

"They flash upon that inward eye
Which is the bliss of solitude".

Relationship to geography naturally links up with general attitude towards science. Wordsworth has been accused of hostility towards science on the flimsy pretext that once or twice in the poems he shows impatience with a certain rather narrow type of geologist or botanist whom he had met in the field and who may partly have deserved his strictures. The issue, however, must be judged on wider grounds than this. Apart from the fact that in one of the prose prefaces bound up with the Oxford edition the author expressly states that the remotest discoveries of the chemist or physicist may one day become the proper theme of the poet's song, the entire tenor of Wordsworth's poetry suggests tacit acceptance of scientific principle. There is a lengthy passage towards the end of *The Excursion* which has to-day quite a prophetic ring in hinting at the dangers to mankind inherent in gaining without moral purpose too much control over the forces of Nature. He saw that truth is one, and that by coming to terms with scientific discovery he would be lending strength and stability to his own spiritual vision. This is no doubt why the poet often commends himself to men of science, and it is at least significant that the first editor of *Nature*, Sir Norman Lockyer, should have selected as the motto for this scientific journal the words which have remained on its cover ever since :

"To the solid ground
Of nature trusts the Mind that builds for aye".
(*"Miscell. Sonnets"*, Pt. 1.)

As Harper, certainly not the least discerning of his biographers, has pointed out, Wordsworth instinctively knew how far he could safely go in the imaginative interpretation of Nature, and time and again he pulls himself up when confronting scientific knowledge. Often he will bring the scientific and æsthetic aspects of natural phenomena into line, as though endeavouring to harmonize the two. Thus there is a curious metaphysical passage in the second book of *The Prelude*, wherein the poet in describing his affection for the sun and moon, both as heavenly bodies and as elements in the local landscape, seems trying with perplexity to co-ordinate scientific knowledge with poetical feeling. Of the lesser luminary he says :

"Analogous, the moon to me was dear ;
For I could dream away my purposes,
Standing to gaze upon her while she hung
Midway between the hills, as if she knew
No other region, but belonged to thee,
Yea, appertained by a peculiar right
To thee, and thy grey huts, thou one dear Vale !"

It is just when we study the great poet in the field of scenic impression that we see that he did more by his outlook upon Nature to lessen the gap between science and the humanities than was apparent in his own time or than perhaps could have been apparent to the Victorians, with their more rigid dualistic conception of the universe. Of various noble passages which might be selected to symbolize his teaching, none suits the context of this article better than the words which he applies to one of his own characters :

"His daily teachers had been woods and rills
The silence that is in the starry sky
The sleep that is among the lonely hills".

SCIENCE OF WEATHER

THIS year, on April 3, the Royal Meteorological Society celebrated its centenary. In honour of this occasion the Director of the Science Museum has presented a special exhibition, portraying modern instruments and techniques in meteorology, and their impact on everyday life. The exhibition was formally opened on March 27 by the Lord President of the Council, the Right Hon. Herbert Morrison, at a ceremony in the lecture theatre of the Science Museum, presided over by the Minister of Education, the Right Hon. George Tomlinson. It will remain open until June 25.

The president of the Royal Meteorological Society, Sir Robert Watson-Watt, spoke of the growing importance of South Kensington as a meteorological centre. The connexion between the Science Museum and the 1851 Exhibition is well known; South Kensington was also at one time the home of the Meteorological Office—the South Kensington office was operating up to the outbreak of the Second World War. The removal of the Royal Meteorological Society to its present home in South Kensington, and the growth of the Department of Meteorology in the Imperial College of Science and Technology, under Sir David Brunt, have firmly established meteorological interests in the district. In commenting generally on the observational network which is being progressively elaborated each year, Sir Robert remarked on the fact that weather observations, besides demanding adherence to a difficult time-schedule, are also inherently difficult to make. Hence observing instruments and techniques require the most careful and continuous examination. At the conclusion of his address, he expressed, to the Director of the Science Museum, the Society's sense of honour at the choice of this occasion for staging a meteorological exhibition.

