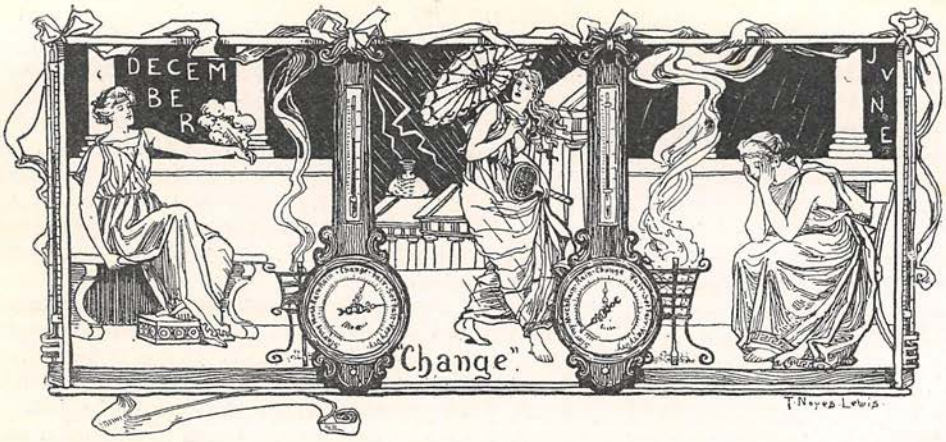


HOW WEATHER FORECASTS ARE PREPARED.

By George F. Millin.

Illustrated by T. Noyes Lewis; *and from Photographs.*

THE weather forecasts that have become of late years familiar features of our daily papers emanate from an unpretentious establishment in Victoria Street, Westminster. It is a tolerably good-sized dwelling-house with a shop on the ground floor and a stone staircase running up to the doors of a number of light and pleasant rooms in which a staff of about forty persons are regularly engaged in the attempt to evolve something like order out of the chaos of our winds and general weather conditions. Nobody would suppose this to be the business on hand from a casual inspection of the place, without any previous information. In a weather office one might expect to find any number of scientific instruments, all sorts of facilities for observing winds and watching clouds and studying sunsets, and weather wisdom plainly written on every face. As a matter of fact there are very few instruments to be seen here, no facilities at all for watching clouds or sunsets, and though among the staff—which includes four or five ladies—there are some very shrewd and capable faces, the weather appears to be the last thing likely to be occupying their thoughts. There is indeed in one room a self-recording instrument connected with a wind-gauge on the roof, in another room there is a glass case full of meteorological appliances, to which something of the interest of a museum attaches, and in a third stands a large piece of mechanism called a harmonic analyser—all covered up however, and at present not in use—designed by Lord Kelvin for some sort of mechanical theorising about curves. For all the rest that may be found inside the Meteorological Office, truth to tell, it is a dreary expanse of tabulated statistics, ships' logs, charts of ocean winds and barometrical readings and reports, which to the uninitiated look as dry as the desert of Sahara. When, under the courteous and instructive guidance of Mr. R. H. Scott, F.R.S., the secretary, one has spent an hour in dipping in to its accumulations and in strolling about the place, he begins to realise something of the complication and difficulty of practical meteorology and of the vast range of the subject.

