

## Science in the Baburnama : A Critical Study

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### Introduction

The *Baburnama* (Memoirs of Babur) is the work of Zahiruddin Muhammad Babur (1483-1530), the founder of Mughal dynasty in India. Written in the form of a diary, Babur's memoirs are the first true autobiography in Islamic literature, and also of the medieval India. The *Baburnama* is one of the marvels of the medieval world. "It belongs to a handful of the world's literary works that can accurately be described as unique" (Amitav Ghosh).

Written originally in Chagatai Turkic, a now extinct dialect of erstwhile Soviet Central Asia and the adjacent region of Chinese Turkestan or Xinjiang, and a language of Ural-Altaic group, Babur's style of writing was highly Persianized. The *Memoires* was later translated into Persian and illustrated during the reign of Babur's grandson Emperor Akbar.

As a writer and intellectual, Babur stood much above the men of his time. The *Baburnama* offers observations of a highly educated Central Asian Royal of the Medieval Era of the world he had seen. There is much on the war and politics of his time but also extensive descriptions on the physical geography, the flora and fauna, the environment, the villages and towns, the people and human relationships.

Despite his preoccupation with war and administration, Babur had an inquisitive mind with fantastic scientific insight and scientific temper. The *Baburnama* described with minute details and critical observations the Physical Geography, Flora & Fauna, Weights & Measures and Time Reckoning System of 'Hindustan' which remained unparalleled till the 19<sup>th</sup> century.

### Babur's Description of Hindustan

Babur described Hindustan in the Section III of the *Memoirs* and first made entries during AH 932 (October 18, 1925- October 08, 1926) which is of course the time of Babur's fifth and final expedition to India. Babur started his descriptions of Hindustan with

this paragraph which shows his accurate knowledge of the geography of India:

*The country of Hindustan is extensive, full of men, and full of produce. On the east, south, and even on the west, it ends at its great enclosing ocean (mubit darya-st-gha). On the north it has mountains which connect with those of Hindu-Kush, Kafiristan and Kashmir. North-west of it lie Kabul, Ghazni and Qandabar. Dibli is held to be the capital of the whole of Hindustan.*

Babur then moves on to describe the climate and people of India

*Hindustan is of the first climate, the second climate, and the third climate; of the fourth climate it has none. It is a wonderful country. Compared with our countries it is a different world; its mountains, rivers, jungles and deserts, its towns, its cultivated lands, its animals and plants, its peoples and their tongues, its rains, and its winds, are all different. In some respects the hot-country (garm-sit) that depends on Kabul, is like Hindustan, but in others, it is different. Once the water of Sind is crossed, everything is in the Hindustan way (tariq): land, water, tree, rock, people and horde, opinion and custom.*

*After crossing the Sind-river (eastwards), there are countries, in the northern mountains mentioned above, appertaining to Kashmir and once included in it, although most of them, as for example, Pakell and Shahmang (?), do not now obey it. Beyond Kashmir there are countless peoples and hordes, parganas and cultivated lands, in the mountains. As far as Bengal, as far indeed as the shore of the great ocean, the peoples are without break. About this procession of men, one has been able to give authentic information in reply to our enquiries and investigations. So far people have been saying that they call these hill-men Kas. It has struck me that as a Hindustani pronounces shin as sin (i.e. sh as s\ and as Kashmir is the one respectable town in these mountains, no other indeed being heard of, Hindustanis might pronounce it Kasmlr. These people trade in musk-bags, saffron, lead and copper.*

One should then be surprised to read Babur's authentic descriptions (much like a good teacher of Geography) of the mountain ranges and rivers of India.

