

**WEATHER FORECASTING IN ANCIENT
INDIA
FROM RIGVEDA TO SIXTH CENTURY AD**

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WEATHER SCIENCE IN ANCIENT INDIA: FROM R̥GVEDA TO SIXTH CENTURY AD

Today, meteorology is a very advanced science, and weather forecasting become easy and accurate. But millenniums ago, modern weather forecasting systems didn't exist. Meteorology is developed in different civilisations of the world in various ways and at different speeds. However, almost all ancient civilisations have signs of meteorology in the form of prognostic aphorism and astronomy.

This thesis undertakes a comprehensive exploration of the concept of weather science or physical meteorology practised in ancient India and its antiquity. It delves into how ancient Indians perceived the atmosphere and weather events and inferred weather forecasting rules based on terrestrial signs of weather change, such as atmospheric phenomena, plants, and animals.

Chapter first deals with the history of science and history of knowledge, Indian knowledge tradition and weather science, and its antiquity. The prime focus of this research is to trace the antiquity of weather science in India. Three opinions exist regarding ancient Indian meteorology. The first opinion is that India did not have meteorological knowledge before the 16th century. The second opinion is that some information on meteorology is available in Indian texts, but they are not scientific. The third opinion is that Indian people were familiar with meteorology, and a systematic study of meteorology was also done. The present study demonstrates that the Indians were actively involved in the observation, recording, and prediction of weather and that they possessed a comprehensive understanding of meteorology. The history of weather science can be traced from R̥g Veda to the arrival of the British. Regarding the antiquity of meteorology in India, we have no direct textual evidence of Indians attempting to measure or record day-to-day weather. Sources do not attempt to record weather, although they give considerable attention to its

prediction. Weather prediction rules could not be formulated without prolonged observation of the weather. Yajurveda mentioned 56 occupations in which observation of stars is also an occupation.

Weather forecasting is very significant in a tropical country like India. India's geographical location creates conditions where human life and agriculture depend mainly on monsoon rain. In addition, Excessive rainfall and famine are directly related to rainfall. Thus, India has a rich culture of weather forecasting, which can be seen in various vernacular languages.

Knowledge of weather science lay in the vernacular languages that emerged from ancient Sanskrit, Pali, Prakrit, and Tamil texts. I examined primarily Sanskrit texts through the historiographical method and tried to trace the development and concept of weather science and weather forecasting.

Chapter First also defines terminology from modern and ancient perspectives. In Indian parlance, people consider the season, climate, and weather to be a holistic approach. Day and night, seasonal change occurs due to the sun's path. Therefore, people studied meteorology under astronomy (jyotiṣa), especially under Saṁhitā Jyotiṣa. However, people call meteorology by the names of "ṛtu-vijñāna", "vāyu-vijñāna" "Parjanya-vijñāna" and "vṛṣṭi- vijñāna".

Chapter second deals with sources of weather forecasting, which is known as saṁhita. Saṁhitā Jyotiṣa is a branch of Jyotiṣa which discusses concerns regarding the earth's fate. Saṁhitā Jyotiṣa discusses national issues, like state, wealth and prosperity, groundwater, minerals, vegetation, geography, weather and climate. Saṁhitā Jyotiṣa is neglected by scholars and considered as a pseudo-science. Is Saṁhitā Jyotiṣa a pseudo-science that should be discarded or contains scientific knowledge? To what extent has scientific

knowledge been discussed in *Samhitā Jyotiṣa*? These questions are discussed in the second chapter of the thesis.

Various seers wrote *Samhitā* texts on *Samhitā Jyotiṣa*. *Varāha Mihira* mentioned 27 scholars before him. However, these texts are unavailable. Some of the texts available in which *Garga Samhitā*, *Nārada Samhita*, and *Vaśiṣṭha Samhitā* are significant. *Varāha Mihira's Bṛhat Samhitā* is the most popular treatise on *samhitā jyotiṣa*. After *Varāha Mihira*, *Bhadrabahu*, *Vasatraja* and *Ballalasena* are famous composers of *samhitā jyotiṣa*.

