TO-MORROW'S WEATHER: HOW IT IS FORETOLD.

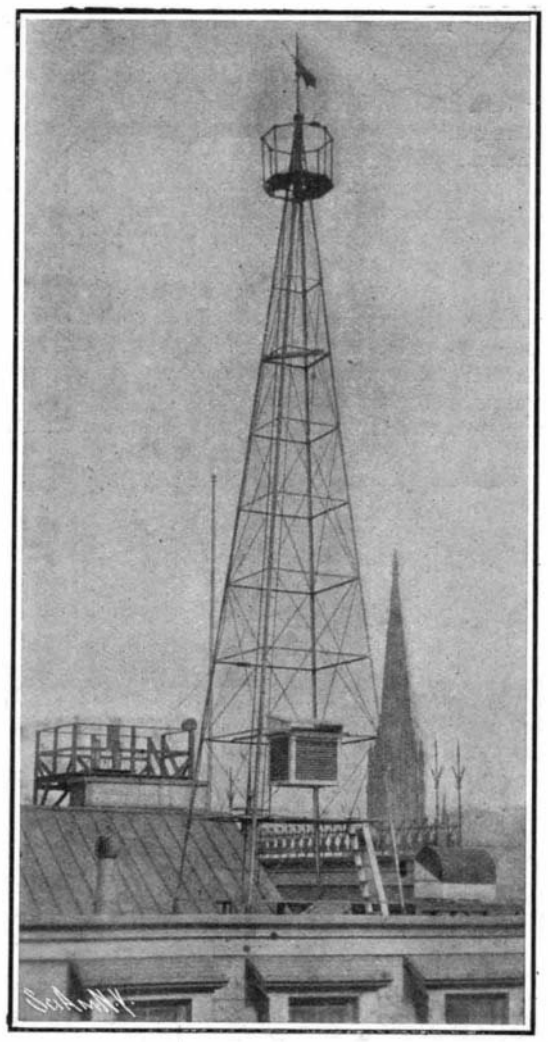
BY DAY ALLEN WILLEY.

The United States government is responsible for the publication of one of the most remarkable daily newspapers in the world. It is a newspaper which has its telegraph dispatches and its local news. It is also illustrated—at least by maps. The "form" is sometimes lithographed instead of being stereotyped, although the paper is run off the press like any daily in a large city. Perhaps the most striking feature of this publication is that its staff of reporters consists of a series of machines, which not only secure the local intelligence but record it by means of the electrical current.

This newspaper—or rather, series of newspapers—is published by the government through the various weather bureaus which have been established in the principal centers of population. While it varies to some extent in size and arrangement, in general it is modeled upon the plan which has been adopted by the Weather Forecasting Division at Washington. Like the Sunday newspaper of the metropolis, this publication of the United States is also prepared in color, the coloring being used to signify storm areas and wind currents.

These newspapers also have an Associated Press service, supplied by the Weather Forecasting Division. As the preparation of the newspaper begins in the telegraph room where the dispatches are received, a brief description of this department is of interest. The staff of operators is not only in communication with the 200 signal stations of the country by the telegraph wire, but also Washington receives not a few wireless messages. These are not directly transmitted to the Weather Bureau. They come from one of the wireless receiving stations in the city and are sent by the ordinary telegraph or telephone. As soon as the observers secure the necessary data concerning the weather, they immediately "wire" it to Washington, where the bulletins or messages are carried to a force of clerks in the Forecasting Division, who summarize and arrange them for compilation and publication. This portion of the weather forecasting staff may be called the copy readers or copy editors of the newspaper. Their copy, however, passes to another force of clerks who note and compare statistics regarding temperature, the atmospheric pressure, velocity of the wind, precipitation of moisture, with the records which are kept by the Weather Bureau, and send them out again in the form of telegrams predicting the weather. These clerks may be termed the editorial staff of the Associated Press.