*Hindus call these mountains Sawalak-parbat. In the Hindi tongue Sawai-lak means one lak and a quarter, that is, 125,000, and Parbat means a hill, which makes 125,000 hills. The snow on these mountains never lessens; it is seen white from many districts of Hind, as, for example, Labor, Sibrind and Sambal. The range, which in Kabul is known as Hindu-kush, comes from Kabul eastwards into Hindustan, with slight inclination to the south. The Hindustanat are to the south of it. Tibet lies to the north of it and of that unknown borde called Kas.*

*Many rivers rise in these mountains and flow through Hindustan. Six rise north of Sibrind, namely Sind, Babat (Jilam), Chanab, Rawi, Blah, and Sutluj; all meet near Multan, flow westwards under the name of Sind, pass through the Tatta country and fall into the 'Uman(-sea). Besides these six there are others, such as Jun (Jumna), Gang (Ganges), Rabap (Rapti?), GumtI, Gagar (Ghaggar), Siru, Gandak and many more ; all unite with the Gang-darya, flow east under its name, pass through the Bengal country, and are poured into the great ocean. They all rise in the Sawalak-parbat. Many rivers rise in the Hindustan hills, as, for instance, Chambal, Banas, Bitwa, and Sun (Son). There is no snow whatever on these mountains. Their waters also join the Gang-darya.*

*Another Hindustan range runs north and south. It begins in the Dibll country at a small rocky hill on which is Firuz Shab's residence, called Jaban-nama, and, going on from there, appears near Dibll in detached, very low, scattered here and there, rocky little hills. Beyond Miwar, it enters the Biana country. The hills of Sikri, Bar and Dulpur are also part of this same including tuta range. The hills of Guallar they write it Gahwr although they do not connect with it, are off-sets of this range; so are the hills of Rantanbur, Chitur, Chandiri, and Mandau. They are cut off from it in some places by / to 8 kurohs (14 to 16 m). These hills are very low, rough, rocky and junghy. No snow whatever falls on them. They are the makers, in Hindustan, of several rivers.*

Next, Babur describes the irrigation and agriculture of India :

*The greater part of the Hindustan country is situated on level land. Many though its towns and cultivated lands are, it nowhere has running waters. Rivers and, in some places, standing- waters are its "running- waters". Even where, as for some towns, it is practicable to convey water by digging channels, this is not done. For not doing it there may be several reasons, one being that water is not at all a necessity in cultivating crops and orchards. Autumn crops grow by the downpour of the rains themselves; and strange it is that spring crops grow even when no rain falls. To young trees*

*water is made to flow by means of buckets or a wheel. They are given water constantly during two or three years; after which they need no more. Some vegetables are watered constantly. In Labor, Dibalpur and those parts, people water by means of a wheel. They make two circles of ropes long enough to suit the depth of the 'well, fix strips of wood between them, and on these fasten pitchers. The ropes with the wood and attached pitchers are put over the well-wheel. At one end of the wheel-axle a second wheel is fixed, and close to it another on an upright axle. This last wheel the bullock turns; its teeth catch in the teeth of the second, and thus the wheel with the pitchers is turned. A 'trough is set where the water empties from the pitchers and from this the water is conveyed everywhere.*

*In Agra, Chandwar, Biana and those parts, again, people water with a bucket; this is a laborious and filthy way. At the well-edge they set up a fork of wood, having a roller adjusted between the forks, tie a rope to a large bucket, put the rope over the roller, and tie its other end to the bullock. One person must drive the bullock, another empty the bucket. Every time the bullock turns after having drawn the bucket out of the well, that rope lies on the bullock-track, in pollution of urine and dung, before it descends again into the well. To some crops needing water, men and women carry it by repeated efforts in pitchers.*

## Animals and Birds of Hindustan

The most absorbing part of Baburnama is its descriptions (with critical analysis) of the flora and fauna of India. Babur starts with a description of Elephant, the animal which fascinated him the most :

*The elephant, which Hindustanis call Hati, is one of the wild animals peculiar to Hindustan. It inhabits the (western?) borders of the Kalpi country, and becomes more numerous in its wild state the further east one goes (in Kalpi?). From this tract it is that captured elephants are brought in Karrab. The elephant is an immense animal and very sagacious. If people speak to it, it understands; if they command anything from it, it does it. Its value is according to its size; it is sold by measure; the larger it is, the higher its price. People protracted beyond the time for which they have provided food, a large portion necessarily dies of hunger. Therumour that it is heard of in some islands as 10 qari high, but in this tract it is not seen above 4 or 5. It eats and drinks entirely with its trunk; if it loses the trunk, it cannot live. It has two great teeth (tusks) in its upper jaw, one on each side of its trunk; by setting these against walls and trees, it brings them down; with these it fights and does whatever hard tasks fall to it. People call these ivory; they are highly valued by Hindustanis. The elephant has no hair. It is much relied on by Hindustanis, accompanying every troop of their armies. It has some useful qualities: it crosses*

