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An Episode in the History of Kew Observatory.

By Sir NAPIER SHAW, F.R.S.

Mr. F. J. W. Whipple, Superintendent of Kew Observatory (Richmond), has found among the archives of the Observatory a photograph (see frontispiece), apparently a collodion positive, which is an interesting reminder of the activity of the Observatory in its early days. The photograph is dated July, 1852, and represents the paraphernalia for meteorological observations undertaken by J. Welsh, F.R.S., Superintendent of the Observatory, in the balloon ascents which were made from Vauxhall Gardens in 1852. Welsh had been appointed superintendent in that year, after two years' service in the Observatory as assistant. He succeeded Sir Francis Ronalds, who had been honorary superintendent from 1842, when the use of the building was granted by the Crown to the British Association for the establishment of a physical observatory, with the lofty idea of being in the van of progress in all such matters as the design and development of new instruments for meteorology, atmospheric electricity, terrestrial magnetism, including its relation to the sun, the variations of gravity, as well as the testing and certifying of all kinds of instruments for physical investigation.

We are somtimes inclined to think that ideas of progress in the investigation of the earth, the air and the sun are a special characteristic of the twentieth century. The following extract, from a memorandum which led to the acquisition of the Observa-

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tory in the Old Deer Park in Richmond, will deserve to be remembered, among other things, in 1942, when the celebration of the hundredth anniversary of what is " known by a misnomer of at least half a century's date as the Kew Observatory " will come due.

> " Among instruments which have been proposed, and which will probably not be constructed and brought into use without the assistance which an Institution like this alone can afford, may be mentioned: a universal meteorograph, which will accurately record half-hourly indications of various meteorological instruments, dispensing entirely with the attendance of an observer; an apparatus for recording the direction and intensity of the wind simultaneously at various heights above the earth's surface; an apparatus for telegraphing the indications of meteorological instruments carried up in balloons or by kites, to an observer at the earth's surface."

The balloon ascents at Vauxhall are sufficient indication that the aspirations of the memorandum were not disregarded, and perhaps the impression of vigorous activity might have been still greater if Welsh had not been the victim of tuberculosis at an early age in 1859, after testing marine barometers on voyages to Leith and the Channel Islands, setting up at the Observatory the standard barometers which are still there, Beckley's modification of Robinson's anemometer, De la Rue's heliograph, the recording magnetographs which have now been removed to Shetland, and having undertaken the magnetic survey of Scotland. " Well begun is half done," but, in the geophysical sciences, the other half is an arduous task. If to do were as easy as to know what were good to be done, Kew Observatory would have become for the average Londoner, as it is now for those who know something more than an island in the mid Surrey Golf course.

In the photograph Welsh is shown on the extreme right with headgear appropriate for ballooning. On a table in the foreground are the instruments to be used for determining the temperature and humidity of the air, provided with adequate means for securing efficient ventilation. Behind the table are members of the Kew Committee; on the extreme left Professor W. A. Miller, of King's College, London, whose celebrated book on chemistry was a source of inspiration to many students in the second half of the nineteenth century; next to him, J. P. Gassiot, Chairman of the Kew Committee, who provided an endowment fund for the Observatory amounting to £10,000, when it had become the Central Observatory of the newly founded Meteorological Office under the Royal Society, and the British Association had withdrawn its grant in 1871. The fund is still in the possession of the Royal Society. Next again is Sir E.

Sabine, at that time sixty-four years of age, President of the British Association and Vice-President of the Royal Society, the leading geophysical spirit of the time. Next to him again, Colonel W. H. Sykes, " one of the members of the British Association Committee, almost its first chairman." Between these notable scientific authorities and Welsh is a Beadle of the Gardens.

We have no record of the balloon ascent on the occasion of the photograph, if the date, July, 1852, is correct. We learn that two ascents were reported to the British Association in that year: the meeting was held at the beginning of September, and might, therefore, have received the reports of two of the four ascents which are described in the *Philosophical Transactions* of 1853. The dates of the four are August 17th and 26th, October 21st and

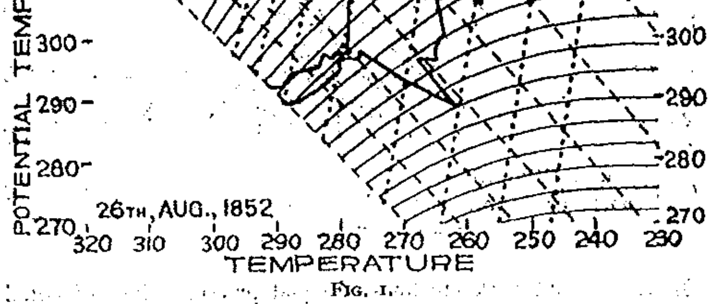

FIG. 1.

November 10th. The results are represented in engraved diagrams in the paper referred to. With the knowledge that is based upon recent experience, they must be pronounced remarkably good for records three-quarters of a century old; the provision for ventilation must have been quite efficient. The greatest height reached was 22,000 feet. On each occasion there was an inversion of lapse-rate of temperature below ten thousand feet. Welsh himself divided the graph of each ascent into two portions, nearly parallel in direction, but separated by a " discontinuity." The individual readings are very numerous and somewhat irregular, as one would expect, but the general run of the graphs is undeniable.