As the majority of the weather newspapers are modeled upon the one issued by the Forecasting Bureau at Washington for this city and vicinity, a brief outline of the manner in which it is published will give a clear conception of the system employed elsewhere. As fast as the weather statistics are received by the telegraph operators any information of especial interest to Washington is transmitted to one of the staff whose duty it is to edit it for composition. Two men usually are sufficient to do the composing and make up the form, for the latter is merely changed from day to day like some of the pages of the ordinary daily paper. The man who makes up the form corrects the map, placing the marks which indicate the direction of the wind as well as other signs upon it. As the preparation of the form begins as soon as the clerk finishes the copy, it is ready for lithographing in a very short time. Meanwhile in the mechanical department the lithograph stone is being prepared for the impression, so that when the form is ready it is reproduced without loss of time. The stone is next placed upon the bed of the press and perhaps in less than an hour after composition began, the paper is being run off. The first sheets are carefully examined to note any possible errors which may have occurred. As soon as the sheets are sufficiently dry they are sent out immediately for distribution.



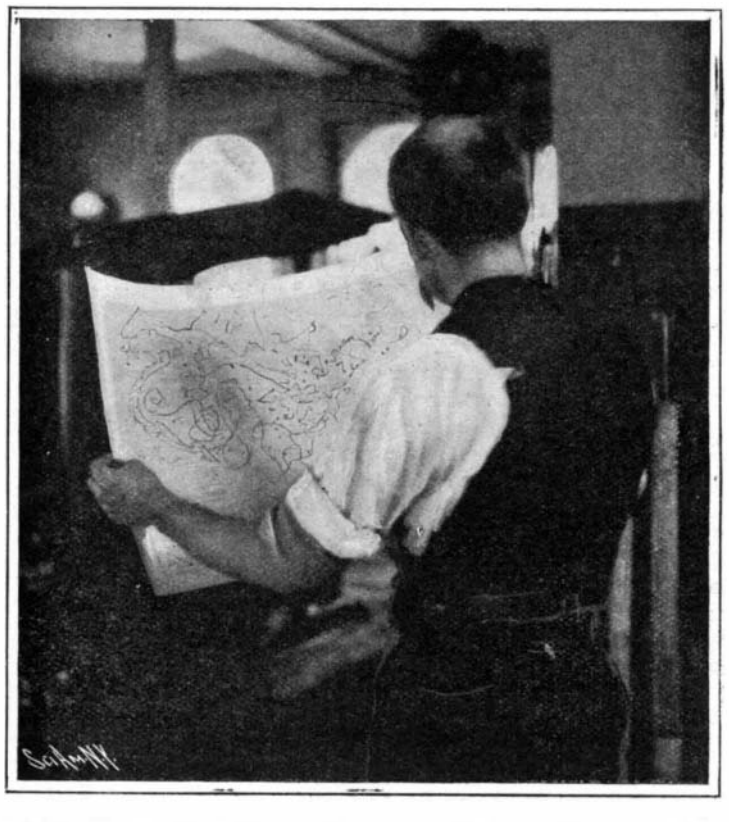
Tower Supporting Weather Vane, Anemometer, and Contact Box.

Only a few of the weather newspapers are lithographed, however. The chalk plate process which is so extensively utilized at present in newspaper illustration, is also employed in preparing the daily weather charts in small districts; for by means of this process the few needed can be prepared at a comparatively small expense. In place of the ready-made symbols showing the temperature, velocity of the winds, etc., the characters are sometimes put in with a pen in using the chalk plate. Some of the newspapers are less than half the size of the sheet published at Washington, but all contain a complete weather map of the United States as well as of southern Canada, with the temperature, barometer, and direction of the wind and condition of the weather at the time the last observation was made. In addition, each contains a weather forecast for the vicinity made by a local observer, in addition to the forecast telegram from Washington for the section from which the bulletin is issued, as well as a brief summary of the weather conditions throughout the country. Despite the variety of information afforded, the entire composition on one of the ordinary small maps is less than a thousand words, so that it can be set up very rapidly, while the tables for recording temperature, wind currents, precipitation, etc., are kept standing in type and need only be corrected. If the city is a seaport or located on one of the larger rivers, additional information relative to stages of water, tides, possible storms, as well as the weather reports from foreign stations may be included.