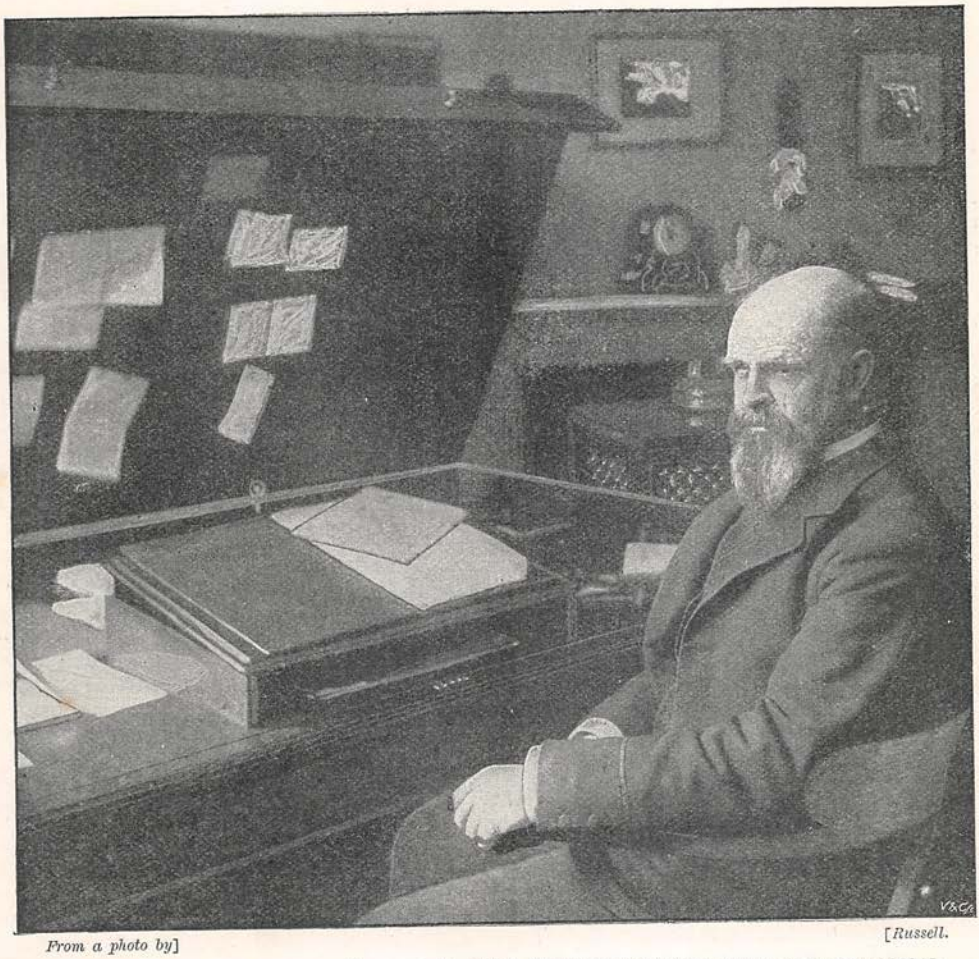
It is not in the Meteorological Office itself that much is to be found likely to interest the general reader, it is only when one comes to regard it as the centre of a very extensive system of scientific observation that one finds the interest of it.

The Meteorological Office as originally established in 1854 was a department of the Board of Trade, and was the outcome of a conference of most of the maritime powers, held in Brussels the year before. Captain Fitzroy—Admiral Fitzroy, as he afterwards became more generally known to the world—was placed at the head of it. The new department was intended entirely for marine meteorology, and the Royal Society—the leading scientific body in the kingdom—were called on to advise and assist. They recommended, not any attempt to predict

changes of weather, but merely the accumulation of evidence from which might be obtained some certain knowledge of the laws which as yet were only dimly and obscurely perceived to be in operation in the rush and turmoil of the winds.

It may be noticed by the way, as a very striking proof of the rudimentary condition of the meteorological knowledge of those days, that at the first great International Exhibition, held in Hyde Park only three years previously, though a large number of barometers were exhibited they were one and all pronounced quite untrustworthy and worthless for any scientific purpose.

The first business of the Board of Trade was to provide good instruments, and to lend them to captains of vessels about to set out to sea on condition that at the end of their voyage they would return the instruments, together with a copy of the records made from them. From that day to this the office has been accumulating facts with regard to ocean meteorology all over the world, and this constitutes the first of the four departments into which the work of the Meteorological Office is divided.



From a photo by] [*Russell.*

THE "CLERK OF THE WEATHER," MR. R. H. SCOTT (SECRETARY OF THE ROYAL METEOROLOGICAL SOCIETY), AT HIS DESK.

Admiral Fitzroy however soon became deeply interested in the possibility of weather prediction, and public attention was forcibly directed to the subject by the havoc played by a terrific storm among our transports in the Black Sea, where we were then in the thick of the Crimean war. Nobody had till then taken much notice of weather prophets. "No man with a scientific reputation to lose," said Arago, "will venture on weather prediction."

