechuli*, which is probably a soaring kite, is said to have the power of sighting its prey from a great height and of swooping down on it at great speed, picking it up in its sharp beak, and of soaring back to the sky.

Some more or less accurate knowledge of the ecology of the various elements of the fauna seems to have existed even in the earliest known Sangam literature.

Thus the ecological divisions are (1) *mallai* (woodlands), (2) *kurinji* (hilly regions), (3) *marudam* (riverine tracts), (4) *neydal*

(seacoast), and (5) *pālai* (dry or desert tracts), each with its own characteristic fauna. The deer, hare, and wild goat which constitute the food of the people are characteristic of (1); the elephant, bear, boar, parrot, peacock, and other birds of (2), where hunting and extermination of locusts are the chief occupations of people; cattle, sheep, goat, rodents, ducks, waterfowl, koel, etc. of (3), where bull-racing is a favourite sport; the fish, shark, alligator, sea-gull, and cattle of (4), and the elephant, tiger, wild dog, eagle, kite, and pigeon of (5)<sup>1</sup>.

#### IV. ANIMAL LIFE IN THE SULTANATE AND THE MOGHUL PERIOD

Although modern Zoology in India may be said to date with the advent of the British into this country, it has its roots in the recorded knowledge left in various authentic works by the Moghul emperors themselves or by their distinguished contemporaries in their courts. The memoirs of Babur and of Jehangir and the *Ain-e-Akbari* of Abul Fazl, and various other Islamic works have been the main sources of such knowledge<sup>2</sup>. The Emperors themselves were great sportsmen and distinguished naturalists of their times, and their interest in the fauna of the country was so great that they could hardly allow their knowledge of it to remain unrecorded. To this knowledge was added the recorded experience of foreign visitors during the Moghul period.

The animals known during this period belong mostly to the phylum Vertebrata, more particularly to the mammals which were wild and hunted or domesticated and used for defence, ceremonial purposes, and amusements. Elephants, horses, hounds, dogs, cheetahs, lynxes, falcons, hawks, cocks, parrots were some of the animals which were most intimately connected with the sports and pastimes of princes or their wars. During the period between the early 13th century and the middle of the 16th century, there is abundant evidence of the civilized way of life in which animals played a great part. Firuz Tughlak is stated to have maintained a Shikar Department which was considered to be one of the most important departments of his Government. Sher Shah is said to have maintained in his Kingdom 5,000 elephants and 3,400 horses, the latter particularly for postal communications. There were many officials to supervise the royal stables. In Muhammad Tughlak's time 2,500 oxen, 2,000 sheep and various other animals and birds are said to have been slaughtered daily to supply the royal kitchen. There were 10,000 followers who rode on horse-back, each carrying a trained falcon for hawking. Horse-racing and dog-racing were so popular that a regular literature is said to have sprung up on the study of the habits and the methods of training horses and dogs. Pedigree horses were maintained, and the game of polo was played substantially as it is at the present day. Horses were employed for conveyance and pleasure-riding in addition

<sup>1</sup> The author is indebted to Prof. K. A. Nilakanta Sastri for placing at his disposal some manuscript notes made by various Tamil scholars in S. India, and to the notes of Sri K. R. Venkataranjan, Reid, D. P. I. and Records Officer, Pudukkottai for the ecological classification.

<sup>2</sup> Ali, Sálim A.—The Moghul Emperors of India as Naturalists and Sportsmen. *JBNHS*, Part I, 31: 833-861 (1927), Part II 32: 34-63, Part III 32: 264-273 (1927-28).

to racing. Elephants are said to have been trained for carrying heavy loads, for riding, and for use on ceremonial occasions.<sup>1</sup> They were found commonly as far afield as U.P. and Orissa, elephant-catching was a profession. The idea of game preserves was probably derived from an old Persian tradition. Great walled enclosures were built to preserve wild and domestic animals. A State preserve near Delhi 12 *krohs* (24 miles) in extent is stated to have been maintained. Rhinoceros and lions, deer and nilgai seem to have roamed at the foot of the hills of the Punjab. The lion was, however, the prerogative of the monarch to hunt whenever one was spotted. Fishing was as popular a sport as pigeon-flying or cock-fighting. Alauddin Khilji maintained a pigeon house, and Akbar was passionately fond of pigeon flying, a pastime which is still so popular among the muslims all over India, particularly in the North. The parrot was a familiar pet in royal palaces, and in the households of the opulent as well as the poor. Monkeys were also kept as domestic pets. Dogs were trained for the chase as well as for guarding houses.