While this interesting journal is published but once a day, it contains only a portion of the information which is compiled by the forecasting division of the Weather Bureau for the general public. Early in the evening the telegraph operators and the staff of clerks are again at work, receiving the batch of night telegrams which come in about eight o'clock, Washington time. These are recorded and summarized, then if necessary, forecasts are telegraphed to stations where such information is of importance. The forecasts are made public in a variety of ways. They may be signaled by colored lanterns from some commanding edifice—usually the tower on the weather observation station. They are published in the newspapers and sometimes printed on small bulletins for additional circulation at night. It is perhaps needless to say that publicity is given the forecasts during the daytime by flags hoisted on the stations, as well as by the familiar slips of brown paper which are sent by mail and messenger in the large cities.

So rapid, yet efficient, is the system that in an hour after the morning forecasts have been wired from Washington, every farmer, for example, who has telephone communication with the most isolated station or is anywhere near a telegraph or telephone office, can obtain data as to the possible weather conditions in his vicinity during the next twenty-four hours. The great value of this information has been many times illustrated, especially in Florida, where timely notice of cold waves has in some instances saved millions of dollars to the orange growers alone.

The weather observation station is usually indicated by the mechanism so often placed upon its roof. It may be in one of the "sky scraper" office buildings, or on a lower structure, but in either case one sees the familiar skeleton tower to which is attached the weather vane and the anemometer, two of the mechanical reporters which gather information, and sometimes the thermometer box. Another necessary addition is the automatic measure for determining the amount of rainfall or snowfall, while to-day, as a century ago, the barometer is one of the reliable methods of predicting weather, and is indispensable in making forecasts. The gaily decorated fowl, trotting horse, or other object which surmounts the roof of the house or barn and is supposed to determine the direction of the wind, is far different from the weather vane used by the meteorologist. The design adopted by the government consists of an iron rod about five-eighths of an inch



Proofreading the Finished Map. The Man Who Makes Up the Form Corrects the Map, Placing the Marks Which Indicate the Direction of the Wind as Well as Other Signs Upon It.

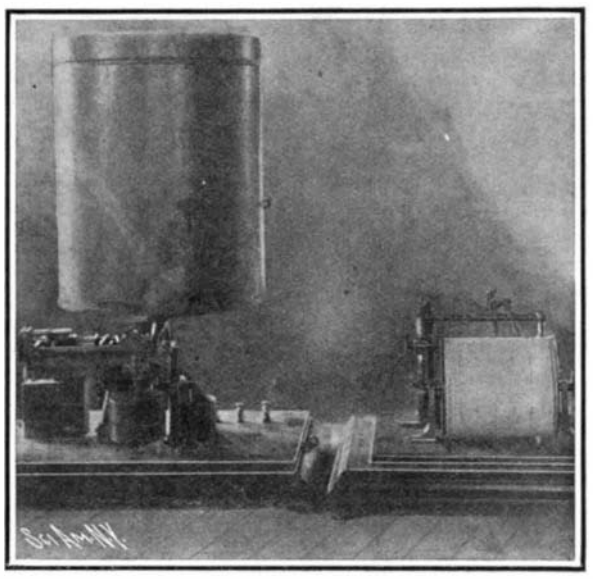
The Condition of the Weather Throughout the Country is Indicated on the Permanent Weather Map by Appropriate Marks as Fast as Telegrams Are Received. The Man in the Picture is Placing Storm Signals Along the Atlantic Coast.

