THE WEATHER BUREAU AND THE PUBLIC SCHOOLS.

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During the school year a million or more children of the public schools make weather observations and study the daily weather maps and forecasts. From its earliest days the Weather Bureau has cooperated to some extent in public school work, and during the past ten years this cooperation has been widely extended. The public schools and the Weather Bureau have a mutual interest in the matter. The school authorities have found in the study of the weather with the assistance of the Weather Bureau a means of satisfying part of the requirements of modern methods of study; and the Weather Bureau is able through the schools gradually to dispel popular superstitions and fallacious beliefs that have hampered its work, and to instill in the public mind a better understanding of the purpose and limitations of its work, enabling both the commercial and the agricultural world to make more intelligent and more complete use of the forecasts, special warnings, weather maps, and climatological publications.

CHANGES IN METHODS OF TEACHING.

The introduction of the study of the weather through the entire school course, from the primary department to the high school, has been the result of a gradual change that has taken place in methods of teaching. Whereas under old systems the energies of the teacher were mainly given to strengthening the memory of the scholar and cramming him with dry facts, more or less accurate, now the endeavor is not only to stimulate the memory but to cultivate to a high degree of perfection the powers of observation and creative imagination. So far as the mere accumulation of facts is concerned, the student is led to acquire his store of information as much as possible from his own observations along practical lines, under the direction of the teacher. Thus the so-called "laboratory system," by which knowledge is acquired through experiment, and which was formerly confined to colleges and universities or to special studies in a few of the more advanced high schools, has been carried down to the primary grades, with the result that the boys and girls are brought to a more practical knowledge of natural conditions surrounding

them and governing their lives; and those that do not enter the high school are not entirely cut off from a study of nature. While the older methods were deserving of much adverse criticism, the newer methods are worthy of commendation. To quote from Professor Huxley:

> Suppose it were perfectly certain that the life and fortune of every one of us would, one day or other, depend upon the winning or losing of a game of chess. Don't you think we should all consider it to be a primary duty to learn at least the names and moves of the pieces; to have a notion of a gambit, and a keen eye for all the means of giving and getting out of check? Do you not think that we should look with disapprobation, amounting to scorn, upon the father who allowed his son, or the state which allowed its members, to grow up without knowing a pawn from a knight? Yet it is a very plain and elementary truth that the life, fortune, and happiness of every one of us, and more or less of those who are connected with us, do depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess. It is a game that has been played for untold ages, every man and every woman of us being one of the two players in a game of his or her own. The chessboard is the world, the pieces are the phenomena of the universe; the rules of the game are what we call the laws of nature.

Much has been said in recent years, particularly in Eastern States, about abandoned farms and the migration of country youth to the cities. It is believed by many educators that this introduction of nature study throughout the school course, in country as well as city, will stimulate a love of nature which will help to counteract this unfortunate tendency.

METEOROLOGY IN THE ELEMENTARY SCHOOLS OF NEW YORK STATE.

As will be seen, this change in method has given meteorology a somewhat unique position in the school curriculum. Observations and study of the weather commence in the first year, before the child can read, and are continued until the high school is reached. To show this in detail the following is quoted from the New York State Regents' Syllabi for Elementary Schools (1906), which are used in the schools of the State, omitting here those portions that do not apply to the subject in hand:

NATURE STUDY AND AGRICULTURE.

First Year.

Natural phenomena: Daily observations of the weather recorded by the teacher in the class calendar.

Second Year.

Natural phenomena: Water and its forms, observation of qualities of water, ice, steam; observation of winds—force, visible effects; observation of clouds—motion, color, portent; weather conditions noted and recorded.

Third Year.

Natural phenomena: Observation of winds—force, direction, visible effects; observation of clouds—motion, color, what they foretoken; observation of the

progress of a storm; the rainbow; the sun as a source of light and heat, its rising and setting, day and night; the moon—light, rising and setting, phases; weather conditions noted and recorded. Positive, direct, discriminating, accurate observations should be required.

Fourth Year.

Natural phenomena: Sun—effects of heat and cold on water, on the soil, on plant and animal life; changes of seasons; heat, light; rising and setting of the sun; observation of the changes of the seasons; experimental illustrations of melting, freezing, evaporation; observations of the weather and record kept; temperature noted and record kept. The work in this year is closely related to the observational work beginning the study of geography.

Fifth Year.

Natural phenomena: Observation of the seasons; weather observations; the barometer; effect of change of seasons on plants and animals. The habit of searching for the causes of phenomena should be formed, and the ability to explain natural events should be developed.

Sixth Year.