Where animals were so largely in use in the four centuries covered by this account, their leather could not have been in less demand. Saddle and bridle for horses, scabbards of swords, covers of books, shoes, bags for packing sugar as in Bengal, mats in red and blue inlaid with figures of birds and beasts as in Gujarat, which evoked the praise of Marco Polo, were all made of leathers of various kinds. Skins of cattle (ox and buffalo), goats, rhinoceros, etc. were dressed and exported in shiploads to Arabia and other countries.

A fairly accurate and dependable knowledge of the fauna of the country during the rule of the Moghul dynasty could be gained from the memoirs mentioned above. There are references to wild animals, such as the elephant, lion and tiger, leopard, rhinoceros, cheetah, lynx and caracal, wild cat and dog, wolf, hyena and jackal, bear and otter, the flying fox and the flying squirrel, the hare and the squirrel, and the lemur, the monkey, and the ape. Babur had distinguished the white-faced Rhesus monkey from the black-faced long-tailed Langur. He knew that the Gibbon was not indigenous, that the flying fox was the great bat, that the elephant was peculiar to Hindustan and occurred in a wild state as far as Kalpi on the right bank of the Yamuna river in the Jalaun District of Uttar Pradesh, and that the rhinoceros was distributed all over north-west India in the jungles of Peshawar and Sind, and on the banks of the Daryu River (Gogra). He is said to have hunted a rhino in the Indus Valley in 1519. Abul Fazl has recorded the tailless ape (*ban-manush* or *jal manus* or orang-utan) as having been brought to Akbar from Bengal. He has mentioned the lion and the tiger as being numerous, man-eating tigers having been recorded from Ajmer in 1572 and at Agra

<sup>1</sup> There are painted representations of horses, elephants and camels in procession on the ceiling of the Virupakshi temple in Hampi dating back to the 14th century A.D. One of the panels shows the sage Vidyaranya borne along in a palanquin preceded by Purohitis and followed by a camel. Another shows the Emperor Krishna Devaraya in state procession drawn by horses and elephants. A panel showing puranic heroes portrays birds and other animals, Hanuman and the Yāti, some of them in a conventional manner. (R. Chionnathambi's article in 'The Hindu' of Sunday, March 22, 1953 on 'Paintings in the Virupakshi Temple in Hampi'.)

in 1609, and the milk of a tigress as being a panacea for eye-troubles, the snow leopard of Kashmir and the lynx and the caracal as used for hunting hare, fox, and blackbuck, the hunting leopard or cheetah which was kept in large numbers by the Moghul emperors for hunting, and the civet cats which yielded the perfume of which they were so fond as mentioned in Abul Fazl's memoir. The animal referred to as *sardol* or *sardoola*, 'smaller than a dog, but preys upon lions and other wild beasts' is not exactly referable to any identifiable beast of prey.<sup>1</sup> The Kheddah operation of capturing wild elephants in the Gond country of Mandla in Madhya Pradesh seems to have prevailed in much the same form as it is practised today. Abul Fazl mentions breast-plates and shields made of the skin of the rhinoceros, and finger-guards for bow-strings etc. from its horn.<sup>2</sup>

Jehangir's profound knowledge of animal life seems to have been born of a passion to observe and record the habits of animals. He referred to the suckling by a goat of a baby langur the mother of which was shot. He knew accurately the difference between the rare Lemurs (slender loris or *threvangu*), of which he had seen an example brought to him from Goa, and the Simians and anthropoid apes, and their habit of feeding on milk and plantains. The lion must have been numerous in his and his father's times for him to have recorded a lion hunt by Akbar, to have shot one himself near Malwa in 1617, and to have permitted Sir Thomas Roe to kill one in his camp near Manda in Madhya Bharat. The elephant appears to have been found in a wild state as far as the Panchmahal District in Bombay. Jehangir has recorded the 'water-dog', probably the otter, in the Jhelum River, the breeding of cheetahs in captivity, and several cases of albinism in a wide range of mammals and birds, including the cheetah, blackbuck, flying squirrel, hawk, and quail.

