the continent, especially during the winter months.[2] Typhoons, the chief object of the forecaster's solicitude in the Far East, reach China from the eastward, after traversing a region that is now fairly well under observation; but even these depressions must be largely conditioned, in their intensity, direction, and rate of progress, by fluctuations in the pressure to the west of the present field of observation.

WHAT IS RESEARCH?

The following excellent remarks, by the editor of the Experiment Station Record,[1] apply so well to meteorology that we take the liberty of quoting them, and inviting our readers to give us their own ideas as to what constitutes research.

The outlining of plans for agricultural work under the Adams act has led to greater consideration of what should be regarded as research in agriculture. The terms "research" and "investigation" have been used freely in reference to experiment station work, and often more broadly than they are employed in science generally. We have fallen into the habit of speaking of much of the work as investigation, which in a strict sense can not be regarded as of that grade. * * *

There are several reasons which contribute to this uncertainty in the use of terms. Agriculture is a new science. Our knowledge is not as well systematized and classified, and the problems for research are not so definitely outlined as they are in the older sciences. Being a composite science, it has been built up on the basis of the pure and natural sciences. It has drawn upon these for many facts, which have been given a scientific or a practical application in agriculture. Important as this application may be, it is not always to be regarded as research or scientific discovery. * * *

Again, the needs of agricultural practise have frequently blinded station workers, and led them to mistake for investigation, tests and demonstrations or simple experiments involving no original features, but which led to an answer to the farmer's question. They have been flooded with practical questions, and have set out to answer these questions in the most direct and quickest way. * * *

Hence it is that much of our experimental work has given results which are largely empirical. We find that if we follow a certain program of operations we will get a given result quite constantly. * * * The experimenter often sees only the final result, and is satisfied with this if it is favorable. The investigator will strive to determine the cause of what he sees and the broader bearings of the results of his experiments. This will stimulate him to make investigations into these problems which will go down to the fundamental facts and enable him to prove his proposition step by step.

These differences in the use of terms, which have grown up as a result of circumstances and environment, make it desirable that we should discriminate carefully and intelligently in applying the funds under a new act which restricts them to investigation. * * *

For example, there was much experimenting upon the use of lime for land. Applications to some soils gave beneficial results, while on others there appeared to be no benefit, and it was thought by some to exhaust the soil and to be ill advised. A few years ago this represented the status of knowledge and experimentation. The results and the practise were entirely empirical. The lime was usually not needed by the crops themselves, although it benefited them, but the purpose it served was not known, and there was no way of reasoning whether or not in a particular case lime would be helpful or its use advisable. Soil tests were relied upon for this purpose, and while they might be regarded as experiments, yet in themselves they did not comprise an investigation.

There were research problems which experience and these experiments had suggested, and after a while these problems became the subject of investigation. The effect of lime in correcting an acid condition of the soil was observed; the relations of this changed reaction to the biological factors of the soil were worked out; and gradually from these and other facts a basis was formed for the philosophy of liming. Through research the knowledge of this common practise had been made "accurate and precise", and this accuracy and precision had been "translated into action". * * *

In feeding work the case is often on much the same plane. For example, we make a comparison of wheat bran and gluten meal for milk production. One of these feeds gives the better result, as measured by the yield and the financial returns, but often the inquiry stops there. * * * The real physiological relation of these feeds, or of their respective constituents, to the elaboration of milk remains untouched by such experiments.

Suppose, again, we feed a lot of steers on heavy rations of corn for fattening. Humanity says: "Shelter them in a warm, comfortable barn". They appear after a little to resent this. They are uncomfortable, and it is difficult to keep them up to the high rations. Divide them into two lots, and turn one out into the cold with only a shed to shelter them from the winter winds. The latter lot does better—is more thrifty, eats better, and makes better gains. Is the question answered? Too often it stops here. We have the empirical result, but it is supported by no reason.

Put one of these heavily fed steers into a respiration calorimeter and we find he gives off heat enough under his heavy corn feeding to keep his body warm without artificial protection. The reason has been found. Again, knowledge of common things has been made accurate and precise, and may be translated into action. * * *

Research is worthy of the name only as it sets up definite ideals or aims which it strives to attain by scientific methods of procedure. This will involve a definite plan of operations, a thorough consideration of what is known of the subject and its bearings, both practical and scientific, and should lead the experimenter to learn something of the reasons for the results he secures. While the aim should remain fixed, the plan will often have to be modified in detail as the investigation progresses. But too often there appears to be lacking any well-thought-out plan or object; this is developed piecemeal and lacks in directness.

There are certain operations which will always be more or less experimental, as they will depend upon a variety of conditions, either indefinite in extent or combined in such a way as to make the outcome somewhat uncertain. Such operations can not proceed with mechanical exactness, and this very element of uncertainty will lend a charm to the work. But the object to be attained and the line of experiment should be matters of mature consideration. An investigation should presuppose this preliminary.