Natural phenomena: Weather observations, use of the weather maps, signals, forecasts; affairs of agriculture; Government helps.

GEOGRAPHY.

It is to be remembered that an ordinarily bright child comes to school with a certain body of geographic information picked up from observation or through conversation with its elders. In the nature-study course of the first two grades, also, much work of a semigeographic character is proposed. With the beginning of the third school year the child has usually learned to read a little, but scarcely well enough to be self-helpful.

Third Year.

During the entire third year, if the work is not provided for in the nature-study course, simple weather observations should be made and records kept by the children. A text-book should not be used until the last quarter.

Fourth Year.

Climate of United States: Show the position of the United States on the globe; point out that the northern part is near the Arctic zone; locate the home, village, or school; have the children describe the usual weather conditions during the summer and winter; give some simple lessons on evaporation and condensation of moisture; explain how moisture evaporated over the surface of the sea is borne by winds into the interior to be condensed and fall as rain; make maps showing the distribution of rainfall in the United States; have children locate on larger maps the regions of (1) abundant rainfall, resulting in much vegetation where it is warm; (2) medium rainfall—enough so that crops will grow; (3) slight rainfall or none, resulting in deserts.

As a result of the relief, temperature, and rainfall, it will be found that different parts of the United States are suited to certain industries; i. e., they furnish certain possibilities of occupation. (Then follows a study of the different divisions with regard to industries. Other countries are studied in the same way, but with less detail.)

Fifth Year.

Similar studies of foreign countries, etc.

Sixth Year.

The work is more largely in physical geography, showing the world, not as a mere assemblage of places and things, but as a world of order and unity, where the different life forms and their environment are adapted to each other.

The land and water in relation to atmospheric movements: Conditions shaping relief features and shore forms; change in temperature; work of winds; dissolving action of atmospheric moisture; winds, tides, and the work which they do.

The air and conditions which determine temperature: (1) revolution of earth about the sun; (2) inclination of earth's axis; (3) the relation of these facts to climate—(a) unequal length of days and nights, (b) seasons, (c) location of the tropics, polar circles, zones; (4) modifying influence of large water bodies; (5) modifying influence of highlands; (6) actual conditions resulting from these influences.

Atmospheric movements (winds): (1) Equatorial belt of calms; (2) trade winds; (3) horse latitudes, or belt of tropical calms; (4) westerlies—(a) general movement, (b) cyclonic storms; (5) seasonal winds; (6) ocean currents and causes.

Rainfall to be studied in connection with the foregoing. Account should be taken of the nature of the rainfall in the different wind zones and calm belts and the influence of elevation upon a body of moist air, regardless of the cause of elevation.

Climate—Outline to be used as a guide in the study of the several continents and countries: (1) Temperature as controlled by (a) position, (b) relief; (2) winds and rainfall—(a) prevailing winds and calm belts to be expected from position, (b) winds actually prevailing, (c) influence of highlands upon winds and rainfall, (d) influence of winds upon ocean currents and of the currents upon winds which cross them, (e) location of rainless areas and the reasons therefor.

Zones of vegetation as dependent upon: (1) Temperature as determined by latitude, altitude, proximity to large bodies of water, and influence of ocean currents; (2) rainfall; (3) character of the soil.

Zones of waste as dependent upon: (1) Lack of moisture; (2) too much moisture.

Seventh Year.

Work continued along the same general lines.

Reference books used in entire course—Standard text-books; daily weather map, and other publications of United States Weather Bureau.

ADVANCED CURRICULA IN HIGH SCHOOLS.

In the high schools meteorological instruments, the properties of the air, and the movement of the atmosphere are studied in the physics course, the weather and its influence on plant life in both botany and agricultural courses, and the weather and climate in considerable detail in the physiography course. A few high schools also offer elementary meteorology as a special subject. In colleges and universities courses in meteorology of greater or less scope are given, adapted

in some instances to special purposes, such as engineering or medicine. In all of this work the Weather Bureau has a part.

PURPOSE AND VALUE OF METEOROLOGY IN SCHOOL WORK.

In addition to what has already been said in regard to the purpose and value of meteorology in school work, there are other practical considerations that should be mentioned. Briefly, all out of doors is the laboratory, and the teacher is never at a loss for laboratory material. The subject is one of interest and speculation to everyone, from the youngest boy or girl who watches the clouds and rain to the university student who studies medical climatology or some other specialized application of weather knowledge. The service of the Government is, so far as practicable, at the command of the teacher. The teacher may receive the publications free; may obtain special data or information or advice by mail or by visit to the nearest local office; may take the class to the local office of the Weather Bureau and have them hear a lecture on the instruments and work; or may receive instruction from a Government official at college or university. The subject offers unexcelled opportunities for strengthening the powers of judgment and observation of the student. City and country schools are on a common ground, neither having the advantage of the other.