Chapter third accesses the historiographical study of the development of weather science in India. The history of weather science in India goes back to the Harappan civilisation, but we have no concrete evidence. However, we can see textual evidence of weather science from the Vedic period. Vedic seers were aware of atmospheric events in a rough form, including the rainfall process. Various references to the rainfall process can be seen in the Vedic texts. They considered rainfall a crucial process that sustains life on Earth. They categorise rainfall based on winds, quantity and quality of rainfall, thunder and lightning. Ancient sages know that sun rays are made of seven colours, which evaporate water from water bodies and are suspended in the atmosphere, and wind transports vapour to the north. This moist wind enters northern India from the east. That is why ancient texts mentioned many times that easterly wind brings rain. Ancient seers believed there is typically a gap of six months between water absorption from the ocean and rainfall delivery in northwest India. Moreover, the concept of the *yajña* system was established in the Vedic times, which is performed to induce rain and purify the environment.

The branches of knowledge that had already reached a distinct degree of advancement in the first period, the Vedic period, simply continued to improve further in the second. One of them was *jyotiṣa*. In the first period, the concept of Meteorology was in its aboriginal form, and we did not find any portent regarding weather forecasting. However, we can see

that in the second period, the scholars tried to understand the basic concept of weather science, and they were successful to a great extent. They reached a level where ancient seers were not only able to understand the concept of weather phenomena but also able to forecast the weather. Parāśara mentioned the concept of cloud formation, delivery period and auspicious and inauspicious portents regarding seasonal rainfall. They also developed a kind of rain gauge for measuring rainfall. At that time, forecasting of weather was purely based on observations of the sky. Thus, we can say that by this time, our ancestors had laid a foundation for weather science. References of weather science and weather forecasting can be seen in Mahābharata, Rāmāyaṇa, Parāśara tantra and Garga Saṁhitā.

In the third phase of development, it is evident that weather science had become a significant part of the ancient Indian knowledge system. Weather science reached its peak and was a very popular discipline in society. Most of the scholars' works on weather science were written during this period.

In the fourth phase, the Siddhantic period, the development of weather science stagnated. Varāha Mihira, Bhadrabahu, Parāśara II, and Ballalasena contributed during this period. Varāha Mihira usually uses a model based on asterism and real-time observation. It is like a climate model used for seasonal rain forecasting. Thus, it gives an idea of good rain, drought, or heavy rain in the season so that farmers do their work accordingly. However, he suggested careful continuous observation and used this data as well.

The trajectory of the development of weather science demonstrates that weather science continues to advance till 500 AD. After 500 AD, the advancement of weather science was merely seen. Most of the scholars compiled the knowledge of existing knowledge of previous scholars, as Varāha Mihira himself mentioned in Bṛhat Saṁhitā. The influence of astronomy and astrology changed the course of weather science. In the beginning, the subject started in a logical manner. However, later, it fell into the hands of a

few less competent people, who blocked further development by giving the wrong orientation to the subject.

Chapter four answers these questions: How did ancient people observe the weather elements, and how did they collect and process this information into predictions? How much do they know about the science of environmental phenomena? What concepts were related to long-term, short-term and nowcast prediction practised in ancient India?

Weather forecasting is the information gained from meteorological data through its analysis, synthesis, and interpretation. Ancient methods of observation, collection, and processing of information differed from modern methods. Ancient knowledge of weather prediction comes through observation and empirical study of the environment. Through keen observation, ancient seers tried to understand the mechanism of weather and its principles to predict the weather. Although their prediction methods differ from modern techniques, they are pretty accurate.

In the ancient world, natural sciences were part of philosophy, and the concept of nature was tried to be understood philosophically. In India, natural science was discussed broadly in philosophy and cosmology. Indian cosmology claims that the universe, our earth, and all living and non-living things are constituted by five basic elements, known as Pancabhuta. These are space, fire, wind, water and earth. It forms the atmosphere, flora and fauna on the earth. The water cycle, energy cycle and all other weather phenomena are constituted of these elements in different proportions. If the equilibrium of these elements is disturbed, disastrous phenomena occur. Thus, the equilibrium of elements should be maintained for the sustainability of life on the earth. Yajña system was used for maintaining the relationship of elements.