It is worth while to bring these results to remembrance. Two years ago I translated them into the language of the twentieth century and deposited a lantern-slide which expressed the results with the Royal Meteorological Society. In order to show the general character of the ascents, I have set out here that of August 26th (Fig. 1) as showing the most notable changes in humidity, and that of November 10th (Fig. 2), the highest ascent of the four, on forms which have been recently prepared for exhibiting the energy of dry or saturated air in relation to the conditions of the atmosphere disclosed by soundings. The lines of reference are temperature, measured along the horizontal from right to left, and entropy (or the logarithm of potential temperature) measured along the vertical from below upward: whence it follows that area on the diagram represents thermal energy.

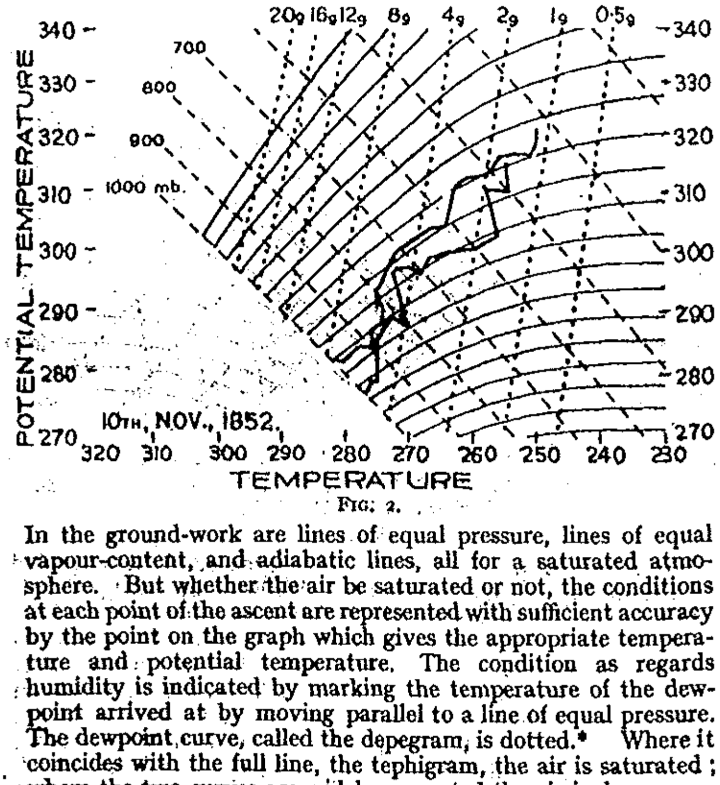

FIG. 2.

In the ground-work are lines of equal pressure, lines of equal vapour-content, and adiabatic lines, all for a saturated atmosphere. But whether the air be saturated or not, the conditions at each point of the ascent are represented with sufficient accuracy by the point on the graph which gives the appropriate temperature and potential temperature. The condition as regards humidity is indicated by marking the temperature of the dew-point arrived at by moving parallel to a line of equal pressure. The dewpoint curve, called the depegram, is dotted.* Where it coincides with the full line, the tephigram, the air is saturated; where the two curves are widely separated the air is dry.

The graph for August 26th shows two main portions of notable

* The dotting of the original has disappeared in the reproduction. The dewpoint curve (depegram) is on the right of the temperature—entropy curve in each of the figures 1 and 2.

lapse-rate, the first from 1,000 mb. to 800 mb., and the second running very irregularly from 700 mb. to 500 mb. These are separated by an "isothermal layer" in which the humidity becomes very small, the dewpoint being as much as 18° C. (32° F.) below the air-temperature though it is nearly saturated on the 800 mb. line. Above the inversion, which is complete at 700 mb., humidity, after fluctuations, is shown increased until something near saturation is reached at 500 mb. The graph for November 10th is smoother and more regular: the tephigram resolves itself into three portions with considerable lapse-rate; 1,000 mb. to 850 mb., 750 mb. to 620 mb., and 550 mb. to 440 mb. Between these are the discontinuities of isothermal layer or inversion.

Apart from the irregularities which occur in readings, either of pressure or temperature, the curves are eloquent of the state of the atmosphere. We can look back on the period of Welsh's superintendence of the Observatory as one of much activity and infinite promise.

The Problem of Atmospherics

By E. G. Bilham, B.Sc., D.I.C.

Readers of the *Meteorological Magazine* will be familiar with the important and interesting work which Mr. Watson Watt has been engaged on under the auspices of the Radio Research Board. Apart from their practical importance to the radio engineer, atmospherics—those irritating extraneous noises which often seriously interfere with our efforts to hear broadcasting from distant stations—are clearly phenomena of direct meteorological interest, since there is a manifest, though not very simple, connection between their degree of activity and the weather. Early in the history of radio communication it was recognised that atmospherics were unusually numerous and violent when thundery conditions prevailed. Subsequent investigation has shown that atmospherics are not produced exclusively in regions where lightning is actually occurring, and the phenomenon is, in short, far more complex than at first seemed probable. The Meteorological Office initiated an enquiry into the possibility of locating distant thunderstorms by observing the apparent direction of arrival of atmospherics, as long ago as 1915. Work on this and cognate problems has engaged the attention of Mr. Watson Watt continuously since that date, with very conspicuous success.

The paper* now under notice deals with a form of recorder in

* The Directional Recording of Atmospherics, by R. A. Watson Watt, *London; J. Inst. Electr. Engin.* 64 (1926), pp. 596-610.