*great rivers with ease, carrying a mass of baggage, and three or four have gone dragging without trouble the cart of the mortar it takes four or five hundred men to haul. But its stomach is large; one elephant eats the corn of two strings of camels.*

Among other animals, Babur described not only in detail but with scientific accuracy Rhinoceros, Wild Buffalo, different varieties of deer, nilgai, antelope, monkeys, squirrel etc. typical to India. Let us consider Babur's comparison of the anatomy of rhinoceros and horses:

*The rhinoceros is another. This also is a large animal, equal in bulk to perhaps three buffaloes. The opinion current in those countries (Transoxonia) that it can lift an elephant on its horn, seems mistaken. It has a single horn on its nose, more than nine inches (qartsh) long; one of two qartsh is not seen. Out of one large horn were made a drinking-vessel and a dice-box, leaving over [the thickness of] 3 or 4 hands. The rhinoceros hide is very thick; an arrow shot from a stiff bow, drawn with full strength right up to the arm-pit, if it pierce at all, might penetrate 4 inches (atitk, hands). From the sides of its fore and hind legs, folds hang which from a distance look like housings thrown over it. It resembles the horse more than it does any other animal. As the horse has a small stomach (appetite?), so has the rhinoceros; as in the horse a piece of bone (pastern?) grows in place of small bones (knuckles), so one grows in the rhinoceros; as in the horse's hand there is kumuk (or gumuk, a tibia or marrow), so there is in the rhinoceros.*

The anatomical details by which Babur supports this statement are difficult to understand, but his grouping of the two animals is in agreement with the modern classification of them as two of the three Ungulata vera, the third being the tapir. Babur has also explored the linguistic origin of names of different animals he saw in India. Take for example of deer:

*Another is a deer (kiytti) after the fashion of the male deer (airkakt huna) ..... Its back is black, its belly white, its horns longer than the hunds but more crooked. A Hindustani calls it kalahara, a word which may have been originally kala -haran or black-buck, and which has been softened in pronunciation to kalahara.*

One would be astonished at Babur's minute description of the flora and fauna of India. This shows his ability to observe nature keenly and to critically analyse it. For example, let us go through the description of Peacock:

*The peacock is one. It is a beautifully coloured and splendid animal. Its form is not equal to its colouring and beauty. Its body may be as large as the crane's (turna) but it is not so tall. On the head of both cock and hen are 20 to 30 feathers rising some 2 or 3 inches high. The hen has neither colour nor beauty. The head of the cock has an iridescent collar (tauq susant); its neck is of a beautiful blue; below the neck, its back is painted in yellow, parrot-green, blue and violet colours. The flowers on its back are much the smaller; below the back as far as the tail-tips are [larger] flowers painted in the same colours. The tail of some peacocks grows to the length of a man's extended arms. It has a small tail under its flowered feathers, like the tail of other birds; this ordinary tail and its primaries are red. It is in Bajaur and Sawad and below them; it is not in Kunur and the Lamghanat or any place above them. Its flight is feebler than the pheasant's (girghawal); it cannot do more than make one or two short flights. On account of its feeble flight, it frequents the Hills or jungles, which is curious, since jackals abound in the jungles it frequents. What damage might these jackals not do to birds that trail from jungle to jungle, tails as long as a man's stretch (qulach)?! Hindustanis call the peacock mor. Its flesh is lawful food, according to the doctrine of Imam Abu Hamfa; it is like that of the partridge and not unsavoury, but is eaten with instinctive aversion, in the way camel-flesh is.*

In India, Babur came across with many anecdotes about animals and birds. But like a man with true scientific temper, he did not accept them on face value. Take for example of a talking Parrot:

*It is an excellent learner of words. We used to think that whatever a Parrot or a Sharak (Himalayan Sterling or Myna) might say of words people had taught it, it could not speak of any matter out of its own head. At this juncture one of my immediate servants Abu'l-qasim Jalazr, reported a singular thing to me. A parrot of this sort whose cage must have been covered up, said, "Uncover my face; I am stifling." And another time when palki bearers sat down to take breath, this parrot, presumably on hearing wayfarers pass by, said, "Men are going past, are you not going on?" Let credit rest with the narrator, but nevertheless, so long as a person has not heard with his own ears, he may not believe!*