Thus, the concept of meteorology can also be traced to the Pancabhuta theory. The Ether denotes space and serves as a medium that provides a spatial environment for the existence and functioning of other elements. Heat is understood in terms of fire, and the sun's rays are the ultimate source of all heat. Thus, the fire element denotes the sun (celestial fire) and heat (temperature) in the mid-region and fire on the earth. Fire's paramount quality (guṇa or swabhāva) is luminous. Air is the third element of the universe and the prime element for life in living beings, which is known as prāna vāyu. Vedic scholars observed the atmosphere and found that air (Vāyu) ruled the mid-region, which is why the atmosphere is known as *Vātaskandha*. Water is a significant regulator of weather and meteorological events on Earth. Three states of water, i.e. solid, liquid and gaseous, are available in the atmosphere. Ancient scholars highlighted water vapour as the most significant element of the atmosphere. Vedic texts emphasised that sunrays extract water from all mobile and immobile things, and this vapour is carried by wind in the atmosphere. After condensation, vapour is converted into water drops and falls down on the earth as rain. This cycle always continues and is known as the water cycle in ancient India. The earth element is a solid element which provides structure to living and non-living things. The atmosphere exists in the earth's surroundings. Earth elements also exist in the atmosphere in dust form, which is crucial for the condensation process. The wind carries dust and fine particles from the earth's surface and uplifts dust into the atmosphere. This dust particle, which is now known as aerosol, plays a vital role in cloud formation.

Chapter four further discusses the understanding of weather events, such as wind, clouds, precipitation, lightning, etc., perceived in ancient India. According to the ancient Indian view, Wind is the most vital force in the atmosphere and the ruler of the mid-region (atmosphere). Wind absorbs sunray heat and moves from one place to another to distribute heat, so wind circulation forms. In the meteorological context, wind has three primary

functions: cloud formation, nourishment, and rain delivery. Vertical circulation of the wind helps in the suspension of water vapour in the atmosphere and the process of cloud formation. The horizontal circulation of wind carries these water vapour and clouds from one place to another, and different winds help in rainfall. Consequently, wind is classified into three types: bhāvaka, sthāpaka, and jñāpaka. The ancient literature provides details on the interpretation of wind direction concerning the weather that was anticipated for weather prediction. These details indicate that it was necessary to conduct nearly daily observations of the wind at each location and maintain a diary of the same. However, we could not find such a type of meteorological diary. It seems that due to the tropical climate (hot and humid), clothes, tree bark, and other means of records may be decomposed. The ancients were probably as acquainted with the local wind as the modern meteorologist, whose knowledge is primarily derived from the use of instruments for measurement.

We can see the ancient Indian concept of clouds, which originate from the combination of smoke (aerosols), fire, wind, and water (vapour). They exist in four major states (condition), namely, Abhra. Varddala, Ghana, and Ghatā (Kadabini 3.39). Among these, the one that had few clouds scattered in the sky was known as Abhra, and it did not provide rain. Spread out cloud which is broken as Ghan and pieces of broken cloud (ghan) were known as Varddala. A cloud, which is spread in the sky entirely as unbroken, is known as ghatā. If we analyse this cloud condition from a modern perspective, it is very similar to the modern cloud cover concept. In modern times, cloud cover conditions are measured in Octa.

Ancient Indians knew both forms of precipitation– solid such as fog, snowfall, and hailstone, as well as liquid precipitation or simply rainfall. Ancient texts also provide different classifications of precipitation and rainfall measurements. Other atmospheric phenomena like thunder and lightning, optical phenomena– halos of sun and moon, mock

sun, sunbeam, rainbow, etc., also known by people and they use these changes in weather prediction.

Weather prediction consists of predicting many incidents, such as rainfall, formation of clouds, earthquakes, falling of meteors, etc. Amongst all these incidents, rainfall prediction is considered the most important because it is directly connected to agriculture and the livelihood of the people. According to ancient Indian meteorologists, the rainy season lasts for only four months. Still, the observations of various elements of nature should be carried out throughout the year because the process of the vaporisation and formation of clouds starts quite a few months early. For next year's rain prediction, observation must be started after the end of the rainy season.