Mr. Herbert Morrison began his opening address by stressing the importance of special exhibitions in the Science Museum, since they provide an excellent means of letting the public know what scientific men are saying and doing. The weather and the weather forecast service are matters of great public importance, and there is an insistent demand for ever greater accuracy of forecasting, notwithstanding that the Meteorological Office forecasts for the London area are already correct nine times out of ten as regards rainfall. Practising forecasters will be grateful for the Lord President's sympathetic reference to the fact that they are called upon to make specific forecasts, even in situations in which they do not feel in a position to do so, whereas scientific men in other fields normally expect to be allowed to withhold judgment when confronted with an ambiguous situation.

The exhibition, "The Science of Weather", is divided into five sections, called respectively "A Century of Meteorology", "Weather Observations", "Forecasting the Weather", "Weather in our Daily Lives" and "Meteorological Research".

The first century of the Royal Meteorological Society has witnessed the transition of meteorology from a mainly observational study to a coherent science, exhibiting an extensive understanding of the physical processes occurring in the earth's atmosphere, or, at least, in the troposphere and lower stratosphere. Since, however, the Exhibition marks the centenary of the Royal Meteorological Society, the historical

section, "A Century of Meteorology", is concerned primarily with that Society during its first hundred years, and makes no pretence of portraying the complete history of meteorology since 1850. The topics illustrated, chosen mainly to do honour to the Society, include publications of the Society, the establishment of Ben Nevis Observatory, and the work of two former presidents, Sir W. Napier Shaw and Mr. W. H. Dines. With regard to the publications, which provide a summary of the state of meteorological science at various stages during the past century, it is of interest to note that the Royal Meteorological Society has so recently as 1946 embarked upon the publication of a new popular monthly magazine called *Weather*, in addition to its more technical and academic *Quarterly Journal*.

The establishment of Ben Nevis Observatory by the Scottish Meteorological Society in the latter half of the nineteenth century was part of a world-wide movement to institute routine observations at mountain stations. To a peculiar degree the operation of such an observatory imposed a very difficult time-schedule upon the observer, such as Sir Robert Watson Watt had referred to in his address. The Observatory was closed in September 1904; but its work remains a monument to the Scottish Meteorological Society, which was incorporated into the Royal Meteorological Society in 1921, and to Dr. Alexander Buchan, to whose efforts the installation and continued operation of the Ben Nevis Observatory were largely due. The exhibit includes some of the original instruments and record books.

The two personalities selected for representation are Sir W. Napier Shaw (1854–1945), whose long life thus nearly spanned the hundred years now being celebrated, and Mr. W. H. Dines (1855–1927). The former was most active in the organisation of meteorological studies, and his four-volume "Manual of Meteorology", first published in 1926, remains a valuable source of reference. The exhibit illustrating Sir Napier Shaw's work consists of a sequence of drawings of the winds circulating around a depression. These drawings, arranged for examination in a zoetrope, give a vivid impression of the wind circulation, as visualized before the modern frontal theory was developed.

W. H. Dines's contribution to meteorology was of a very different character. His interest in the subject was first aroused by the disaster of the Tay Bridge, which was carried away by a squall of wind in 1879. He applied his very great inventive ability to the study and measurement of wind, a phenomenon greatly complicated by turbulence; and several of his wind-speed devices are shown in the exhibition, including the pressure-tube anemometer, with which his name is indissolubly linked. The other aspect of his work illustrated is that dealing with the meteorograph. This instrument has now been made obsolete by the *radiosonde*; but, at the time, W. H. Dines made an important contribution to the subject by producing a model which did not require the heavy clockwork mechanism favoured elsewhere, and could therefore be sent to greater heights.