Wherever Babur led an expedition, he looked for new flora and fauna. Whenever he came across a new one, he tried to find out its origin and characteristics. Here are some examples:

*The Sharak (Persian) is another. It is numerous in the Lamghanat and abounds lower down, all over Hindustan. Like*



*the parrot, it is of many kinds. The kind that is numerous in the Lamghanat has a black head; its primaries (qana) are spotted, its body rather larger and thicker than that of the chughurchug (Turkic). People teach it to speak words. Another kind they call pinaazvali; they bring it from Bengal; it is black all over and of much greater bulk than the Sharak (here, house Myna). Its bill and foot are yellow and on each ear are yellow wattles which hang down and have a bad appearance. It learns to speak well and clearly. Another kind of Sharak is slenderer than the last and is red round the eyes. It does' not learn to speak. .... Again, at the time when (934 A H.) I had made a bridge over Gang (Ganges), crossed it, and put my adversaries to flight, a kind of Sharak was seen, in the neighbourhood of Lakenau and Aud, for the first time, which had a white breast, piebald head, and black back. This kind does not learn to speak.*

Babur has described large number of birds in his memoirs. They include Peacock, Parrot, Sharak (Myna and some other birds), Lujeh, Partridge (Durraj), Pul-paikar, Chils, Sham, Budineh or Quail, Kharchal (or Bustard), Charz (or Floriken), Baghri-kara (or Rock-Pigeon), Water-fowl, Dig (or Adjutant), Saras, Minkisa, Yak Ding, Buzek (or Curlew), Gheret-pai, Shahmurgh, Zumej, Starling, Ala-kurgheh (or Magpie), Crow-pheasant, Chamgidri (or Flying Fox), Aakeh, Karcheh or Koel. It is surprising to note that Babur has included Flying Fox in the list of birds!

Among the aquatic animals, Babur's description of crocodiles is interesting. He described three types: *shl-tibi*, *Siyab-sar*, and *Gharial*. Here are some examples.

*The (P.) Siyah-sar (black-head) is another. This also is like a lizard. It is in all rivers of Hindustan. One that was taken and brought in was about 4-5 qari (cir. 13 feet) long and as thick perhaps as a sheep. It is said to grow still larger. Its snout is over half a yard long. It has rows of small teeth in its upper and lower jaws. It comes out of the water and sinks into the mud.....*

*The Gharial (Gavialis gangeticus) is another. It is said to grow large; many in the army saw it in the Saru (Gogra) river. It is said to take people; while we were on that river's banks (934-935 A.H.), it took one or two slave-women, and it took three or four camp-followers between Ghazipur and Banaras. In that neighbourhood I saw one but from a distance only and not quite clearly.....*

Babur named many animals and birds in Chagatai Turkic, which became difficult to understand later on. The problem was partially solved by Babur's Grandson

Akbar and Great Grandson Jahangir, who himself was a naturalist, when they identified many. Still some confusion persisted about the identity of some fauna, e.g. Sharak in Persian really means a closely related group of birds, and not a particular one.

## Plants, Trees and Fruits

Among the Indian fruits Babur was full of praise of mango.

*The Mango (Amb, Persian Anbak) is one of the fruits peculiar to Hindustan. Hindustanis pronounce the b in its name as though no vowel followed it. This being awkward to utter, some people call the fruit [P.] naghzak as Khwaja Khusrav does. Mangoes when good, are very good, but, many as are eaten, few are first-rate. They are usually plucked unripe and ripened in the house. Unripe, they make excellent condiments ..... Taking it altogether, the mango the best fruit of Hindustan. Some so praise it as to give it preference over all fruits except the musk-melon...*

Babur has also described other fruits like:

*The (Sans.) Jaman (Eugenia jambolana) is another. Its leaf, except for being thicker and greener, is quite like the willows. The tree does not want for beauty. Its fruit is like a black grape, is sourish, and not very good.....*