in diameter and 42 inches long, the tail of the vane being formed of thin wooden boards spread apart about 9 inches at the outer ends. To the other end is attached an arrow point. Despite the weight of metal in the vane, it revolves upon a series of three anti-friction rollers, so nicely adjusted that they do not require lubrication and the amount of oscillation is reduced to a minimum. Connecting it to the recording apparatus is an iron rod usually terminating in a contact box, as it is termed. The anemometer, which is the cup design invented by Robinson, consists of four hemispheres made of aluminium or brass attached to small square steel arms. Their revolutions turn a spindle which terminates in an endless screw fitting into a series of geared wheels. One of these drives another screw which, in turn, actuates two dial wheels divided into miles and tenths. The anemometer may be attached to the tower supporting the weather vane by a side arm or mounted above it as may be convenient. The height of the tower varies according to the surroundings. It is necessary to have the instruments where they are exposed to the direct force of the wind—where its direction is not diverted by buildings or other obstacles.

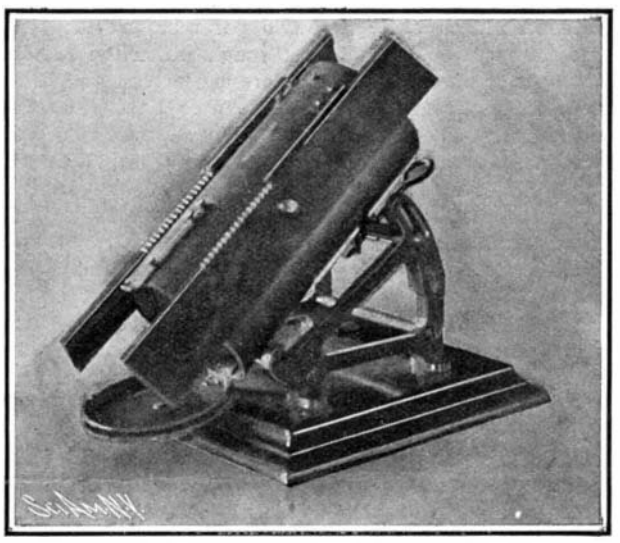
Not only are the velocity and direction of the wind thus reported, but with the aid of the electric current they are recorded as well. The meteorograph utilized for this purpose is one of the most remarkable instruments in the weather service, for it not only keeps a record of the performances of the weather vane and anemometer, but registers the amount of precipitation or the duration of sunshine, as the weather is clear or otherwise. For this reason it is sometimes termed a quadruple register, and with good reason. As will be noted in the accompanying illustration, the register contains a drum around which is wrapped a sheet of paper which receives the characters made by the recording pens, which note the changes in all the mechanism. This drum makes one revolution every six hours, being moved by clockwork to insure regularity. After each revolution the drum is moved endwise about half an inch by the action of a screw, thus preventing a record already made from being marked over.

From the meteorograph, wires extend to the gearing, which is actuated by the spindle of the anemometer. As the toothed wheels revolve they open and close an electric circuit, thus operating magnets which in turn actuate a recording pen. The direction of the wind is recorded by the use of four magnets which, however, allow eight different directions to be noted if necessary. To the armature of each magnet is attached a long printing arm terminating in a pen point. When a current opens and closes the magnet, the printing point is forced down upon the cylinder, making a dot. The position of the dot on the paper indicates the direction of the wind. The contact box connected with the weather vane contains a series of four cam collars and levers, also four contact springs, one for each point of the compass. When the wind begins to blow directly north the base of the rod extending from the vane to the contact box presses against what is called the "north" spring, which, in turn, touches the corresponding lever, thus sending an electric impulse through the corresponding magnet. When it is blowing northeast, for example, two of the springs are brought into contact with the levers, with the result that two circuits are closed and two magnets will actuate the pens with which they are connected.

As rainfall is a rarity during the period when the sun is shining, one magnet and pen are usually employed to record these indications. The electric current for the sunshine record passes through what is called a clock contact, which gives an electric impulse once every minute by connection with the hand of a specially designed clock. The record for sunshine is a series of short pen strokes arranged in zig-zag fashion. The characters for rain are also zig-zag, but obtained by the precipitation in the rain gage which is connected to the magnet by an electric circuit. While what is known as the hand measuring gage is still in use, an automatic or tipping bucket gage is being substituted for it at the principal weather stations throughout the country. By means of this apparatus, every hundredth of an inch of rainfall is accurately registered. The precipitation which is, of



Automatic Gage for Measuring Precipitation in the Form of Rain, Snow, or Sleet.