THE WEATHER MAP IN SCHOOLS AND OTHER AIDS GIVEN TO TEACHERS.

The daily weather map is the publication most widely used in all grades. In New York State about 529 schools or schoolrooms are supplied with the map each day, and it is, as a rule, displayed in the corridor for the benefit of all students, as well as used for class study. An oak frame for the purpose is furnished by the Bureau. The number of maps issued for school purposes in New York State daily comprises about 15 per cent of the total issue, and it is believed that this per cent applies at the present time throughout the country; at least this view is supported by the writer's experience in Montana, Arkansas, Mississippi, Alabama, and Georgia. This would make the number of schools or schoolrooms supplied daily in 1907 nearly 4,000. The number increases each year. In New York State a fair estimate places the total number of public-school children having access to the weather map each day at 175,000. Other publications of the Weather Bureau, such as the Weekly and Monthly Climatological Reports of the separate States and the United States, the Monthly Weather Review, and the Weekly Snow and Ice Bulletins, are much used, but their distribution is not as general as that of the weather map. In many instances, particularly in country districts, teachers act as cooperative observers of the Weather Bureau and are loaned the necessary instruments. Certain necessary conditions must be com-

plied with, however, before this can be done. Instruments of the standard Weather Bureau pattern may be purchased at a moderate cost. All the normal schools of New York State are provided for in one of these ways.

SIMPLE HOMEMADE INSTRUMENTS.

Several of the more important instruments used in weather observation can be made at home by the pupils or teacher, and such homemade instruments are of greater educational value than the more elaborate ones that can be purchased. They will not, of course, give accurate records, but they can be made to work, and will interest the boys and girls. The anemometer, or wind measure, for instance, can be imitated by any bright boy at a cost of 20 or 30 cents, as illustrated in figure 31, the ribs of a broken umbrella being used for the cross arms and vertical spindle and the halves of two baby's ball rattles for the cups. These are made of paper, celluloid, or rubber, and can be purchased at any toy store. A size about 4 inches in diameter should be selected. The distance from the vertical axis to the center of the cups should be 6¼ inches, and the length of the vertical axis should be about 12 inches. The bottom of the shaft should rest on a piece of glass, to reduce the friction, and a couple of small screw eyes fastened in a wooden upright may serve as bearings. A counter may be made out of two wooden disks and nine small wire nails, as indicated in the sketch. If the instrument is properly constructed, the number of revolutions of the larger disk in a minute will correspond approximately to the number of miles per hour that the wind is

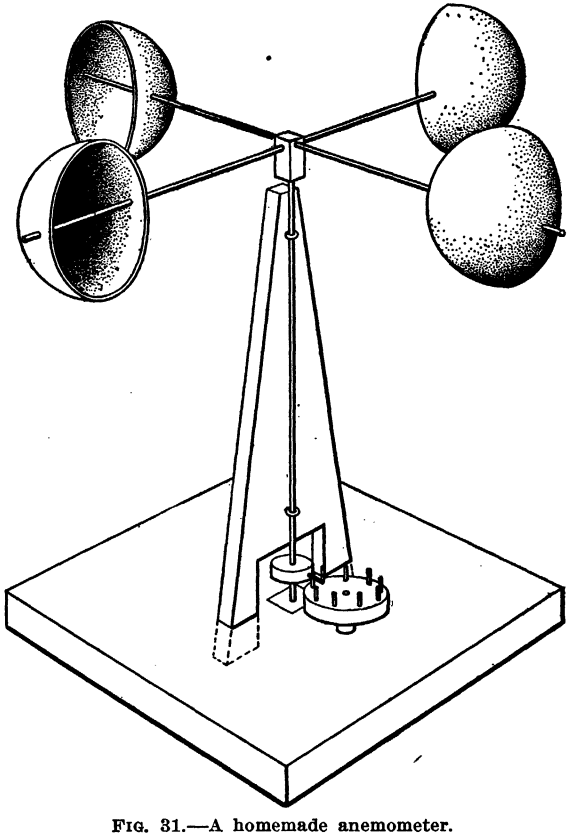

FIG. 31.—A homemade anemometer.

blowing. About 540 revolutions of the cups will measure a mile of wind.

To determine the number of revolutions of the wheel, if a watch is not at hand, seconds may be counted, and this is a valuable exercise for the children. To count seconds, say "one-half and one," "one-half and two," "one-half and three," and so on, at an ordinary conversational rate of speed, up to 60 (one minute), then begin over again for other minutes.