The line of demarcation between investigation and the lower grades of inquiry is not always clear and sharp, but the character of the problem does not determine this. The lowliest and the most common subject may be a proper matter for real investigation. It is the man in charge of the work and his mental attitude toward it which determines whether it shall be a simple test, a conclusive experiment, or a thorough investigation. If he has none of the scientific spirit or sees only the purely practical phase, his work will stop with comparisons and simple experiments; but if he has the true spirit of the investigator and is trained to observe, even though he may not have seen a college classroom, his results will contribute something toward establishing a scientific fact.

We have been accused in our experimental [agricultural] work of having the immediately practical results too constantly in mind. The immediately practical work is important and desirable. It has helped to make the American stations strong in the confidence of their constituents. It should be continued and the results carried to the farmer in demonstrations, cooperative experiments, and other popular ways. But it is equally important to get at the scientific facts, which have a wider and more permanent application. Surely there is no conflict between such investigation and the securing of practical results.

[2] The relative number of storms reaching the China coast from the eastward and the westward is shown by the following statistics for the six years 1893–1898, as given by Father Froc in his "Atmosphere in the Far East during the six cold months" and "Atmosphere in the Far East during the six warm months." (Shanghai Meteorological Society. Seventh and eighth annual reports.)

	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Total.
Typhoons	21	9	4	0	0	2	2	7	10	27	15	18	115
Continental storms	13	23	26	23	27	34	32	29	20	8	5	9	249

[1] Issue for June, 1906, pp. 929–933.

THE INTERNATIONAL SEISMOLOGICAL ASSOCIATION.

The United States of America, through the Secretary of State, lately indicated its willingness to take part in the above-mentioned international association for the study of the large earthquakes of the globe. This association has its central bureau at Strassburg, Germany, Professor Doctor G. Gerland being the director, and he submits the following circular for republication in the MONTHLY WEATHER REVIEW:

The Central Bureau of the International Seismological Association, founded in 1903 by the Second Seismological Conference, which met in Strassburg, is now completely organized and in full activity.

The central bureau is located in Strassburg (Alsace), Schwarzwaldstrasse 10; the undersigned has the honor to be its director; the personnel consists of two assistants, one mechanist, and one servant. The workrooms are on the second floor of the building, the first story being occupied by the Imperial German Central Station for Earthquake Investigation.

The Observatory of the Central Station, which is located near the Bureau, is furnished with the following instruments: (1) a Rebeur-Ehlert triple horizontal pendulum with photographic register; (2) a two component Rebeur pendulum with photographic register; (3) a Milne

pendulum; (4) the Wiechert pendulum, weighing 1000 kilometers, with a mechanical register; (5) the three-component microseismograph of Vicentini; (6) the Omori horizontal pendulum; (7) the Bosch horizontal pendulum (tromometer) weighing 100 kilograms; (8) the triflar gravimeter of August Schmidt.

These instruments, which are all in active use, are giving accurate comparative observations; their seismograms, when carefully discussed, form a valuable collection.

The instruments and records of the central station are at the disposal of foreign visitors, especially citizens of the States associated in this work, who wish to use them for special study, with the restriction that the regular records of the instruments are to be undisturbed. The workrooms of the central bureau are open to foreign visitors for scientific, practical, or theoretical researches; the collection of seismograms of the central station may always be consulted by them.

In accordance with these provisions the geophysicist and seismologist, Doctor Pécsi, was sent by the Hungarian government to study at the central bureau for several weeks in order that he might make use of the records, with the assistance of the personnel of the central bureau and the central station. Professors Omori and Michailovitch intend to work at the central bureau for some time.

The principal work of the central bureau, as prescribed by its director, is at present directed toward the study of apparatus, and has for its object the enlargement of our knowledge of instruments and improvements in their use. Negotiations have been begun for the purpose of engaging a seismologist of great reputation to pursue extensive works of this nature at the central bureau with the apparatus of the central station.

These two institutions are distinct organizations, but their work is along parallel lines. The Imperial German Central Station places at the disposal of the Central Bureau of the International Seismological Association its instruments, its records, and in part its quarters; and on the other hand the central bureau, its rooms, and its personnel are of considerable service to the central station. Much work that is of great importance to the better understanding of the seismometry of our globe, which is the principal object of the Seismological Association, could only be carried on by the active cooperation of the two institutions, and work of all kinds is facilitated by this combined activity.

Literary works also are incumbent upon the central bureau; several have already been completed or are about to be; these works have as a basis the records and the researches of the central station. The central station is publishing at the present time, in the Beiträge zur Geophysik, a catalogue of all the microseismic earthquakes known to have occurred in eastern Asia; this catalogue, composed by Professor Rudolph, will be continued. The catalogue of earthquakes observed during the year 1903, begun by Rudolph (Beiträge zur Geophysik, Supplement III), will be continued for following years by the central bureau and a catalogue of all microseismic movements will be prepared.