The knowledge of the ungulate and bird-fauna of India as recorded in the memoirs of Babur, Abul Fazl, and Jehangir in the Moghul period was no less profound. The Yak, the wild buffalo, the various kinds of goats, and the Nilgai, the antelope, the hog deer, the wild boar, the dolphin or porpoise, a large variety of game and other birds, common in the garden and near human habitations and in the jungles near about, all find a mention in these records. The Moghul emperors were as a rule fond of hunting, and spared no personal exertion in the pursuit of sport. They appraised their game by weight, and not by the dimensions of the body or the horn as is done in modern times.

Babur had known the wild buffalo (*Bos bubalus*) to be larger in size and more ferocious and destructive than the common buffalo. He described the *kälä hirau* of Hindustan or the Indian antelope or blackbuck (*Antilope cervicapra*), and had noted the occurrence of the dolphin (*Platanista gangetica*) in all the rivers of Hindustan and described its habits accurately by calling it the water hog (*khink-abi*).

<sup>1</sup> [It may be the wild dog (*Canis alpinus*) called *dhole* in central India. Eds.]

<sup>2</sup> Timur is recorded to have hunted and killed many rhinoceros on the frontiers of Kashmir in 1398, and a rhino is reported to have been sent from India to King Emmanuel of Portugal as a present in 1513, who in turn presented it to the Pope. ('The Return of the Rhinoceros' by B. V. Ramanujulu in 'The Hindu' August 9, 1953).

The wild ass of Sind (*Equus hemionus khur*) was hunted by Akbar (April 1571) on the banks of the Sutlej River. Jehangir has recorded its flesh to be *halal* and good eating, as also that of the mountain goat (*Capra falconeri*). Abul Fazl has recorded the occurrence of the Yak in the mountainous parts of Kumaon where it corresponds to the domestic cow. Though luxurious growth of wool on the limbs had been noticed by Jehangir, its close resemblance to a buffalo in form and appearance was not missed. Abul Fazl described how a wild buffalo was hunted with the help of a tame cow on heat by being lassoed or held in nooses.

There is good evidence of breeding experiments and hybridisation of goats and deer having been undertaken during Moghul times. Jehangir carried out such experiments between the Ibex and the Barbary goat, and Abul Fazl has mentioned the maintenance of regular deer studs to breed blackbuck to be trained as decoys for catching and hunting the wild antelope. The hunting of the hog deer (*Avis porcinus*) and the wild boar (*Sus scrofa cristatus*) was a sport in the district of Tutta in Sind. Abul Fazl has referred in his *Fauna of Hindustan* to a species of deer larger than a fox with a rough coat of hair and two protuberance-like tusks, but without horns, occurring in the northern mountains and Kumaon. This is probably the musk deer of whose flesh Jehangir had spoken as being tasteless and inferior. The female of this species is noted to be without the musk bag, which gives out the characteristic odour only when it has been dry for a few days. More modern opinion about the flesh of the musk deer as expressed by European taste is that it is free from the flavour of musk and very good to eat. The wild boar which is still plentiful in Sind and a serious pest to cultivation afforded a very popular hunt. England's ambassador to India (Sir Thomas Roe) has recorded the receipt of a gift of a wild boar for his table but with the unusual request for the return of the extraordinary-sized tusk.

Among the birds described or noticed during the Moghul period were the common crow (*Corvus splendens*), the sparrow, the green magpie, the racket-tailed drongo, the scarlet minivet, the dipper, the starling, the myna, the lark, the cuckoo, and the koel near human habitations, apart from the parakeets, eagle, kite, falcon, fowl, pheasant, quail, partridge, green pigeon, etc. of the jungles, and the aquatic birds crane, stork, spot-billed duck, ibis, and the large bustard, florican, etc. Sparrows were probably such a pest that their numbers had to be thinned out by pellet bows fitted with bow strings. Akbar seems to have amused himself with the training of frogs to catch sparrows. Jehangir has recorded the habits of the pied crested cuckoo (*papiga*) and the koel, the former laying its eggs in the nest of babbler which brings up its young, as the latter does in that of a crow. Akbar is said to have maintained 20,000 carrier pigeons. The Italian traveller, Manucci, has described how the nobles in the court of Shah Jehan bred pigeons to carry messages, or to take part in pigeon-fighting as a sport. The peacock does not appear to have been favoured for the table by Babur, though classical works allude to its appreciation at banquets.