The second section, "Observing the Weather", illustrates particularly two modern aspects of meteorological observations. The first is the increasing extent to which naked-eye observations are being superseded by instrumental observations; the second is the very great prominence now being given to upper air sounding.

Many weather phenomena, such as type of cloud observed or of precipitation, though not susceptible of instrumental techniques, are nevertheless of the greatest importance to the forecaster, because of the valuable indications they give of the physical processes occurring within the atmosphere. Apart from such phenomena as these, however, there are many meteorological quantities the routine determination of which was for a long time left to the senses unaided by special instruments, and which are gradually being brought within the realm of instrumental techniques. We may cite cloud-base height, visibility, and wind-speed measurement. Moreover, the organisation of the Ocean Weather Service and of meteorological reconnaissance flights reflect a determination to fill the gaps in the chart in those parts of the oceans not normally traversed by shipping lines.

The first of the principal objects of the British (now Royal) Meteorological Society, at the time of its foundation a century ago, was: "A collection of correct manuscript observations". The importance of upper-air sounding to a proper appreciation of the meteorological situation has been recognized throughout the past century; but only in the past decade has it been possible to extend this exploration, as a routine process over a wide area, from the earth's surface upwards throughout the troposphere and into the lower stratosphere. This has been made possible by the *radiosonde*, an airborne transmitter carried upwards to a height of as much as 60,000 ft. by a hydrogen-filled balloon, and designed to transmit coded signals, defining the pressure, temperature and humidity of the various layers of atmosphere through which the instrument is being carried. The *radiosonde* display exhibits the transmitter in considerable detail, and includes a working demonstration of the ground-station procedure. To emphasize the important place occupied by routine meteorological observations of the upper atmosphere, a *radiosonde* balloon was launched from Hyde Park during the opening ceremony, and the signals from it were received on a ground station in the exhibition gallery itself. Adjacent to the *radiosonde* exhibit is a display describing the radar measurement of upper winds.

Another topic of great importance, the location of thunderstorms, though not specifically a branch of upper-air sounding, receives special attention in the exhibition. A special display shows the radio method which has come into routine use in the Meteorological Office.

The third section of the exhibition is entitled "Forecasting the Weather". An essential preliminary to forecasting is the collection of weather observations from a large area, and their presentation to the forecaster in a readily assimilable form. The area to be covered by a weather chart depends upon the forecaster's purpose; but the chart will in any event require a knowledge of the weather at several hundreds of stations, several times daily. The 'weather code' and 'station plotting model', which have been developed to meet this double need, are integrated into a single working display in the exhibition. Forecasting procedure is illustrated by two series of weather charts: (i) for August Bank Holiday, 1949; (ii) for D-Day. The Daily Weather Reports, which are issued by the Meteorological Office, are being posted in the exhibition gallery for the duration of this exhibition.

As a counterpart to the historical exhibit, mentioned above under the name of Sir Napier Shaw, the 'Forecasting' section of the exhibition shows a model illustrating the three-dimensional structure of a warm-sector depression, based upon a depression that crossed the British Isles in January 1946.

In the fourth section, "Weather in our Daily Lives", it has been necessary to select a few topics for illustration from the very considerable range of subjects. Transport—land and air transport, and shipping—are examples of undertakings manifestly affected by the weather, and dependent upon meteorology for their most efficient operation. Other topics illustrated in this section are agriculture (including a model illustrating the effect of a shelter-belt protecting an orchard), water supply, electricity supply (including a model of a projected 100-kW. wind generator), climate and house design (including an illustration of an investigation by the Building Research Station of the Department of Scientific and Industrial Research on a group of experimental houses at Abbott's Langley), atmospheric pollution, and civil engineering (this is illustrated by an exhibit dealing with the determination of the fine structure of the local wind, in connexion with the design of the proposed Severn Bridge).