*The (H.) Kamrak (Beng. Kamruna, Averrhoa Carambola) is another. Its fruit is five-sided, about as large as 3 inches long. It ripens to yellow; gathered unripe, it is very bitter; gathered ripe, its bitterness has become sub-acid, not bad, not wanting in pleasantness....*

*The lote-fruit (Sanskrit ber, Zisypus jujube) is another. Its Persian name is understood to be kanar. It is of several kinds: of one the fruit is larger than the plum; another is shaped like the Husaini grape. Most of them are not very good; we saw one in Bandir (Guallar) that was really good. The lote-tree sheds its leaves under the Signs Saur and Jausa (Bull and twins), burgeons under Saratan and Asad (Crab and Lion) which re the true rainy-season, then becoming fresh and green, and ripens its fruit under Dalu and Haut (Bucket i.e. Aquarius, and fish)....*

*The coco-nut palm (P. Nargil, Cocos nucifera) is another. An Arab gives it Arabic form and says narjil. Hindustan people say narikel, seemingly by popular error. Its fruit is the nut from which black spoons are made and the larger ones of which serve for guitar-bodies. The coco-palm has general resemblance to the date-palm, but has more, and more glistening leaves. Like the walnut,*

*the coco-nut has a green outer husk; but its husk is of fibre on fibre. All ropes for ships and boats and also cord for sewing boat-seams are heard of as made from these husks. The nut, when stripped of its husk, near one end shows a triangle of hollows, two of which are solid, the third a nothing, easily pierced. Before the kernel forms, there is fluid inside; people pierce the soft hollow and drink this; it tastes like date-palm cheese in solution, and is not bad.*

Babur has described many flowers with minute details. Here is one example of hibiscus.

*In Hindustan there is great variety of flowers. One is the jasun (Hibiscus rosasinensis or China rose) ... It is not a grass; its tree is rather taller than the bush of the red-rose. The flower of the jasun is fuller in colour than that of the pomegranate, and may be of the size of the red-rose, but, the red-rose, when its bud has grown, opens simply, whereas, when the jasun-bud opens, a stem on which other petals grow, is seen like a heart amongst its expanded petals. Though the two are parts of the one flower, yet the outcome of the lengthening and thinning of that stem-like heart of the first-opened petals gives the semblance of two flowers. It is not a common matter. The beautifully coloured flowers look very well on the tree.....*

Babur's botanical insight and interest in linguistics have greatly helped scientists and historians of science. For example, when Babur first saw plantain (Banana) plants, he promptly identified it as a kind of weed or grass and not a proper plant. Surprisingly, this is botanically correct. Similarly, we now understand the origin of the word tamarind (Imli) as Babur described it as tamar-i-hind or Indian date-palm.

### Time reckoning

In his memoirs, Babur has discussed in detail the Indian systems of weights, measures and time reckoning. Here are Babur's descriptions of seasons:

*Whereas there are four seasons in those countries, there are three in Hindustan, namely, four months are summer; four are the rains; four are winter. The beginning of their months is from the welcome of the crescent-moons. Every three years they add a month to the year; [Babur here mentions about the intercalary month] if one had been added to the rainy season, the next is added, three years later, to the winter months, the next, in the same way, to the hot months. This is their mode of intercalation. Chait, Baisakh, Jeth and Asadh are the hot months, corresponding with the Fish, Ram, Bull and Twins; Savan, Bhadon, Kijfir and Katik are the*

*rainy months, corresponding with the Crab, Lion, Virgin and Balance; Aghan, Pus, Magh and Phalgun are the cold months, corresponding with the Scorpion, Archer, Capricorn, and Bucket or Aquarius.*

*The people of Hind, having thus divided the year into three seasons of four months each, divide each of those seasons by taking from each, the two months of the force of the heat, rain, and cold. Of the hot months the last two, i.e. Jeth and Asadh are the force of the heat; of the rainy months, the first two, i.e. Savan and Bhadon are the force of the rains; of the cold season, the middle two, i.e. Pus and Magh are the force of the cold. By this classification there are six seasons in Hindustan.*

Babur's descriptions of divisions of time give us not only the minute details of time reckoning system prevalent in India and Central/Western Asia but also their comparative study. Babur also mentioned of performing experiments to ascertain the exact duration of a second. This can be expected only from a man of true scientific mind-set.