Amongst the reptiles and amphibians the marsh crocodile, the gharial, the python, the cobra, and frogs find mention, while among

the fishes the hilsa and rohu are recorded. A few insects like the bee, and the silkworm, the gnats, fleas, flies, and lice are also referred to.

Babur referred to the Marsh Crocodile (*Crocodylus palustris*) as the *sherabi* or 'Water Lion' or *siyah sar* (=black head in Persian) (*Crocodylus porosus*), as occurring in the rivers of Hindustan, and to the gharial (*Gavialis gangeticus*) as an inhabitant of the Gogra (Sarju River) ready to carry off unwary bathers. Jehangir has recorded the shooting of a crocodile in Dhar State, the swallowing of hares, hog deer, etc. by a python near Aligarh, and of a cobra by a king Cobra (*Naja hammondi*). Manucci, the Pepys of Moghul India, has recorded the punishment of corrupt people by the bite of poisonous snakes in the court of Shah Jehan, while Prince Shah Shuja, Shah Jehan's son, has recorded the extraordinary migration of cobras from fields near Rajmahal in Bengal.

Babur has closely observed the skipping of frogs (*Rana cyanophlyctis*) along the water surface. The habit of bull-frogs in swallowing birds including chickens and even snakes, along with the training of frogs to catch sparrows, are mentioned in Abul Fazl's memoirs. The same author has recorded the fishing of *palla* (hilsa of Bengal) near Tutta in Sind in the months of February and March and referred to its unrivalled, fine, and exquisite flavour. Jehangir was interested in fishing as in the hunt. He thought rohu was the best fish of Hindustan and recorded an instance of blindness in fish in one of the streams (Andha Nag) of Kashmir.

The silk industry and silkworms find a mention in Abul Fazl's memoirs. The silkworms seem to have been abundant in Kumaon and Kashmir, and so were mulberry trees the leaves of which constituted their main food. The eggs were, however, imported from Gilgit and Tibet.

According to Abul Fazl the Kashmir valley appears to have been infected with gnats, flies, fleas, and lice. Jehangir has recorded the visit of black bees to the flowers of the lotus and the kumuda.

The maintenance of various animals (goats, rams, cocks, quails, stags, antelopes) for fights to amuse people, and of hospitals or pinjrapoles for the care of these and other animals seems to have been common in the Moghul era. The traveller, Pietro della Valle, had seen during Jehangir's reign a pinjrapole at Cambay for many kinds of birds (cock, pigeon, peacock, duck), mice, etc., and the traveller, Thevenot, had known a hospital for birds in Ahmedabad during Aurangazeb's time, apart from hospitals for camels, ox, horse, and other animals. He also recorded that in Dehly (Delhi) wealthy individuals and kings maintained hawks, camels, dromedaries, mules, asses, elephants, elks, rhinoceroses, and buffaloes. The last-named were described to have been of such size and power that they were unafraid of lions. Some of the home-bred camels seemed to have been capable of carrying considerable weights, and Jehangir has recorded an instance of one such having carried on its back a weight of 42 maunds (1,460 lb.). Thevenot has described a curious method of capturing water fowl during Aurangazeb's time by men swimming upright in water with their heads completely hidden in a many-holed pot covered by birds' feathers to cheat the ducks and water fowls,

and cunningly catching hold of their feet under water and pulling them down into it to drown them. Equally strange was the method of catching sandgrouse and other similar game birds recorded by Jehangir in which the birds concerned were rendered powerless to fly by a murmuring sound produced by some Kashmiri bird-catchers.

