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Henry Francis Blanford and the Beginning of Scientific Meteorology in India, 1874-1889

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***Abstract*:** The introduction of scientific meteorology in India is remarkable. The British were the first to introduce organized meteorology and storm warning systems in India to serve their imperial interests. One of the most prominent British administrators and scientists who introduced scientific meteorology in India was HenryFrancisBlanford. After being appointed Honorary Secretary of the Asiatic Society of Bengal in 1864, he began detailed meteorological experiments in India. He also submitted a report on the Calcutta cyclone in 1864 with the help of one of his colleagues and recommended the introduction of storm warning systems at various ports. When the Bengal Provincial Meteorological Office was established in 1867 AD, he was appointed as its Metrological Reporter and undertook to form an all-India organization for the collection and imposition of meteorological data in India. Finally, with his personal initiative and the goodwill of the British Government, the Indian Metrological Department was established in 1875. H.F. Blandford was appointed the first Imperial Meteorological Reporter and pioneered scientific meteorology in India. He put a plan for the unification of the provincial meteorological systems into an imperial system. He sketched out general guidelines for how meteorological work should be done in India. Apart from bringing about changes in the administrative and operational procedures of the department, he personally wrote several research articles and books on the issues of India's weather and climate through his intelligence and diligence and discovered many unknown facts. He examined irregularities in the seasonal monsoon rainfall, periodic recurrence of drought, and the fluctuation of monsoons across the plains and foothills. In fact, he introduced the study of tropical meteorology for the first time. In the present article, I have explored how H. F. Blanford was associated with the establishment of the Indian Meteorological Department and how organized and scientific meteorology began in India under his leadership. His ground-breaking studies on several aspects of India's weather and climate are also discussed here.

***Key Words*:** H.F. Blanford, Calcutta Cyclone, Indian Meteorological Department, Scientific Meteorology, Tropical Meteorology, Synoptic Monsoon, Drought, Himalayan Snowfall

I. Introduction: Education and Early Career

HenryFrancisBlanford (1834-93), a renowned meteorologist and geologist, was born on June 3, 1834, at Bouverie Street, Whitefriars in London. He joined the Geological Survey of India in 1855 after receiving training under De la Beche, Smyth, and Percy at the Royal School of Mines and the Mining Academy of Freiburg.[1] He worked for the Survey for seven years before being forced to leave due to illness. Then he was offered the Science Professorship in the Presidency College, Calcutta, by the late Mr. W. Atkinson, at that time Director of Public Instruction in Bengal. Mr. Blanford accepted this position and, near the end of 1862, he began working for the Bengal Educational Department. In 1864, he was elected as one of the honorary secretaries of the Asiatic Society of Bengal. About the same time, perhaps as a result of his secretary responsibilities, he began to focus on meteorology. He began studying cyclones closely in 1867 while serving as a meteorological reporter for the Government of Bengal. In 1874, he became the head of the Indian Meteorological Department. He moved to Folkestone after retiring in 1888. He passed away on January 23rd, 1893, at the comparably young age of fifty-eight. He was elected F.G.S. in 1862, F.R.S. in 1880, and president of the

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Asiatic Society of Bengal in 1884. He wrote about fifty papers on meteorology and geology. He was elected an honorary member of several foreign meteorological societies because of his work as a meteorologist. [2] His unwavering efforts and immense expertise led to the growth of legitimate scientific meteorology in India.

