

# SCIENCE

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## CONTENTS:

<i>A Magnetic Survey of the United States by the Coast and Geodetic Survey</i> : DR. HENRY S. PRITCHETT.....	729
<i>The Jesup North Pacific Expedition</i> .....	732
<i>On the Brightness of Pigments by Oblique Vision</i> : PROFESSOR FRANK P. WHITMAN.....	734
<i>An Extension of Helmholtz's Theory of the Heat of the Sun</i> : DR. T. J. J. SEE.....	737
<i>On the New Genus of Lamprey Macrophthalmia Chilensis</i> : PROFESSOR BASHFORD DEAN.....	740
<i>Note on the Spawning Season of the Eel</i> : EUGENE G. BLACKFORD .....	740
<i>Evolution of the Embouchure in North American Indian Flageolets</i> : E. H. HAWLEY.....	742
<i>Scientific Books</i> :—	
<i>Angot's Traité élémentaire de météorologie</i> : DR. FRANK WALDO. <i>Collins on the Genesis and Dissolution of the Faculty of Speech</i> : E. W. T. <i>Codex Borbonicus</i> : M. H. SAVILLE. <i>Schimper's Pflanzengeographie auf physiologischer Grundlage</i> : DR. FREDERICK E. CLEMENTS. <i>Victor von Richter's Organic Chemistry</i> : PROFESSOR E. RENOUF. <i>Van Deventer's Physical Chemistry</i> : PROFESSOR HARRY C. JONES. <i>Books Received</i> .	743
<i>Scientific Journals and Articles</i> .....	750
<i>Societies and Academies</i> :—	
<i>The Chemical Society of Washington</i> : WM. H. KRUG. <i>The Geological Conference and Students' Club of Harvard University</i> : J. M. BOUTWELL.	751
<i>Discussion and Correspondence</i> :—	
<i>Telepathy Again</i> : PROFESSOR WM. JAMES. <i>On the Wehnelt Current Breaker</i> : HOWARD MC-CLENAHAN.....	752
<i>Thermodynamic Action of 'Steam Gas'</i> : PROFESSOR R. H. THURSTON .....	753
<i>The Removal of Dr. Wortman to the Carnegie Museum</i> : H. F. O.....	755
<i>Scientific Notes and News</i> .....	755
<i>University and Educational News</i> .....	759

## A MAGNETIC SURVEY OF THE UNITED STATES BY THE COAST AND GEODETIC SURVEY.

IN the plan of reorganization of the 'survey of the coast,' adopted in March, 1843, explicit provision was made for magnetic observations.

Determinations of the magnetic declination were made at various points along the coast, under the superintendency of F. R. Hassler; the real work of magnetic observations, however, began with Superintendent Bache, who had previously made a magnetic survey of Pennsylvania and who had established the first magnetic observatory in this country, that of Girard College, Philadelphia.

Since that time the three magnetic elements, the declination, the dip and the intensity, have been determined by survey parties at various points in the United States, including Alaska, and in some foreign ports.

The general charge of this work, as well as the theoretical discussion which has given it value, has been in the hands of the Assistant Schott, Chief of the Computing Division, who has called attention from time to time to the need of a systematic prosecution of a magnetic survey of the country. It is largely due to Mr. Schott and his energy in that work that the present state of advancement has been reached.

In recognition of his contribution to Ter-

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restrial Magnetism, the Paris Academy awarded him last year the Wilde prize of four thousand francs, which was personally presented by the President of the United States. This honor is especially *apropos* and particularly welcome to the friends of science in this country, inasmuch as Mr. Schott has just rounded out fifty years of magnificent work in the Survey.

With the addition of the islands of the Atlantic and of the Pacific which have come to the United States in the last year, and with the need for investigation of general laws of Terrestrial Magnetism for the whole globe, it seems that the time has now come for systematic magnetic operations, not only upon the continent of North America, but also on the islands in its vicinage. With the purpose of carrying forward such a magnetic survey and of completing in a reasonable time the collection of such data as may be necessary for a partial discussion of the problems of the Magnetic Field of the Earth, a new Division has been organized in the office of the Coast and Geodetic Survey, known as the Division of Terrestrial Magnetism. Dr. L. A. Bauer, formerly assistant professor of mathematics and mathematical physics at the University of Cincinnati, and editor of the *Journal of Terrestrial Magnetism* has been called to take charge of this new division of magnetic work.

The following general plan of work, which has been outlined as the basis for the magnetic survey of the United States and its adjacent islands may be of interest.