#### V. ANIMAL LIFE IN INDIA IN THE POST-MOGHUL PERIOD UP TO MODERN TIMES (17TH CENTURY TO MIDDLE OF 20TH CENTURY)

Although there are many stray references to Indian animals in the chronicles of foreign travellers, and evidences of trade and traffic in animals (ivory, apes, and peacocks) between eastern Europe and India, the earliest published works based on a study of indigenous animals were from the pen of foreign residents and sojourners in India. Robert Knox's 'Historical Relation of the Island of Ceylon in the East Indies' (1681), Koenig's account of the white-ants of India (1779), Patrick Russell's accounts of the Indian Serpents of the Coromandel Coast (1796) and of the Fishes of the Visakhapatnam Coast (1802), Hamilton-Buchanan's account of the Fishes of the Ganges and its branches (1822), and Gray's 'Illustrations of Indian Zoology' (1830-32), featuring a large number of Vertebrates of the Indian region, are of this nature.<sup>1</sup> This tradition of detailed recording of observed natural phenomena relating to the fauna of India has been more or less continuous during the three centuries following the disruption of the Moghul dynasty, but much of the organised study of animal life which struck deep root in the country we owe to the British residents in India some of whom were keen sportsmen-naturalists, but more particularly to the learned societies, like the Asiatic Society of Bengal in Calcutta, and the Bombay Natural History Society in Bombay, which they helped to establish with the influence they wielded as the representatives of the British ruling class.<sup>2</sup> The accumulation of permanently preservable parts of animals, such as bones, skins, and feathers, for exhibition by the members of the former Society led to the founding of the Oriental Museum of the Asiatic Society (1814), which led later on (1866) to the establishment of a public museum under Government auspices in Calcutta, but the 'ahimsa' or non-violence attitude of Sir William Jones, the Founder-President of the former Society, who discouraged the killing of animals to gain natural knowledge proved a set-back to the study of animal life in India for sometime (till 1828). The natural curiosity of interested observers to learn more and more of the structure and habits of animals could not, however, be curbed for long. From 1829 onwards there was a stream of contributions dealing with animal structure, particularly of those animals whose anatomical parts could be preserved in the dry state, as for instance the bones, skins, feathers, and scales in mammals, birds, reptiles, amphibia, and fish, and the shells, internal or external, of cuttle-fish, snails, mussels, cockles, clams, and oysters.

<sup>1</sup> Gravely, F. H.—*Proc. Asiatic Soc. Bengal (N. S.)* XVII, p. cxxxii. (1921).

<sup>2</sup> *Centenary Review of the Asiatic Society of Bengal (1784 to 1883)*. Calcutta (1885).

The records of observed habits of animals in their natural environment led to considerable curiosity in others who, if they could not satisfy their curiosity to observe them in their natural haunts, in the forests, and on the mountains, could at least see them alive confined in cages. This natural curiosity led to the establishment of zoological gardens, or 'Zoos' in short, within the municipal limits of towns and also from the Asiatic Society as early as 1842, and probably the first zoo in India was opened in Calcutta in 1876 with the object of 'developing and displaying the zoological wealth of the country and of facilitating acclimatisation, domestication, and breeding of animals, and improving the indigenous breed of cattle and farm-stock'. This was followed by other zoos in the country in Madras, Mysore, Trivandrum, Bombay, etc. The maintenance of wild life in zoos and in sanctuaries to be mentioned below has helped the study of the natural longevity of various species of animals on a more or less scientific basis, confirming or rejecting existing beliefs on the subject, recorded or otherwise. The exhibition of dead animals in museums, stuffed in their skins, and in attitudes often grotesque and unnatural though based on the observations of sportsmen and naturalists, did not satisfy the natural curiosity of people to learn something of the environment in which the animals lived. This gave a new stimulus to museum technique though borrowed from the West, particularly the United States of America, where museum technicians excelled in the art of mounting the elements of their fauna in as lifelike a manner as seen in nature against a background of the proper environment. This environment was cleverly painted on walls in vivid colours with the illusion of depth and in settings made of natural materials obtained from the environment, or their substitutes artificially made to resemble them, the whole scenery suitably illuminated with electricity to resemble the lights and shades prevailing in the natural environment. A pioneer in this method of exhibition in India has been the Bombay Natural History Society in the Prince of Wales Museum, Bombay, which is, slowly though gradually, being adopted by other museums in the country.

A similar renaissance in the organisation and exhibition of living animals in zoological gardens is taking on the form of total elimination of all bars to the freedom of movement and of life of animals kept in them, such as has been introduced in the founding of national parks elsewhere in Europe, Africa, and America, which serves a double purpose, namely of protecting animals from wanton destruction by shikaris and trophy-hunters and of educating the public in the study of animal behaviour in their own natural and native environment. A chain of game sanctuaries for wild life (fish as well as birds, reptiles, and mammals) is being established all over this country. The protection to the lion<sup>1</sup> and the rhinoceros<sup>2</sup> which have been noticeably