*As in our countries what is known by the term kicik gimdiiz (a day-and-night, nycthemeron) is divided into 24 part each called an hour (Ar.saa'ab), and the hour is divided into 60 parts, each called a minute (Ar. daqeeqab). The daqeeqab is about as long as six repetitions of the Fatiha with the Bismillah, so that a day-and-night is as long as 8640 repetitions of the Fatiha with the Bismillah, consists of 1440 minutes, so the people of Hind divide the night and day into 60 parts, each called a (S.) Ghari. They divide the night into four and the day into four, calling each part a (S.) pabr (watch) which in Persian is a pas. A watchman (Pas u pasban) had been heard about (by us) in those countries (Transoxania), but without these particulars. Agreeing with the division into watches, a body of g'harialis is chosen and appointed in all considerable towns of Hindustan. They cast a broad brass (plate-) thing, perhaps as large as a tabaq and about two hands'-thickness; this they call a ghari and hang up in a high place. Also they have a vessel perforated at the bottom like an hour-cup. The g'harialis put this into water and wait till it fills. For example, they will put the perforated cup into water at day-birth; when it fills the first time, they strike the gong once with their mallets; when a second time, twice, and so on till the end of the watch. They announce the end of a watch by several rapid blows of their mallets. After these they pause; then strike once more, if the first day-watch has ended, twice if the second, three times if the third, and four times if the fourth. After the fourth day-watch, when the night-watches begin, these are gone through in the same way. It used to be the rule to beat the sign of a watch only when the watch ended; so that sleepers chancing to wake in the night and hear the*

sound of a third or fourth Ghari, would not know whether it was of the second or third night-watch. I therefore ordered that at night or on a cloudy day the sign of the watch should be struck after that of the Ghari, for example, that after striking the third Ghari of the first night-watch, the gharialis were to pause and then strike the sign of the watch, in order to make it known that this third Ghari was of the first night-watch, and that after striking four Gharis of the third night-watch, they should pause and then strike the sign of the third watch, in order to make it known that this fourth Ghari was of the third night-watch. It did very well; anyone happening to wake in the night and hear the gong, would know what Ghari of what watch of night it was. Again, they divide the Ghari into 60 parts, each part being called a Pal. By this each night-and-day will consist of 3,600 Pals. They say the length of a pal is the shutting and opening of the eyelids 60 times, which in a night-and-day would be 216,000 shutting and openings of the eyes. Experiment shows that a Pal is about equal to 8 repetitions of the *Qul-hwaa-allah* and *Bismillah*; this would be 28,000 repetitions in a night-and-day.

## Weights & Measures, Counting System

The people of Hind have also well-arranged measures : 8 raitis = 1 masha ; 4 masha = 1 tank = 32 raitis ; 5 masha = 1 misqal = 40 raitis ; 12 masha = 1 tula = 96 raitis ; 14 tula = 1 ser. This is everywhere fixed: 40 ser = 1 maund; 12 maund = 1 mani; 100 mani they call a manyasa. Pearls and jewels they weigh by the tank.

[Generally (S.) 1 rati = 8 rice-grains (Eng. 8 barley-corns) ; the (S.) masha is a kidney- bean ; the (P.) tank is

about 2 oz. ; the (Ar.) misqal is equal to 40 raffis ; the (S.) tula is about 145 oz. ; the (S.) ser is of various values]

The people of Hind have also an excellent mode of reckoning : 100,000 they call a lak ; 100 laks equal to a kriir ; 100 kriirs equal to an arb ; 100 arbs equal to 1 kharb, 100 kharbs equal to 1 nil, 100 nils equal to 1 padam; 100 padams to 1 sang. The fixing of such high reckonings as these is proof of the great amount of wealth in Hindustan.

It seems that *arb* is Sanskrit *Arbud* and *nil* is Sanskrit *Nirbud*. It also appears that Babur was not aware of India's great mathematical heritage. This is of course natural in the medieval India; it took 300 years more for the European Indologists to unearth India's glorious past.

Babur's interest in Science reappeared in his great grandson Jahangir, who was a leading naturalist of his time. *Tuzuk-i-Jahangiri* gives us many accounts of flora and fauna of that time. We shall discuss the same in another article.

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