Sir Gilbert Walker—pioneer meteorologist and versatile scientist

P. R. Pisharoty

Sir Gilbert Thomas Walker, a former Director-General of Observatories, India, made outstanding contributions on world weather relationships, particularly with reference to the Indian summer monsoon. These contributions were made while he held the post of Director-General with marked distinction for twenty years from 1904 to 1924. In recent years his classical work has assumed renewed importance through the current studies on the 'Southern Oscillation'*, an atmospheric phenomenon discovered by him. It is a see-saw variation in the seasonal atmospheric pressure between the equatorial Indian Ocean and the southeast Pacific Ocean. An associated atmospheric zonal circulation in the vertical plane has been named 'Walker circulation' by Prof. J. Bjerknes. The current studies on this circulation and its connection with middle-latitude weather have further enhanced the value of Walker's work.

Gilbert Thomas Walker was born on 14 June 1868. He went to St Paul's School in London. In 1885 he was awarded a scholarship for mathematics at Trinity College, Cambridge. Four years later, in 1889, he graduated as a Senior Wrangler, or First Man of the Year in Mathematical Tripos, in which the second place went to Frank Dyson, later Astronomer-Royal.

Walker was appointed a Fellow of Trinity College in 1891, and later became University Lecturer. In this capacity he did original scientific work, for which an Sc D degree was awarded to him in due course. He continued to work there till 1903. During this period Walker's original work was almost entirely in two fields, dynamics and electromagnetism. His papers 'On the motion of elongated projectiles' (*Proc. R. Artill. Instt.*, 1892) and 'On boomerangs' (*Phil. Trans. R. Soc. A.*, 1897) had given him the reputation of an authority on this branch of dynamics and led to his being invited to write an article, 'Spiel and sport', for the *Encyklopadie der Math. Wissenschaften*. The first of a series of papers on electricity was a substantial Memoir, 'Repulsion and rotation produced by alternating currents' in the *Phil. Trans. Roy. Soc.*, 1892. In 1900 he was awarded the Adams Prize by the University of Cambridge for the essay, 'Aberration and some other problems connected with the electromagnetic field'. By 1903, he had published two other substantial papers, connected with allied subjects. For all this work he was elected to the Royal Society in 1904. Thus, in 1903, when he was invited by the Government of India to join as Director-General of Observatories, Walker had already established his reputation as a mathematical physicist. As meteorology was a foreign realm to him at that time, he first visited meteorological offices in Europe and America and then, on arrival in India, spent a few months in close touch with Sir John Eliot before taking over charge on 1 January 1904. He was able to bring a fresh and truly vigorous scientific mind to bear on the problems of meteorology in this country.

Much can be written about Walker's scientific work in India. A fuller account can be found in the *Administration Report 1924–25* of the India Meteorological Department.

The comparative weakness of the monsoons in north-west India after 1894 had made the Government fear the possibility of a permanent change of climate and consequently the Government of India requested Walker in 1908 to prepare a report on the subject of climate change in India. After examining all possible meteorological evidence, Walker came to the conclusion that the deficiency was not due to increase of irrigation or diminution of forests, and that it had not lasted long enough to justify a verdict of permanent change of climate. He added that there were marked indications of an impending return to good seasons. The years following 1908 fully supported those conclusions. (A similar question posed to the Planning Commission by the Government of India in 1973 and again in 1983 drew similar answers.)

The main problem that faced Walker was the problem of forecasting monsoon rainfall. In a search for factors useful in forecasting the monsoon, he began with investigations on the influence exerted by temperature and pressure in the pre-monsoon period, went on to examine relationships with conditions in and around the Indian Ocean, and later extended his work to influences of conditions much further afield. To test relationships Walker computed the correlation coefficients and pioneered their use in meteorology. He contributed a criterion of significance for use when the highest of a large number of correlation coefficients are chosen. Within a few years Walker selected snowfall accumulation in the Himalayas at the end of May, pressure over Mauritius and rainfall in Zanzibar in May, and pressure over South America in April and May as the best factors* for use in forecasting the monsoon. It may be mentioned here that in these studies about *three thousand* correlation coefficients were computed.

Walker always critically examined the details of his data and the interrelationships between them before publishing a result or even making a recommendation. Also, he was always on the

*This atmospheric phenomenon is closely associated with an oceanic phenomenon called El Niño. During and El Niño year, in the months December to March, sea surface temperatures off the coast of Peru are about 5°C higher than the normal temperatures for those months. Scientists now call the combined phenomena ENSO. Much study is currently carried out all over the world on ENSO and its relation to the Indian summer monsoon.