<sup>1</sup> The lion seems to have been progressively driven out west further and further from its original haunts in N. India extending up to W. Bengal and Bihar at the beginning of the 19th century to the Gir forest in Kathiawar (Saurashtra, now merged in Bombay State) at the present day. Lions had been recorded alive in Palamau in Bihar up to 1814, in Central India (Madhya Bharat) up to 1872, in Gujarat up to 1880, in Haryana (Pepsu) up to 1834, and even as far west as Kot Diji in Sind up to

getting rarer in their natural haunts in India has been one of the first steps in governmental action to preserve the fauna peculiar to India.<sup>3</sup> A greater and more recent stimulus to this idea of wild life preservation has been the organisation under Government auspices of an Indian Board for Wild Life, to which is entrusted the task of creating interest in the people in the wild life resources of the country, both in their economic and philosophical aspects, and of sustaining it by continuous educative propaganda and publicity.

Knowledge of the animals in the seas around India appears to have been confined, however, during the many centuries of Indian History to certain large-sized animals like the whales and the sharks, which were apparently brought to the notice of people living on the coast by the carcasses of dead animals sometimes washed ashore. Even the ardour of British sportsmen and naturalists resident in India to extend the bounds of knowledge of animal life in the country lay dormant so far as the sea was concerned. The success of the British 'Challenger' Expedition in its cruise round the world, and the efforts of influential British biologists on the Council of the Asiatic Society of Bengal were some of the contributory causes to the inauguration of a marine survey in India in 1874. The interest of the naturalists of the Indian Museum had already been stimulated by the deep-sea investigations in 1872 conducted by Wood-Mason in the deep-sea off the Andaman Coast, and led later on to the appointment of a Surgeon-Naturalist to the Marine Survey of India. Deep-sea investigation was a complicated and costly task. It required a fairly large sea-worthy vessel and special equipment to capture sea animals at various depths. The building of the 'Investigator' for the Marine Survey and the procurement of equipment from the 'Challenger' which had completed its cruise in 1877 helped to organise the investigation of animal life in the Indian seas. Between 1884 and 1926, the year in which the 'Investigator' ceased to carry a naturalist on board, the fauna of the seas along the coasts of India, Burma, Ceylon, and as far afield as the Persian Gulf, and in depths down to 2,000 fathoms, around the oceanic islands of the Andamans and Nicobars, the Maldives and the Laccadives, was investigated. This survey revealed a great wealth of animal life, both Vertebrates and Invertebrates, of the most varied and weird kind, which was described and illustrated in special publications brought out by the authorities of the Indian Museum from 1898 onwards.

For the first time in India, the attention of the Indian students of zoology in the Madras and the Punjab universities, where the subject

1842 which is only about 20 miles east of Mohenjodaro. The introduction of East African lions into Gwalior late in the 19th century when the Indian Lion had almost become extinct proved so disastrous that they had to be exterminated soon after their introduction.

<sup>2</sup> To ensure the maximum possible protection to the Rhinoceros in Assam, which is the State emblem of the Assam Government because of its almost exclusive occurrence in that State, a 'Rhinoceros Preservation Bill' is being drafted by that Government.

<sup>3</sup> This protection has now been extended by the Board to 11 more species viz. the snow leopard, the clouded leopard, the cheetah, the wild ass, the Kashmir stag, the musk deer, the brow-antlered deer, the pygmy hog, the great Indian Bustard, the pinkheaded duck, and the whitewing wood duck.

had been introduced for higher studies, was drawn to the far greater wealth of animal life in the sea than on land, most of which was unfamiliar except to those actively engaged in catching fish at sea for many generations, and of which there exists no recorded knowledge in history. The part played by museums of Natural History, of which there are only a few in number at present in this country, and by aquaria, which can be counted on the fingers of one hand, in disseminating an authentic knowledge of the infinite wealth of life in the sea is still so small that it will take many years of effort to attain a decent standard of public education in the subject of the unfamiliar aquatic world.

The pride of founding the first aquarium in India as early as 1909 goes to the Government Museum of Madras which arranged to exhibit, in specially built glass-faced cisterns with arrangements for constant circulation of water and air, some colourful sea-animals, particularly fish of certain types common on our Coast.<sup>1</sup> After nearly 33 years of existence on the Madras Marina Beach opposite the Presidency College, the aquarium was closed down in 1942 in the middle of the Second World War, and reopened to the public only recently in an attenuated form exhibiting a few small species of freshwater fish. The aquarium at Trivandrum maintained by the Marine Biology Department of the University of Travancore and the more modern one on the Marine Drive (Taramporevala Aquarium) at Bombay maintained under the auspices of Fisheries Department of Bombay continue to stimulate the curiosity of people in the forms of life which inhabit the sea.