Automatic Blue-Printing Machine by Which the Intensity of the Sunlight is Photographed.

course, received in the top, enters a funnel-shaped receptacle with a small opening in the center, so that the water is conducted to a point directly over the tipping bucket, as it is called. This is divided into two compartments, one of which is always presented to receive the water. When the quantity of liquid has reached a hundredth of an inch, it tips and empties the compartment, the other side of the "bucket" being elevated at the same time. The liquid which has been emptied is collected in a receptacle below, so that it can again be measured by hand gage if desired. The motion of the tipping bucket opens and closes the electric circuit and thus actuates the precipitation recording pen.

But wonderful as are the accuracy and reliability of the instruments which we have described, perhaps the most notable mechanism is the barograph, which is in use at the present time in the majority of the weather stations. As the name implies, it is not only a barometer but also a barometric recorder. While the ordinary barometer is also employed, the barograph has become an actual necessity, as it makes a continuous record of the barometric oscillations, hour by hour, upon a sheet of moving paper. The design of Prof. C. F. Marvin, who has become so noted for the construction of meteorological apparatus, is employed.

In this form of the barograph the barometer tube is placed at the left of the recording section of the apparatus, suspended by a hook from what is known as a balance. The weight of the barometer tube upon the horizontal beam with which it is connected at the top is balanced by a rolling carriage and a fixed weight. The equilibrium of this carriage is maintained by a contact spring attached to a balance beam at the extreme right and immediately over the recording cylinder. By the employment of this spring the carriage is moved into the proper position by means of a wheel turned by a horizontal screw. Every time the carriage is set in motion by the disturbance of the equilibrium caused by the movement of the mercury, the spring closes an electric circuit, thus actuating a recording pen which traces the pressure curve, as it is called, upon the paper cylinder. Thus, the rise and fall in the mercurial column is noted. So delicate is the adjustment of this instrument that it is affected by an atmospheric pressure as slight as the ten-thousandth of an inch.

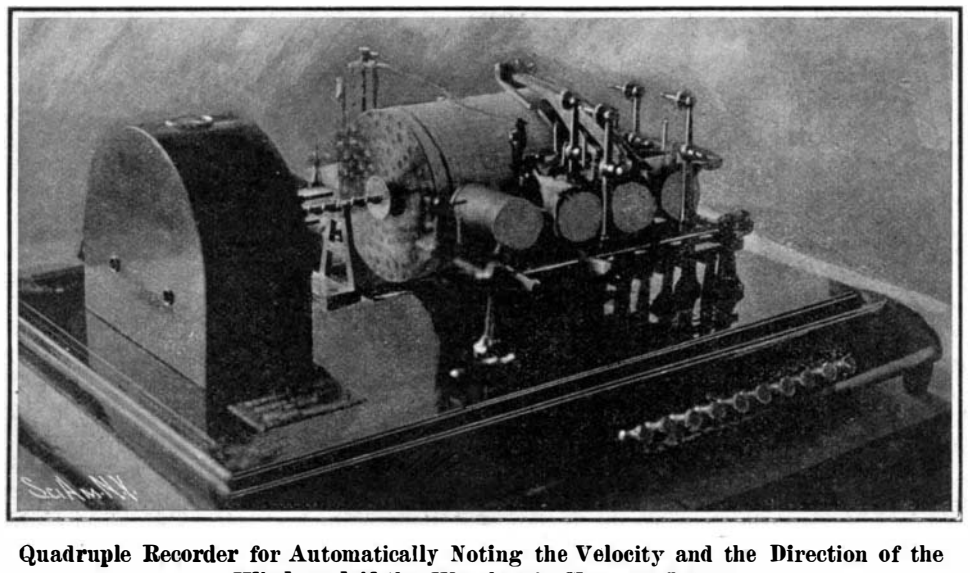
One of the auxiliary instruments utilized at Washington and some of the larger stations is what is called an automatic sun photographer. This machine, which is illustrated in the accompanying photograph, is so designed that the intensity of the sunlight is photographed automatically, being reproduced on a strip of blue-print paper. Thus the record can be kept of the clearness of the atmosphere at various points in the United States.