In the fifth section of the exhibition, "Meteorological Research", the following topics are illustrated: cloud physics, turbulence, radiation, upper atmosphere, atmospheric sounding, and synoptic meteorology. Radio, and especially radar, methods of investigation have substantially improved the meteorologist's ability to study cloud processes *in situ*, and a number of charts and photographs show methods of studying free water in clouds, and the wave-form of lightning discharges. Working demonstrations are provided of a method of determining drop-size distribution in a cloud or in rainfall, and of the growth or decay of a hygroscopic particle when subjected to an atmosphere of variable humidity. A display of very wide appeal is a cloud chamber in which periodical demonstrations are given of the principle of the artificial production of rain from a cloud containing supercooled water droplets, by seeding with solid carbon dioxide.

The exhibit dealing with turbulence is concerned with turbulence occurring within a few feet of the ground, and shows a variety of pieces of apparatus developed for measuring the phenomenon.

Radiation research is represented by ozone spectrophotometry. Dr. G. M. B. Dobson's original instrument is exhibited, together with drawings and photographs of the modern commercial instrument developed from it. Accompanying the apparatus are charts showing the correlation of ozone content with weather.

In studies of the upper atmosphere, radio investigations of the ionosphere have confirmed the existence of high wind velocities at that level, which had already been deduced from the examination of luminous night clouds and of the polar aurora. The evidence for these winds is displayed, with a working model explaining how the notion of a wind at ionospheric level may be deduced from observations of radio fading, and its speed and direction measured.

The general title "Atmospheric Sounding" has been used to describe a group of exhibits illustrating research into instruments for various observations: the frost-point hygrometer, as developed to measure frost-point temperatures as low as $-80^{\circ}\text{C}.$; an airborne radar 'transponder' which will enable the

range of radar wind-finding equipment to be increased to about a hundred miles; and a photo-electric visibility meter.

Research in synoptic meteorology is illustrated by two exhibits: one is a series of weather-charts representing research now being pursued in Great Britain to extend the period of useful forecasting; and the other shows how observations of wind-finding balloons may be applied to measuring large-scale vertical motions in the atmosphere.

A collection of current books on meteorology and weather is included in the exhibition.

D. CHILTON

HIGHER TECHNOLOGICAL EDUCATION IN GREAT BRITAIN

A SPECIAL conference on higher technological education in Great Britain was held in the rooms of the Royal Society on the afternoon of March 27, under the chairmanship of Sir Henry Tizard. The conference had been arranged by the Advisory Council on Scientific Policy with the view of bringing together those primarily interested in future policy for the organisation of higher technological education in the United Kingdom. Those present included the president and several fellows of the Royal Society, representatives of the Ministry of Education, the University Grants Committee, the Advisory Council on Scientific Policy and university departments of applied science, together with a number of the contributors to recent correspondence in *The Times* and others who had shown a special interest in the subject. Mr. M. J. Kelly, executive vice-president of the Bell Telephone Laboratories in New York, also attended by invitation and gave a short address.

Sir Robert Robinson, president of the Royal Society, in opening the proceedings, said that he thought it was most valuable to have a conference of the sort which had been organised with the view of bringing together advocates of the different policies which had recently been supported. He suspected that some of the differences were not so deep as they might at first sight appear to be. Sir Henry Tizard said that it is a matter of common agreement that it is vital to the interests of Great Britain to increase rapidly the output of those who could apply the fundamental principles of science. Discussions at meetings of the Advisory Council on Scientific Policy and elsewhere had shown an unfortunate divergence of opinion about how this could best be done, and he feared that if agreement were not reached, effective action of any sort might be delayed.

The first speaker to give his views was Lord Cherwell, who said that the vital need of Great Britain after two costly wars is to increase exports, since otherwise a disastrous fall in the standard of living would occur. For this purpose the important thing is to translate scientific knowledge into application. So far there is general agreement; the present controversy turns on the question whether the technical education required can be best provided by university departments of applied science or by independent institutes of higher technology. He believes that the decisive reason why the universities would not be able to do the work effectively is that they could not, without changing their whole character,