The development of meteorologyin India:

The development of meteorology in India as a separate branch of science is interesting. In India, modern scientific meteorology began with the expansion and consolidation of British colonial power. The British rulers wanted to understand the unique characteristics of tropical weather and climate, which was unlike the extra-tropical ones of Europe. Hence, in order to control tropical weather, a new sort of meteorology—tropical meteorology—began to be explored and comprehended. [3] Meteorology in India was an indigenous discipline, unlike other areas of science introduced to the country in the nineteenth century. As a result, it was less influenced by metropolitan science in London, even if it periodically required the Royal Society's assistance in its early years. [4]Scientific meteorology began with the master mariners of the era of sailing ships, who carried with them measurement instruments and carefully recorded observations (in their ship logs) of winds, currents, surface pressure, and temperature.By the end of the eighteenth century, scientific research on the monsoon climate and weather of India had started. The system of meteorological observations in India began in 1796 at the Madras Observatory, set up by the East India Company (EIC) to record astronomical observations, which were considered important for sailing vessels. [5] The nature of the queries into the monsoon and the theoretical responses from the ancient men of wisdom had altered due to the new science of the seventeenth century. The emphasis shifted from clinging to myths, traditional notions, and accumulating visual observations to attempts at compiling meticulous, objective observations, searching for physical connections, and analyzing causes.[6]In the first half of the nineteenth century, there was no organized effort to establish a system of meteorological observations in India. The Company was basically interested in the commercial endeavor.[7] The state's objectives to promote science were by and large missing, except for some efforts on the periphery. During the first half of the nineteenth century, three important astronomical observatories were set up in Bombay (1823), Calcutta (1829), and Trivandrum (1836).[8] The military stations in India, also, began to take meteorological observations as a safeguard from the impacts the weather and climate had on the health of soldiers. But the observations had ceased between 1857 and 1862 as a result of the Mutiny in 1857. However, after the takeover of the Indian administration by the British government (after 1857) much interest was shown in the record of meteorological and other scientific observations.

Mr. Blanford's Report on the Calcutta Cyclone and the Establishment of the Indian Meteorological Department (IMD):

Henry Francis Blandford was greatly influenced by the Calcutta cyclone of 1864. It was one of the worst storms ever recorded in Calcutta. Colonel Gastrell and Mr. Blanford created a report on the cyclone of 1864, and the Lieutenant Governor of Bengal ordered its publication in 1866. According to this report, the storm surge swept up the Hooghly River and swamped the nearby lowlands, killing up to 40,000 people.[9] This cyclone was followed within a few weeks by another, which passed over Masulipatnam, and the storm wave again caused the loss of about 30,000 lives. It is incredibly detailed in its description of all the key characteristics of that cyclone despite the fact that a large portion of the data is insufficient. The conclusions demonstrate a solid understanding of the issue and are, in virtually every way, consistent with the findings of later research on storm formation and motion in India.[10] These startling disasters naturally aroused the attention of the Indian Government and the public generally to the necessity of systematic meteorological observations, and the importance of establishing a proper system of storm warnings for the protection of the ports of India, and especially Calcutta. Shortly after the Bengal cyclone, a committee was quickly formed at the request of the Lieutenant- Governor to set up a system of storm warnings for the port of Kolkata. Mr. Blanford became the secretary of this committee. Observatories were established at a number of coast stations, and the findings were telegraphed daily to Calcutta. In order to continue the system of storm warnings and general meteorological observations, the Bengal Provincial Meteorological Department was established in 1867. Mr. Blanford was appointed Meteorological Reporter for Bengal while maintaining his Professorship and lecturing primarily in the Presidency College on chemistry and physics.[11]

After the devastating cyclone of 1864, the Asiatic Society of Bengal repeatedly urged the colonial government to strengthen the central meteorological system. The Enquiry Commission

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of Orrisa and Bengal Famine (1866) also recommended the establishment of an all-India meteorological department. The existing knowledge of Indian meteorology was incorporated into C.R. Markham's memoir on the Indian Surveys, which was published in 1871. It was clear that systematic knowledge was needed.[12] The Government of India (GOI) issued a statement to the Secretary of State for India in October 1871 suggesting a meteorological setup in India after carefully evaluating the views of various parties. The Meteorological Reporter to the Government of Bengal at the time, H.F. Blanford, also submitted a memo with this dispatch noting that the procedures implemented under the Province Meteorological System since 1865 were insufficient. General Richard Strachey, Secretary of the Asiatic Society, also included a comment about the potential establishment of scientific meteorology in India. A restructuring of the meteorological observations in India was considered in 1874, on the advice of the Royal Society and the English Meteorological Council. The India Meteorological Department was founded as a result of a letter from A.O. Hume, Secretary to the Department of Revenue, dated December 17th, 1874. Finally, in 1875, the Indian Meteorological Department (IMD) became functional with just one staff member, Henry F. Blanford. Blanford was appointed the Imperial Meteorological Reporter to the Government of India (GOI).[13] He played an outstanding role in the development and advancement of the Indian Meteorological Department.