No less important and vital contributions to our knowledge of the infinitely varied life, both in its grosser and in its minuter and cryptic forms, in the vast world of Invertebrates both on land and sea were made in the first half of the twentieth century. These were inevitably the result of scientific investigations undertaken in connection with agriculture, forestry, medicine, animal husbandry, and other applied biological sciences. Innumerable animals, acting as pests and vectors of diseases in plants, animals, and human beings, were discovered and described and controlled, among other means, by the employment of biological methods based on the mutual natural animosity of two or more species of animals. The discovery of the method of transmission of the malarial and plague parasites (?), which was made on Indian soil, led to appropriate efforts in the direction of controlling the actual vectors, namely the anopheline mosquitoes and the rats respectively, which carried the disease-causing parasites.

Although the elements of every group of the animal kingdom have their own environment to which they are adapted in every way, the competition for living space and food often compels them to extend their domain into neighbouring regions. The study of the geographical distribution of animals, on which many theories of the present and past configuration of continents and seas are based, has therefore been a subject of considerable importance. In so far as the Indian fauna is concerned, this study of geographical distribution of strictly indigenous and related species of animals has been greatly furthered by the publication of records of animal distribution maintained in the course

<sup>1</sup> The control of the Aquarium was later (1919) transferred from the Government Museum to the Madras Fisheries Department.

of expeditions under official auspices during the British regime in India into the adjoining extra-territorial regions. The Yunnan Expeditions (1868 and 1875), the Persian Boundary Commission (1870-72), the Second Yarkand Commission (1873-74), the Dafla Expedition (1874-75), the Afghan Delimitation Commission (1885), the Afghan-Baluch Boundary Commission (1896), the Pamir Boundary Commission (1896), the Military Expedition to Lhasa in Tibet (1903-04), the Seistan-Arbitration Commission (1903-05), and the Abor Expedition (1911-12) have not only brought to light some rare and hitherto unknown groups of animals, but also the peculiarities of distribution of various animals of the Indian continent, and their excursions into adjoining geographically similar territories ignoring man-made political boundaries<sup>2</sup>.

## VI. FISH AND FISHERIES IN INDIA

There are several references to the knowledge of fish and fisheries in India through the ages<sup>3</sup>. One of the earliest of them on the subject is to be found in the *Susruta Samhita* (ca. 600 B.C.)<sup>4</sup> where a knowledge of the known marine and freshwater fishes of India and their habits in relation to their habitat, form, and motion is clearly indicated. It is found that in the Sanskrit names given to freshwater fishes of various kinds living in the larger rivers like the Sindhu and the Ganga (Indus and Ganges) there is some significance in reference to their structure or habits. Names like *prithuroman*, *sakula* or *sakalin*, *salkin*, *sunvar* seem to have such significance, though terms like *matsya*, *meena*, *animisha*, *jalasaya* and *usha* may be applicable to any kind of fish in reference to their habits, and their places in the classification of the animal kingdom. In the age to which *Susruta's* works (ca. 600 B.C.) and *Kautilya's* *Arthashastra* (ca. 300 B.C.) refer, there seems to have been ample evidence of a more or less detailed observed knowledge of fish as a valued item of food and as providing an industry, as being aquatic and oviparous, and as capable of being classified in terms of their structure (scales and body plates, spines, barbels, colour and markings) or habits (in standing or flowing waters, swimming and sticking to substrata, etc.). The identification of the fish or fish-like aquatic mammals which find a mention in *Asoka's* pillar edict V, attempted by Hora (1950), appears to be quite plausible, and the fish referred to are the boneless or cartilaginous sharks and skates, the slippery eels, the death-deigning globe-fish, and the lumpy-bodied porpoise. Coins of the Pandyan Kingdom are stated to bear the fish symbol as the Chola and Chera coins bear other animal symbols like the tiger, bird etc. (vide Dandapani, T.S. in 'The Hindu', 14th March, 1957).

<sup>1</sup> 'Progress of Science in India during the past twenty five years'. Ind. Sci. Congress Association Silver Jubilee, 1938. Edited by B. Prashad.