A photographic sunshine recorder may be made out of a large baking-powder can and some blue-print paper, on the principle of a pin-hole camera. The space in the can should be divided by a partition running lengthwise (fig. 32) into halves, one for the morning record and one for the afternoon, with a pin hole for each. The blue-

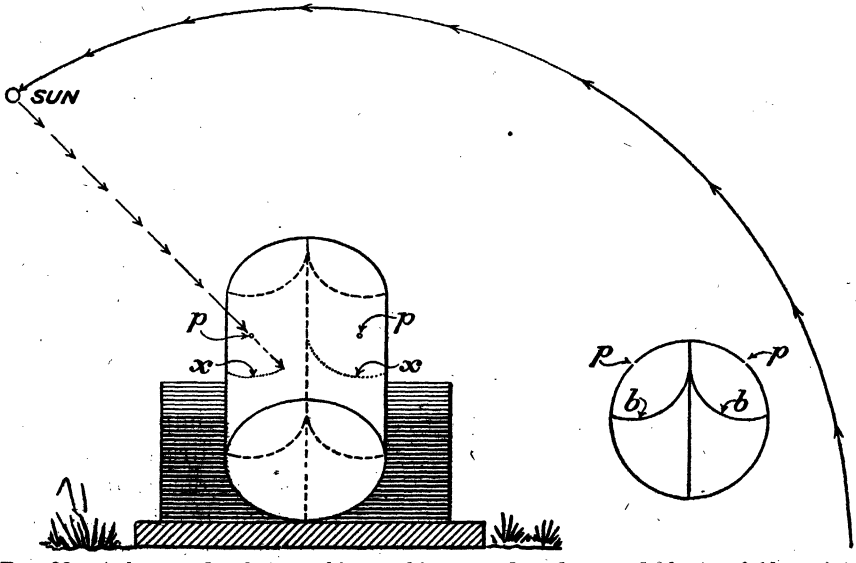

FIG. 32.—A homemade photographic sunshine recorder: *b*, curved sheets of blue-print paper; *p*, pin holes; *x*, line traced on blue-print paper by sun's rays.

print paper should be curved to the arc of a circle (*b*) of which the pin hole (*p*) is the center. The partition wall in the can may be made of tin or of pasteboard. The sun shining through the pin hole will trace a line (*x*) on the blue-print paper, and this line will be broken by clouds. To show time the pin hole may be covered for a few minutes at the beginning of each hour for one day, and, if the instrument is properly constructed, the hour lines thus found will be the same as for other days. To obtain several days' record on one sheet the blue-print paper may be slipped upward a little each morning or evening, or several pin holes that can be uncovered consecutively may be used. A can 5 or 6 inches in diameter will give the best results. The blue-print paper may be purchased of any dealer in photographic supplies for a few cents.

A simple barometer is easily made as illustrated in any text-book of physics, but the cost of mercury and tubing is somewhat too great for the average schoolboy and the results attained are not especially interesting.

Any cylindrical can with straight sides may be used for a rain gauge, but the smaller the size the less accurate will be the measurement. The standard pattern is exactly 8 inches in diameter inside. For greater ease and accuracy in measuring the depth of the rainfall, a measuring tube is used that is exactly 2.53 inches in diameter, which magnifies the depth of the water 10 times. If you have a suitable can for a gauge and wish to have a measuring tube made for it that will magnify the amount 10 times, measure the exact inside diameter of the can, square this, divide the result by 10, and extract the square root. The result will be the inside diameter of the measuring tube. Suppose the diameter of the can is 8 inches; 8 squared equals 64; this divided by 10 equals 6.4, of which the square root is 2.53, which is the diameter of the tube in inches.

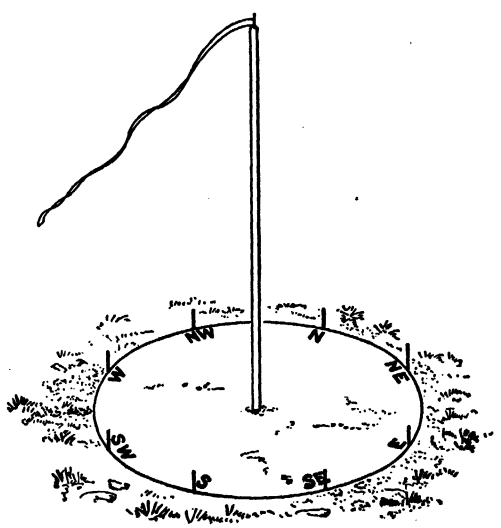

FIG. 33.—A simple device to show the direction of the wind.