But when the great storm of November 1854 burst over the Black Sea and sent the ships and men of the allies to the bottom, the director of the Imperial Observatory in Paris, M. le Verrier—who had a reputation of the first order—declared that such a storm might have been predicted. Scientific men were just beginning to perceive faint indications of the reign of law in the movements of the winds and the bursting of storms, and in the public distress at the loss of so many sailors and soldiers there was every disposition to take the fullest advantage of whatever science could do in the elucidation of the dread mystery in which all the movements of storms had thus far been shrouded. Admiral Fitzroy turned nearly the whole strength of his staff in this new direction, and the result was the establishment of the second department of the Meteorological Office, that with which this article has more particularly to do—weather telegraphy. The third deals exclusively with the phenomena of climate—that of the British Isles more particularly, though of late years observations from foreign parts have come within the range of the office to some extent. There is a fourth department, dealing with miscellaneous matters, such as experiments with instruments, the management of the library and the expenditure of the office.

The whole institution is now controlled by a council of six members, five of whom are nominated by the Royal Society and are appointed by the Treasury, the sixth member being the hydrographer to the Admiralty, who occupies his seat at the board by virtue of his office. The institution no longer has any connection with the Board of Trade. It occupies an entirely anomalous position among scientific bodies It is not a Government office; its staff are not civil servants; yet the Treasury pays practically the whole cost of the establishment. The general public, who in various parts of the country get private weather forecasts, pay altogether about £600 a year, and the Treasury makes a grant of £15,300. Of this sum £1000 goes to the members of the council, who meet once a fortnight, £3000, roughly speaking, to expenses of ocean meteorology, nearly £4000 to land meteorology, and nearly £4000 more to weather forecasts.

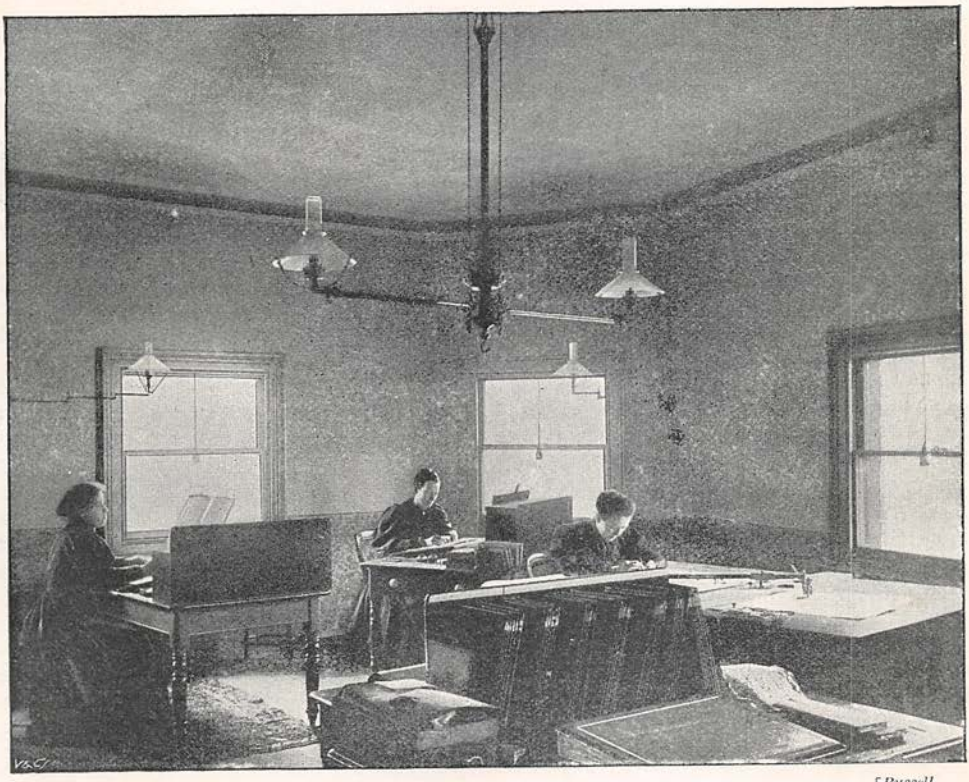
The connection of the office with the meteorological world outside is established by a single Wheatstone instrument and a private wire linking it with the central telegraph office in St. Martin's-le-Grand, through which it last year received information from about 250 districts in all parts of the British Isles. The Royal Meteorological Society supplies information in addition from some thirty of its own stations at carefully selected points, with its own officers in charge of them. From these and other trustworthy observers—persons in lighthouses and observatories, coastguard stations and so on—there are received in Victoria Street sixty reports every morning, seventeen every afternoon, and twenty-nine every evening. It need hardly be said that the Central Telegraph Office requires to be paid for its services, and indeed last year over £1500 was paid to the Postmaster-General for his share in the business of weather telegraphy. It is important therefore to keep communications down to the smallest possible limits. The principal daily report—that transmitted at eight o'clock in the morning—is required to state what was the height of the barometer at six o'clock the previous evening, the force of the wind, the temperature and the general character of the weather. It should also state the height of the barometer, direction and force of wind, sea disturbance, weather, and temperature by dry and wet bulb at the actual time of transmission, and it must say also what have been the maximum and minimum thermometer readings and the total rainfall during the preceding twenty-four hours.