<sup>2</sup> The *Atharva Veda* and the *Satapatha Brahmana* are said to narrate a legend in which a fish saved a Manu from a deluge. Similar legends seem to exist in some of the earliest mythologies of the world (vide U. Venkata Krishna Rao in *Bhawan's Journal*, 3 (7) : 56-58, 1956).

<sup>3</sup> According to the agreed chronology at the Symposium of the National Institute of Sciences of India, the dates of *Susruta Samhita*, *Arthashastra*, and *Charaka Samhita* 4th century B.C. have been advanced to 100 to 200 A.D.

## VII. REFERENCES

- Ali, Sálim A. (1927-28) : The Moghul Emperors of India as Naturalists and Sportsmen. *JBNHS*, Part I 31 (4) : 833-861; Parts II and III 32 (1) : 34-63; (2) : 264-273.
- Ashraf, Kuwar Muhammad (1935) : Life and Conditions of the People of Hindusthan (1200-1550 A.D.) mainly based on Islamic Sources. *Journ. Asiatic Society of Bengal*, Third series : 103-339.
- Gravely, F. H. (1921) : History of Zoology in India and Ceylon.—*Proc. Asiatic Soc. Bengal*, N. S. 17 : cxxxii-cxlv.
- Hora, S. L. (1935) : Ancient Hindu Conception of Correlation between Form and Locomotion of Fishes. *Journ. Asiatic Soc. Bengal*, 1 : 1-7.
- (1948) : Sanskrit names of Fish and their Significance. *Journ. Roy. Asiatic Soc. Bengal Science* 14 (1) : 1-6.
- (1948) : Knowledge of the Ancient Hindus concerning Fish and Fisheries of India I. References to Fish in Arthashastra (ca. 300 B.C.), *Ibid* : 7-10.
- (1950) : II. Fishery Legislation in Asoka's Pillar Edict V (245 B.C.) *Journ. Roy. Asiatic Soc. Bengal*, Letters 16 (1) : 43-51.
- (1951) : III Matsyavimoda or a Chapter on Angling in the Manasollasa by King Someswara (1127 A.D.), *Ibid*, 17 (2) : 145-169, pls. xviii-xxi.
- (1951) : Zoological Knowledge with Special Reference to Fish and Fisheries in India before 225 B.C. *Archiv. Internat. D. Hist. Sci.* 15 : 405-412.
- (1951) : Maintenance of Irrigation Tanks through Fishery Revenue in Ancient India. *Journ. Roy. Asiatic Soc. Bengal*, Letters, 17 (1) : 41-50.
- (1951) : A Sanskrit work on Angling of the Early Twelfth Century. *Nature*, 167 : 778.
- (1951) : History of Science and Technology in India and South East Asia. *Nature*, 168 : 1047.
- (1952) : Central Board for Wild Life—*Science & Culture*, 18 (11) : 512-515.
- Macdonell, A. A. and Keith A. B. (1912) : Vedic Index of Names and Subjects (Indian Texts Series)—John Murray, London.
- Marshall, John (1931) : Mohenjodaro and the Indus Civilisation. Arthur Probsthain, London.
- Piggot, Stuart (1952) : Prehistoric India (Pelican Books A 205), 293 pp.
- Panikkar, N. K. (1956) : Fish and Fisheries in 'Progress of Science in India', 1939-50, Section VIII, Zoology, by H. Srinivasa Rao. Nat. Inst. Sci. India, Sub-section III, Fish and Fisheries, pp. 92-151.
- Prashad, Baini (1932) : Some Pre-Linnaean Writers on Indian Zoology. *Acharya Ray Commemoration Volume*, pp. 68-76 (Calcutta).
- Prater, S. H. (1948) : The Book of Indian Animals—pp. xxxii and 263, pls. 101 and 1 map. Bombay Natural History Society.
- Rao, H. Srinivasa (1938) : An Outline of the Fauna of India. 'An Outline of the Field Sciences of India' by S. L. Hora. Ind. Sci. Congress Assn. Silver Jubilee Session, 1938, pp. 91-124, pls. v-vii.
- (1938) : Progress of Zoology in India during the past twenty five years. 'Progress of Sciences in India' by B. Prashad. Indian Sci. Congress Association Silver Jubilee, 1938, pp. 353-433.
- Seal, B. N. (1915) : The Positive Sciences of the Ancient Hindus—Hindu Classification of Animals—pp. 177-201 (London).