Henry F. Blanford: Pioneer of Scientific Meteorology in India

He was one of the pioneers in the introduction of scientific meteorology in India. In order to provide information for the company to utilize meteorology for social purposes, Blanford gave the IMD the paramount goal of gathering scientific data regarding Indian meteorology. From the very beginning of the IMD, which started with the image and responsibilities of a Scientific and Technological Organization for Atmospheric Physics and Weather and Climate-Related Studies in India, tasks like special observations and research by members of the IMD were considered part of their functional responsibilities. As the other scientific institutions were tied to the phrase "Survey," the IMD might be considered the first scientific department of the Government of India.[14] Together with storm warnings and general service features, scientific research fell within the purview of the IMD. A report that Blanford submitted to the government on July 26, 1875, was accepted by the GOI on September 27, 1875. This effectively set the groundwork for India's pursuit of scientific meteorology.

As a Meteorological Reporter in Bengal, he contributed two articles to the Royal Society which also set some principles of scientific meteorology. These two articles were "On the Origin of a Cyclone" (Proc. Roy. Soc., Vol. 17, 1869) and "The Winds of Northern India" (Phil. Trans., Vol. 166). He described the main characteristics of the typical air currents over Northern India and pinpointed their origin and causes, to the extent that they can be identified, in the regional physical changes of the atmosphere.[15] It was made evident how the northeast and southwest monsoon currents related to one another, to India's temperature, and to other conditions. He used recent advancements in the physical sciences in the discussion of the various meteorological problems. In addition to being the first essay on Indian meteorology as a whole,it was also the first attempt to discuss this important question using relatively nascent data.[16] The topic was also treated for the first time as a problem of dynamic meteorology.

Administrative contribution to Indian Meteorological Department:

Blanford was also a great organizer and administrator. After the establishment of the Indian Meteorological Department in 1874, Mr. Blanford was appointed head of the new department and he was asked to put together a plan for the unification of the provincial meteorological systems into an imperial system. He sketched out general guidelines for how meteorological work should be done in India. He also suggested expanding the work of observation and centralizing the Department to ensure consistency in methods and results tabulation.[17] It has remarkably withstood the test of time, and over the course of its eighteen-year existence, the Department has developed in the ways that Mr. Blanford had fully anticipated.

With his thorough knowledge of Indian meteorology, Blanford was able to recognize that the practical uses of meteorology that were most significant to India were not at all the same as those that had captured the interest of meteorologists in Europe and America. So, the primary goal of Blanford's plan was to conduct a comprehensive study of India's climate and meteorology as a whole and use the results of that study to produce weather predictions and timely warnings for cyclonic storms.

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Yet, this served as the impetus for India to embrace standardized observational techniques.[18] The main goal Blanford outlined for this department was to open a Central Observatory in Calcutta with photographic self-recording equipment. Another significant task of this observatory would be to compare and verify the quality of all instruments provided to meteorological observatories in India, as well as to increase the number of observatories from 70 to 92, with additional observatories to be set up in Burma, Rajputana, Central India, and Bombay Presidency. He also proposed to accumulate the discussion of meteorological data of the whole of India in an annual volume and to coordinate the meteorology of India with neighboring countries and Europe.[19] The Department took over the Survey of India's time ball service and chronometer rating in 1880. The time ball was a metallic ball that was dropped from a tower or close to the port at regular intervals so that it could be seen by the ships in the harbor. These time balls were used by the ship's officials to compare and adjust their watches. Calcutta, however, stopped offering the time ball service for shipping in February 1947.[20] He instituted a system for the publication of research findings made by IMD employees in the form of Memoirs of the India Meteorological Department to spread meteorological knowledge across all classes in India.