Of course if all these particulars were to be transmitted in the ordinary way of messages, the Postmaster-General's £1500 a year would soon run up to a good way towards the £15,000 received from the Treasury for the entire maintenance of the office, and a code of signals has therefore been carefully devised. The messages are supposed to be despatched at 8 a.m. They are however intercepted by the Intelligence Department of the Post Office, which extracts from them such information as may be required for its own wind and weather reports. They therefore reach Victoria Street about nine o'clock in the morning. If we stand by as they come clicking and rattling in by the Wheatstone we shall find that they are not very suggestive of weather. They come from all the stormy heights and breezy headlands around our coasts, from the Shetland Islands to Jersey, from Spurn Head to Valencia, and they might be expected to tell plainly of roaring seas and howling tempests, or of calm sunsets and moonlit skies. What they really do present

to the inquisitive onlooker, however, may be something like this: "97622 09549 96228 06253 50046 64485." That may be the whole message, or a few words may be added, such as "Gale began at 7 p.m., ended at 5 a.m. Sky still overcast." The numbers however constitute the main report, and in the morning they always consist of six groups, each of five figures.

The first group relates to the barometer and the direction of the wind at six o'clock the previous evening, and will be understood to mean that the mercury stands at (2)9·76, and that the wind, as indicated by the 22, is W.S.W. Similarly, the second group refers to the force of the wind, the weather, and the temperature of the air. The 09 will be interpreted to mean that at the same hour the previous evening a strong gale was blowing. The figure 5 means that it was raining, and 49 was the temperature by the dry-bulb thermometer. The next two groups of figures give similar information for the time at which the message was despatched, and the two following groups, read in accordance with the code, give the reading of the wet-bulb: rainfall for the preceding twenty-four hours, the maximum and minimum temperature for the same period, and the condition of the sea at the time of despatch. Latterly the observers have been required to pay special attention to the character and movements of the clouds, and the study has afforded some valuable results. It has been found possible, for instance, to predict with certainty a southerly storm within twenty-four hours when the form of clouds known as "mare's tails" are observed to be driving across the sky from the north-west, and the reason of it is now very well understood.

The officer who receives the reports by the Wheatstone calls out the groups of figures, and they are entered upon charts and maps by clerks. Numbers are obviously more liable to error in transmission than sentences would be, and it is not always easy to get thoroughly competent and painstaking observers. The misreading of a single barometer will sometimes be sufficient seriously to mislead the experts at headquarters and to bring discredit on the office.



From a photo by] [*Russell.*

THE HYDROGRAPHIC ROOM OF THE ROYAL METEOROLOGICAL SOCIETY.

Recently, for instance, they were led to predict a storm over the south-west district. The storm however did not keep the appointment, and on the evening of the day on which it seemed to be due the observer at an important station sent to say that he had made a mistake of a tenth of an inch in the height of his mercury. Such little mishaps not infrequently bring scathing and contemptuous comments upon the discredited prophets. "If you can't give better information you'd better shut up shop," writes one. "Where's your violent cyclone that was to burst on British coasts two days ago?" demands another. "A dead calm, of course." That, by the way, was decidedly rough on our meteorologists, for it was the Yankees who promised that cyclone, as they were in the habit of doing for a long time. "Bah!" exclaimed another irate correspondent. "Call yourselves weather prophets? Why, you ain't in it with my old turkey-cock. If ever he screeches I knows what's coming; that's more than I can say for the weather office."

Every possible care is taken to ensure accuracy. The best of instruments are provided, and they are all properly tested at the Kew Observatory before they are issued, and inspectors are employed to visit the various stations from which reports are received to see that the appliances are properly fixed and efficiently used. Something like £400 or £500 a year is spent in this work. Nevertheless three experts at headquarters are pretty steadily employed in the detection and correction of what appear to be errors of observation or transmission and the necessary correspondence entailed.