According to ancient Indian meteorology, weather can be predicted by observing four kinds of *nimittas* or indications (elements that help us to predict the weather). These are— bhaum nimittas, antarikṣa nimittas, divya nimittas and misra nimittas.

One should observe the winter season for cloud conception and forecast the precipitation of the next rainy season, which can be called long-range prediction. Observation of the summer season was necessary for detecting the growth and conditions of clouds and other favourable natural phenomena, which provided good rainfall and prosperity. On the basis of summer observations, seers made predictions for the upcoming rainy season. This type of prediction can be called medium-range prediction. In addition, observation of itself the rainy season helps to forecast the week before, which can be called short-range prediction.

Ancient weather science comprises long weather observations and, after that, prediction rules formulated. Thus, it focuses on climatological models to predict weather and rainfall variability. Despite pollution and climate change, these rules are quite accurate and reliable. This thesis examines some of the prediction rules. Chapter five presents a weather

forecasting model from ancient times and also tries to validate some rules over the Lucknow district. In this chapter, my specific focus is on examining the identification of atmospheric indications and comparing reliable weather predictions in old writings with contemporary observations of the Indian Meteorological Department (IMD) dataset collected for the districts of Lucknow, which is far away from where these rules are formulated. This comparison serves to validate the accuracy and reliability of ancient weather forecasting methods. Here, some rules related to long, medium, and short-range prediction are chosen for scrutiny. Primarily, those rules are chosen that are based on atmospheric observation. These rules based on the Conception of clouds, retention days, Rohiṇī Yoga, Svāti Yoga, Āṣāḍhī Yoga, and the first rain in particular asterism are chosen.

The results of the study underline that predictions based on Rohiṇī-Yoga show a very strong relationship between weather events on the Rohiṇī-Yoga day and the total seasonal rainfall of the year. Similarly, based on the first rainfall above one mm in the Śravaṇa month under 27 asterism after Pūrvāṣāḍhā asterism and the moon's mansion, the prediction of seasonal rainfall shows a strong relationship.

Ancient scholars might have reached these conclusions after centuries of observation. However, one-day observation-based prediction rules damaged the advancement of meteorology. Thus, we could not see further development in meteorology after the sixth century. The development of weather science became stagnant after the sixth century, with texts related to weather science being merely commentaries of early texts, a clear indication of the impact of external factors on the field. The external factors are social, economic and political.

The necessity of meteorology in daily life gives it new life in the form of weather lore and proverbs in vernacular languages, which is now known as traditional knowledge. These weather lores are transmitted in the local languages, and formers added some rules. These

rules primarily focus on agricultural meteorology. Most of the folklore comes from Hindi, Gujarati, Rajasthani, Panjabi, Bengali and Tamil. Among these, the works of Ghagh-Bhaddari in Hindi and Rajasthani, khanā in Bengali, Dāk in Maithil, Bhadali Vakyō in Gujarati, Sahadev Bhadali in Marathi, Tirikkurala Rattamatasastrasu in Kannada and Karan Pathu in Tamil are pretty famous. Indian Council of Agricultural Research collected more than 5200 weather folklore from all over the country. These folklores vary according to their local conditions. Due to the dispersion of meteorological knowledge in local languages, it became accessible to even illiterate people. Thus, meteorological knowledge became state-organised to people's knowledge in later times.

This thesis provides new readings and interpretations of passages and texts containing knowledge of weather, which have previously been understudied. It shows that the use of observational meteorology declined over time, and astronomy-based computational meteorology became popular, which is linked. In my opinion, this is related to social and cultural trends of that time. The cultural significance of astronomy and horoscopy reduces the scope of weather signs and the study of saṁhita texts.

This thesis posits that ancient India had a sophisticated understanding of weather science. This hypothesis is substantiated by a meticulous analysis of ancient Sanskrit texts and a comparative study of ancient weather forecasting rules with actual observed datasets. The results reveal a positive correlation and a high level of accuracy, thereby validating the advanced state of weather science in ancient India. This research has the potential to contribute to the history of science, but more than this. It may have an in-reach cultural heritage and traditional knowledge of India.