H.F. Blanford and His Major Works on Climatology:

He produced a number of valuable and ground-breaking studies on the climatology of India, which are discussed in the following paragraphs:

i. Journal of the Asiatic Society of Bengal:

He was the first meteorologist to introduce the study of tropical meteorology. He wrote a number of papers on tropical meteorology in the *Journal of the Asiatic Society of Bengal*. The three most significant ones were "On certain protracted irregularities of Atmospheric Pressure in Bengal in relation to the Monsoon Rainfall", "On the Normal Rainfall of Bengal" and "On some recent Evidence of the Variation of the Sun's Heat" (*Jour. As. Soc. Bengal*, Vol. 44, Part 2). It discussed how abnormal pressure variations frequently persist over substantial portions of India for durations ranging from a few months to two or three years, as well as the relationship between these prolonged abnormal features and significant changes in rainfall distribution.[21] Mr. Blanford spent a lot of time thinking about this issue, which is becoming more crucial in relation to the current forecasting of the general characteristics of the monsoon rains, now performed by the Indian Meteorological Department.[22]

Mr. Blanford, as a Meteorological Reporter for the Government of India from 1874 to 1889, wrote a number of short and valuable papers for the Asiatic Society's Journal. Some of his most valuable papers were: "On the High Atmospheric Pressure of 1876-78 in Asia and Australia, in relation to the Sun Spot Cycle", "On the Relations of Cloud and Rainfall to Temperature in India, and on the opposite Variations of Density in the Higher and Lower Atmospheric Strata", "The Theory of the Winter Rains of Northern India", and a series of papers on the "Diurnal Oscillation of the Barometer." In the first paper, Blanford requested meteorological services and observatories around the Indian Ocean, and Asian to Australasian regions to provide the IMD with their observations of atmospheric pressure and general climatic conditions after severe monsoon failure and extremely high atmospheric pressure readings over India in 1877.[23]Blanford discovered that, in 1877, an abnormally high-pressure pattern had spread to western Siberia, northern China, and southern Australia (the El Nino of 1876–1877 was one of the strongest in the previous 200 years). Blanford also investigated potential connections between the solar cycle and rainfall during the Indian monsoon in 1881, as suggested by Sir Norman Lockyer.

ii. On the Connection of the Himalaya Snowfall with Dry Winds and Seasons of Drought in India:

In the study *On the Connection of the Himalaya Snowfall with Dry Winds and Seasons of Drought in India*, Blandford explored a phenomenal aspect of Indian meteorology: how unusually large snowfall in the Himalayan region affected the pressure and temperature conditions over Northern India during the hot summer, which in turn affected how much rain fell during the ensuing southwest monsoon.[24]The dominance of monsoons was proven through the synoptic meteorology of the summer monsoon. He was the first to note its variations over the plains and foothills (active and break monsoon events). He was the first to properly comprehend the significance of this component in Indian meteorology, which has since evolved into the foundation for the seasonal predictions currently published by the Indian Meteorological Department.

iii. Indian Meteorological Memoirs:

His series of annual reports on the meteorology of India (from 1876 to 1885) and the papers he gave to the *IndianMeteorologicalMemoirs*, a journal he

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started soon after the foundation of the Indian Meteorological Department, were certainly his most significant works at that time. These articles demonstrate how heavily he focused on India's recurring diurnal and seasonal weather fluctuations. In his opinion, a thorough understanding of these issues is crucial as the resolution of these problems could shed critical new light on some of the most significant anomalous elements of Indian meteorology and provide a possible remedy.[25]

iv. The Rainfall of India:

He conducted research to provide an accurate understanding of all the more general characteristics of the distribution of rainfall in India, as well as of the main causes or factors (physical and topographical) determining the law of its distribution in *The Rainfall of India* (*IndianMeteorologicalMemoirs*, Vol. 3). He discussed the problem of the periodic recurrence of drought and provided data on the incidence of 38 droughts from 1769 to 1878 over different parts of India.[26] He made the following crucial deductions from the empirical facts on drought occurrence:
During intervals of 9 to 12 years, and sometimes in between, droughts of varying degrees of severity are likely to occur in some regions of Southern India. On average, these droughts start approximately a year before the sunspot minimum, but there is no evidence—or even any evidence—that one kind of phenomenon is dependent on another. In addition, Northern India experiences droughts occasionally during years of maximum sunspots. As far as the data of recent years admit of a definite conclusion, these (as those of the former class) follow heavy Himalayan snowfall either in the earlier months of the year, or, it may be in the early parts of the monsoon.[27]

v. Climates and Weather of India:

He presented the chief results of his investigations and those of his co-workers in India to the English public in 1889, in his book *A Practical Guide to the Climates and Weather of India, Ceylon and Burmah and the Storms of The Indian Seas*. It is a valuable work on local climatology and presents all the more important results of the work of the Meteorological Department during his regime in an interesting form for English readers. The main intention behind writing this book was "to enable the lay public to understand and intelligently appreciate the mass of meteorological literature …".[28] The book addressed more particularly to the agriculturists, medical officers, engineers, pilots, and other seafaring men and to those of the general public to whom the weather and the climates of India are practical and not scientific objects of interest.
vi.IndianMeteorologist'sVadeMecum

IndianMeteorologist'sVadeMecum became a useful book of reference for Indian observers and was practically the first treatise that placed the ideas of the modern school of dynamical meteorology in an easily accessible form before ordinary readers. It was for many years the best treatise on modern meteorology and was the forerunner of the numerous treatises on the science which have been published in the United States, Germany, and England. The main goal of this was to instruct Indian observers on what and how to observe, in order to ensure that their observations were precise and helpful.[29] This portion of the work forms Part I of the *VadeMecum*. In order to arouse an intelligent interest in their work, Mr. Blanford, in Part II, gave an interesting account of all the more important features of Indian meteorology so far as then known, together with explanations based on the data and ideas of physical science.

II. Conclusions:

So, it is clear that Blanford was not only an expert meteorologist but also a competent administrator and organizer. He was a diligent and patient worker. The fruits of his labor are evident in the Annual Reports on the Meteorology of India, as well as other brief suggestive articles he presented to various Societies. His own monumental work on the *RainfallofIndia* (vol. III of the Memoirs) has made a lasting impression and is unparalleled for the clarity of its explanation and the breadth of its implications. He established the connections between the seasonal monsoon and the pressure patterns over Australia and Russia. He measured the amount of winter and spring snowfall in the Himalayan region. One of the more significant aspects of Indian meteorology, and likely tropical meteorology in general, was highlighted in his works. He is credited with the initiation and advancement of scientific meteorology in India. The rapid expansion of the Indian Meteorological department under his leadership is the best indication of his unique meteorological qualifications as well as his enthusiasm and unwavering energy. It was his major impetus to elevate his department to the same level for scientific and practical work in meteorology as similar departments in Europe and America, and it is hardly too much to say that he fully succeeded.

European meteorologists almost immediately recognized the value of the work done by the department under him. In fact, the Government of India (GOI) expressed "the high estimate which has been formed by the Governor General in Council of the zeal and ability displayed during the several years of his (Blanford's) incumbency of the Office of the Meteorological Reporter to the Government of India" in its administrative report of the IMD in 1888–1889.[30] The IMD had a solid basis laid by Blanford, which was subsequently reinforced by all of the successive heads. He can, therefore, be referred to as the most significant among the "Makers of the Meteorology of India".

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