For the framing of the weather forecasts, the charts and maps, when all the reports have been received and duly entered upon them, are taken from the instrument room to another apartment, known as the discussion room, where there are five gentlemen engaged in various branches of the work of systematising and co-ordinating the information that is constantly reaching the office in its several departments. The forecasting devolves upon each of them in turns, a week at a time. Their principal reliance is, of course, on the barometer readings. As they are received these readings are entered on blank maps which, by the time the sixty stations have been filled in, afford something like a graphic representation of the winds that have been moving about our corner of the world. Winds, it is now known, always move in circles, and where they are blowing in cyclonic storms, in the centre of the circle

the barometer is always low. The stronger the wind the lower will be the barometer in the midst of the hurly burly; or, to put it the other way, the lower the barometer stands in the centre of a storm the more violent will be the winds.

But though these depressions show how the winds are actually blowing at the time, they do not afford the means of predicting what the weather is going to be. They show what the winds are now, but not what they are likely to be to-morrow. These storm-centres however are not stationary. While the winds are whirling about the centres the centres themselves are on the move, just as a boy's whip-top may move along the pavement while it is spinning round its axis, or as a small whirlpool may move along a stream. From one map it would be quite impossible to arrive at any idea what changes were in progress or from what quarter to-morrow's winds would be likely to be blowing at any given part of the kingdom. Reference to two or three preceding maps however may show very clearly which way these depressions are going. At eight o'clock yesterday morning a storm centre, we will suppose, was hanging over the North of Scotland; last evening at six o'clock barometer readings showed that it lay over Glasgow; this morning it appears that the Isle of Man is in the centre of the disturbance. It is clearly moving down in the direction of the Bristol Channel and Cornwall, and an expert may tell with tolerable certainty how it is likely to affect the weather there and may make his forecast accordingly. There may however be more than one of these strong eddies of wind whirling about the Atlantic or North-Western Europe, and their influence may tend to fill up this depression before it reaches the extreme south-west, and the storm will thus die out. Or it may sheer off in another direction and leave the south-west without the predicted disturbance. Our Meteorological Office has connection with a sufficient number of continental observatories to be kept pretty well informed about the movements of atmospheric disturbances to the east of the British Isles, and they can make allowance for them. But unfortunately our great generator of storms is the Atlantic Ocean, and from the whole vast expanse of it between our shores and America our weather office can get no storm-warnings at all. The best our meteorologists can do is to study very carefully the movements of the barometer at their extreme western stations, and from these movements endeavour to detect the approach of disturbances from the west. It was thought at one time that the Atlantic cables might have been utilised for giving warning of storms that seemed to be sweeping across from America, and that we might thus be able to avoid being taken altogether unawares. Results of protracted experiments were however very disappointing. Storms that blustered out with great violence from the American coasts, and seemed to be making straight for our own, would often die down long before they reached us, or they would be deflected in another direction. On the other hand our western shores were often swept by tempests that had not come from America, and of which therefore we got no warning. They must often have been generated out at sea. It has been found, in fact, that warnings from the other side of the ocean have little or no practical value.

What is really wanted is a station out about 500 miles from our western shores, and it has seriously been proposed to moor a small vessel out at that distance in the Atlantic with telegraphic connection with Valencia, so that we might get tidings of approaching storms. After careful consideration however the idea has been pronounced wholly impracticable. To lay the cable would cost from £50,000 to £60,000, and to anchor a vessel in a thousand fathoms of water would be scarcely feasible. The managing director of the Telegraph Construction and Maintenance Company, who was applied to to give an estimate for a cable, after giving the cost, added—

"You might moor a good-sized buoy to the end with a cage upon it to accommodate an observer. The cage should be of sheet-iron, and well padded with felt and blankets. You must have a tube for him to breathe through. He would have to guess at the state of the weather from the motion. Perhaps a gas arrangement might be fitted to enable him to read off his instruments, and the advantage would be that he would probably find himself landed on the Irish coast, on an average about once a fortnight, without any effort of his own. A sounding apparatus might be fitted by which he might fix his intermediate positions. It would be well," added the waggish director, "to get the experience of some of the officers of the *Brisk*, which was moored off Scilly for six weeks in 70 fathoms of water. One of them on landing went to a lunatic asylum for some months."