Another interesting form of mechanism in connection with the work of the Forecasting Bureau is the recorder attached to the weather kite, as it is termed. To the kite is fastened a small anemometer of the design shown in the illustration, which is connected by wiring to the recorder, which is inclosed in an aluminium case. It is modeled on the same principle as the quadruple register already described, but is only intended to note the direction and velocity of the wind, so that it is provided with but two pens for this purpose. With the kite instruments, much valuable data has been obtained at heights several thousand feet from the surface. Experiments on an elaborate scale are being made with it at the new observatory at Mount Weather, Virginia.

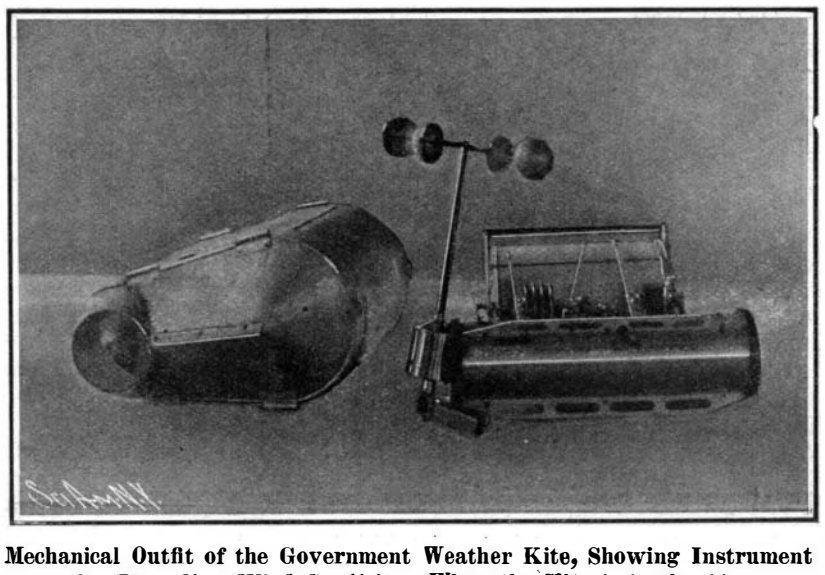
Fusibility of the Slag of Blast Furnaces.

The Revue de la Metallurgie contains an account of the researches of M. O. Boudonard on the fusibility of blast furnace slag. This fusibility is regarded as one of the most important properties of the slag for investigation. The fusing temperature of a slag should be about that of the metal. If too refractory, it necessitates a useless consumption of the combustible. On the other hand, a viscous slag, though much lighter than the metal, will form an emulsion with it, which subsists even after prolonged repose. Great fluidity is, therefore, necessary to avoid drawing off globules of metal held in suspension. The investigation has included the systematic study of the fusibility of the silicates of lime and of alumina, the aluminates of lime, and alumino-calcic silicates.

Brilliant effects for electric signs are now to be readily obtained with little cost by the use of small colored transparent caps which fit over the rounded ends of the incandescent bulbs. This permits the owner of a changeable electric sign to alter the legend at will and to indulge in the use of colors without the necessity of keeping on hand a large supply of colored lamps, some of which are very expensive.



Quadruple Recorder for Automatically Noting the Velocity and the Direction of the Wind, and if the Weather is Clear or Rainy,



Mechanical Outfit of the Government Weather Kite, Showing Instrument for Recording Wind Conditions When the Kite is in the Air.

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