A very simple device to show the direction of the wind, and one that is useful even in the primary grades, is a vertical stake standing several feet above the ground (fig. 33). A nail is driven into the top, to which is attached a long thread or narrow ribbon. The thread will be blown by the wind and show its direction very accurately. A circle may be drawn in the sand or dirt around the stake and the points of the compass indicated on this by stakes or marks. The direction of the streamer may be marked in the dirt at intervals during the day and the children led to note the changes in the direction of the wind.

Thermometers are so easily obtained that no special mention is needed.

LANTERN SLIDES AND THEIR USE.

The great popularity and increased cheapness and convenience of amateur photography have brought the stereopticon into more general use in class work, and a majority of the city schools and many coun-

try schools have lecture rooms fitted for this purpose or have the simple gasoline outfits that may be purchased quite cheaply. Where electricity is available, there is no better or more convenient way of presenting large charts that are needed for the study of an entire class than by means of the stereopticon, the room being sufficiently darkened by pulling down the curtains and a sheet being unnecessary where a white wall is available. Photographic copies of the most complicated charts may be purchased in the form of lantern slides for 25 to 50 cents, when the originals of sufficient size for the school-room would cost as many dollars and would soon be worn out, besides being cumbersome and inconvenient. In New York the State department of education maintains a division of visual instruction which expends about $20,000 annually in the preparation of lantern slides and their distribution to the public schools of the State. These are deposited in the schools for class-room use, or sets of them are loaned to teachers and superintendents for lecture purposes. Here, too, the Weather Bureau has assisted by furnishing a lecture on The Weather, What It Is and How It Is Observed and Forecast, which is sent free of expense from the local office at Binghamton, N. Y., to schools in the State upon request, the only conditions being that the lecture shall be public and that no admission fee or collection of any kind shall be taken. This is the only lecture of the kind that has been used by the State department of education. The demand for the lecture during 1906 and 1907 was three times as great as could be met.

At the central office of the Weather Bureau in Washington, D. C., also, is kept a collection of slides, from which loans are made to station officials when they desire to give illustrated lectures of a public nature. Many such lectures are to teachers at summer institutes, normal schools, colleges, or public gatherings, and have proved very popular.

THE FORECASTS AS USED IN SCHOOL ADMINISTRATION.

The health and comfort of school children demand constant consideration, and the daily forecasts are carefully considered in school administration. During, or on the approach of, inclement weather it is common for school superintendents to consult the weather forecasts and warnings or to telephone to the local office of the Weather Bureau for advice in planning to dismiss the school for the day or prepare for a double session. In the larger cities especially the schools are all connected by telephone and arrangements for a double session can be quickly made upon the advice of the local forecaster, or the schools can be dismissed. In the rural districts the farmers' telephone lines place the warnings of heavy

snow, blizzards, cold waves, etc., at the disposal of the country school quickly and without expense, since the forecasts are in most instances distributed free to their patrons by the telephone companies.

The janitor, too, watches the forecasts closely so that he may not be taken unawares by rapid changes in temperature and thus let the rooms become too cold or too warm for the health and comfort of the pupils. He needs also to take account of the conditions of rain or snow in planning his work.

Sometimes it becomes advisable to close the schools entirely upon receipt of Weather Bureau information. Thus on the western prairies the schools may be closed when a blizzard is expected; in New England or elsewhere, when heavy snow is on the way; in the far South, when snow sets in to continue until the ground is covered, so that the children may join with their parents in frolicking and enjoying to the utmost the unusual pleasure. In the fruit district of California, where thousands of tons of raisins, apricots, prunes, etc., are dried outdoors in the sun, the schools are closed upon receipt of a rain warning, in order that the children may at once be put to work covering up the trays of fruit to prevent loss.

SUMMARY.

Modern methods of teaching in the public schools provide an important place for weather study and make liberal use of the publications of the Weather Bureau and the local officials and offices. This use begins in the primary department and ends with the colleges and universities. The policy of the Weather Bureau, under the direction of the Secretary of Agriculture, has been to assist the public schools as far as its resources and general duties to the public will permit. About 15 per cent of the daily issue of weather maps is used in the public schools and it is estimated that about 4,000 schools now receive them, and many of these have files preserved from past years. Lectures are given by Weather Bureau officials at teachers' institutes and elsewhere, and, in many instances, regular courses of instruction are given by them at colleges and universities. Classes from the public schools visit the local offices of the Weather Bureau. The forecasts and warnings are widely used in school administration.