*In course of time, the importance of these factors, except that of pressure over South America and of snow accumulation over the Himalayas, has been lost.

lookout for the physical causes behind relationships. He carried out a series of investigations correlating sunspots with temperature, pressure and rainfall over different parts of the world. His Memoirs on these subjects are a standard source for the relationship between solar radiation and terrestrial weather. (Recent workers in this field have apparently not delved into Walker's work.) They proved that the sun does not directly control the weather and that the immediate source of radiation in terrestrial weather must be sought within the atmosphere itself. Walker went on to study world weather using quarterly means of pressure and rainfall at about 90 centres over the earth. Since these were correlated with one another for contemporary and consecutive seasons it involved a lengthy computational programme.

Walker's results were published in two Memoirs of the India Meteorological Department, and after he left India in 1924, by the Royal Meteorological Society. These Memoirs are a mine of information, out of which emerged the familiar see-saw connection between the pressures over Azores and Iceland, and a similar connection in the north Pacific, besides the Southern Oscillation already mentioned. The Indian monsoon has its place in the southern oscillation, more as a precursor than as the outcome of other events. In these papers Walker revealed many important relationships that merit further attention and suggested forecasting formulae for other areas of the world as well as for India. Taken together, the series of Memoirs on seasonal weather formed a most important programme of research.

While world weather was his main theme, Walker pursued many other lines of enquiry in India, for example: the question of change of climate (already mentioned), the theory of musical instruments, and the soaring flight of birds. He was a keen observer of bird flight throughout his years in India, gave several lectures on the subject, and eventually wrote an article on animal flight in the *Encyclopaedia Britannica*. From its beginning he participated in the meetings of the Indian Science Congress and was the General President in 1918. It may be recalled that he played a significant part in getting the mathematical genius of Ramanujan recognized and in preparing the way for him to go to Cambridge as a colleague of G. H. Hardy. Walker was a source of encouragement to Indian scientists, including C. V. Raman and K. R. Ramanathan in their younger days.

Walker received a knighthood on leaving India in 1924, and soon succeeded Sir Napier Shaw as Professor of Meteorology at Imperial College, London. There he spent another productive ten years. Of special interest was the new direction of much of his thought. He and his pupils devised striking laboratory experiments to test the effect of varying the rate of shear in an unstable fluid. They obtained important results whereby they explained the mode of formation of various cloud forms. In 1933 Walker was President of Section A of the British Association for Advancement of Science. He was also a President of the Royal Meteorological Society (1926–27) and was for several years the editor of its journal. He resigned his chair at the Imperial College in 1934 when he was sixty-six.

An idea of the vigour of his mind may be obtained from the fact that during World War II, at the age of 75, Sir Gilbert took an active part in the research programme under the auspices of the Meteorological Committee of the Air Ministry and contributed research papers on long-range forecasting, symmetry points, correlation coefficients between various upper air data, and the relation between European weather and Arctic ice.

Sir Gilbert Walker passed away at Coulsdon, Surrey, England, on 4 November 1958 at the age of 90. His was a life of fruitful scientific activity and lasting contributions to meteorology.

His series of Memoirs on seasonal weather deserve a reappraisal, now that the data for sixty or more years have become available. Performance tests can be applied to the correlations that appeared to be of significance in the 1920's and new correlation coefficients among upper air data and sea level data may be determined that can be of value in meteorology and long-range forecasting.

The India Meteorological Department would do well to reintroduce the system of inviting outstanding scientists with an established reputation to take up scientific jobs at the highest levels. Only that can provide a quantum growth in scientific advancement, similar to what occurred in the case of Gilbert Walker.

Other references

Obituary notices: *Quart. J. R. Met. Soc.*, April 1959, p. 186. *Indian J. Met. Geophys.*, January 1959: pp. 1–2, by the editor; 113–115, by C. W. B. Normand; 115–117, by S. K. Banerji; 117–118, by V. V. Sohoni; 118–120, by S. Mull.

P. R. Pisharoty is Professor Emeritus, Physical Research Laboratory, Ahmedabad 380 009.

Edited and published by Prof. S. Ramaseshan, Current Science Association, Bangalore 560 080.
Typeset and printed at Book-Makers (I) Pvt. Ltd., Bangalore 560 009.