In order that these works may be as complete as possible, the central bureau earnestly requests all delegates appointed by the cooperating nations to see that the most exact information regarding seismological observations in their respective countries be transmitted to the central bureau at the end of each half year, or better still, each quarter year. The most practical manner of attaining this object will be to send copies of all seismic perturbations of considerable importance registered by the different stations; they will be preserved at the central bureau and will be placed at the disposal of all who need them in their studies or researches.

The central bureau will also be much pleased to receive published works bearing on seismology, particularly investigations of different countries or of the entire globe. These works will form the nucleus of the future library of the central bureau.

ASTRONOMY *versus* METEOROLOGY.

The Astronomical Association, organized in 1865 in Germany, and the Royal Astronomical Society of London, organized in 1820, publish annually condensed reports of the work done by the more prominent astronomical observatories in the world. The last number of the Notices of the London society and the last Vierteljahrschrift of the German society give such reports from 27 English and 39 continental institutions, respectively. Although astronomy is the prime work of all of these, and although some of them necessarily pay special attention to atmospheric conditions, in so far as they affect astronomical work, yet only a few maintain regular meteorological observations comparable with those of our regular stations. Nevertheless the fact that 13 out of the 27 English, and 10 out of the 39 continental observatories do maintain such series is an interesting evidence of the intimate relation between the two branches of science. In many of these cases the meteorological record is continued by the observer as a pious duty, in view of its having been begun many years ago when the astronomer was the accurate observer of all geophysical phenomena, and when men looked to him for information with regard to earthquakes, terrestrial magnetism, and the weather, as well as the stars. In recent years each of these has become a special branch of science, requiring a special building and instruments. It is, however, very fortunate for meteorology that the astronomer, with his accurate instruments, can frequently give measurements from which meteorologists derive great benefit. Very few of the latter have at hand apparatus for determining the exact angular dimensions of halos, the absorption bands due to the air and the vapor, the exact location of a meteor train, the altitude and azimuth of the twilight arc, the degree of polarization of the skylight, or the ordinary phenomena of refraction and the extraordinary refractions of the mirage. For information on these and other points we generally depend on the astronomer, or some individual physicist; but it is to be hoped that we may eventually have many meteorological institutions where these matters are properly attended to. The so-called regular observations, that have been made since the days of Ferdinand II, the Grand Duke of Tuscany, who organized the first system of stations in 1653, certainly need to be supplemented by observations in every field that modern science has opened up to meteorological research.—*C. A.*

RECENT PAPERS BEARING ON METEOROLOGY.

H. H. KIMBALL, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——

Bulletin of the American Geographical Society. New York. Vol. 38. Aug., 1906.

Ward, Robert DeC[ourcy]. The classification of climates. II. Pp. 465-477.

Journal of the Meteorological Society of Japan. Tokyo. 25th year. July, 1906.

Takagi, T. On the dust-haze (Hoang sha) in the Yangtze Valley. [Japanese.]

London, Edinburgh, and Dublin Philosophical Magazine. London. 6 ser. Vol. 12. Sept., 1906.

Eve, A. S. On the radioactive matter in the earth and the atmosphere. Pp. 189-200.

Nature. London. Vol. 74. Aug. 30, 1906.

—— Meteorological kites in India. P. 448.

Physical Review. Lancaster. Vol. 23. Aug., 1906.

Joslin, Lulu B. The contemporaneous variations of the nucleations and the ionization of the atmosphere of Providence. Pp. 154-165.

Science. New York. New Series. Vol. 24. June 24, 1906.

Smith, D. T. The source of the energy of cyclones. Pp. 247-248.

Science Abstracts. London. Vol. 9. Aug., 1906.

B[utler], C. P. Eclipse shadow bands. [Abstract of article by M Roso de Luna.] P. 402.

Scientific American. New York. Vol. 95. Aug. 25, 1906.

—— The effect of the sea upon climate. Pp. 130-131.

Annuaire de la Société Météorologique de France. Paris. 54 année. Avril 1906.

Moureaux, Th. Observations magnétiques pendant l'eclipse de soleil du 30 août 1905. Pp. 113-115.

Besson, Louis. Halos et taches solaires. Pp. 115-119.

Angot, Alfred. Régime pluviométrique de la Méditerranée. II. Tripolitaine. Pp. 119-122.

Goutereau, Ch. Sur la variabilité de la température. Pp. 122-127.

Marchand, E. L'électricité atmosphérique au Pic du Midi (2860 m.). Pp. 137-146.

Brunhes, Bernard. Sur la dissymétrie de la déperdition électrique en montagne. Nouvelles observations faites aux environs de Nauriac. Pp. 147-149.