To indicate completely the laws which hold in the Magnetic Field of the earth, it would be desirable to have simultaneous observations at a vast number of stations over the continent of North America and of the adjacent islands. This is, of course, impossible, and the magnetic survey which must be made will necessarily depend on observations made at different times and

reduced as accurately as possible to some mean epoch. To arrive at a first preliminary result, it will probably be necessary to make a general magnetic survey of the country, observing the magnetic elements at stations thirty or forty miles apart, making these stations more frequent in disturbed areas if necessary. The secular variations will necessarily be determined by repeating the observations at representative stations as the work goes on. The areas of the countries at present belonging to the United States are approximately as follows:

United States,.....	3,025,600	square miles,
Alaska,.....	577,390	" "
Hawaiian Islands,.....	6,250	" "
Puerto Rico,.....	3,530	" "
	<hr/> 3,612,770	

This area is nearly equal to that of all Europe and is one-fifteenth of the entire area of the globe. As magnetic surveys have been most vigorously prosecuted in Europe, it will be of interest to note the density of distribution of the magnetic stations in two recent, fruitful magnetic surveys, viz., that of Great Britain, where there was one station to every 139 square miles, and that of Holland, embracing one station to every 40 square miles.

Suppose we were to decide upon one station, on the average, to every 100 square miles—an end that we must hope to attain some day—then we should require the determination of the magnetic elements at 30,000 stations within the United States. At the rate of 400 stations a year, the magnetic survey, as detailed as this, would require for its completion 75 years. It is not well, however, to have a magnetic survey extend over such a long interval of years. The errors incurred in reducing the observations to a common epoch would greatly exceed the errors of observation.

It is evident that we must either have a very large number of observers and instru-

ments at our disposal so as to complete the survey within a short interval, say 10 years at the most, or we must content ourselves for the present with taking a less detailed survey.

Let us say that our present means will enable us to complete 450 stations per annum, of which 400 are to lie within the United States. Suppose that at the end of the year 1910 we shall have occupied 4,000 stations in the United States and have made the necessary 'repeat observations,' and that the stations have been to some degree uniformly distributed, then we shall have on the average one new station to every 756 square miles. Selecting as the epoch to which the observations shall be reduced January 1, 1905, we should then have with the addition of about 1,000 former stations, which we could utilize, a magnetic survey, the stations of which would be distributed at the average rate of one to every 600 square miles, or, approximately, one station to an area 25 miles, 40 kilometers, square.

This will give a very satisfactory representation of the distribution of the earth's magnetism within our confines and will suffice for the accomplishment of many of the practical purposes of magnetic surveys.

We will call this our 'first survey' and, as stated, its epoch 1905. We shall now be able to tell in what portion of the country more stations are needed. That is the density of the ultimate distribution of stations will not be a uniform one. In regions where the distribution of magnetism is fairly regular comparatively few stations will suffice, while in magnetically disturbed areas the number of stations must be increased in uniformity with the character and extent of the disturbance. The subsequent work will consist then in filling in stations where most needed and repeating observations at the 'repeat stations.'

In short, the plan of conducting a magnetic survey of this country which appears

to be best suited to the present conditions, and one that is possible to carry out within a reasonably short time, is as follows: To make, first, a general magnetic survey of the country with stations about 25 to 30 miles apart; then, as opportunities present themselves, to observe more closely the magnetically disturbed areas. The observations at the 'repeat stations' made from time to time will furnish the proper secular variation corrections.

The great advantages of this plan over that of attempting a very detailed magnetic survey at once, the steady progress of which over the entire country, on account of its extent, would necessarily be very slow, will be readily perceived. The plan thus briefly outlined will make it possible within a reasonable time to construct two sets of magnetic maps for the same epoch, each set based upon a different distribution of the stations. An opportunity will thus be afforded, as in the case of the recent magnetic survey of Great Britain, to obtain some idea of the accuracy with which the iso-magnetic lines can be determined. The satisfactory solution of this question will serve as a valuable guide in future magnetic work.

Several State Geologists are making plans for detailed magnetic surveys of their respective States, in cooperation with the Coast and Geodetic Survey.

In addition to the observation of the magnetic elements at numerous points it is necessary to maintain a few magnetic observatories where continuous observations over a term of years will afford the data for comparing and reducing observations and for detecting the general changes in the earth's magnetic force. The Coast and Geodetic Survey has a number of years maintained such an observatory, for a time at Los Angeles and later at San Antonio, at which point the observations were brought to a close, as they have been in the

case of the Naval Observatory at Washington, by the interference of trolley wires.

Just what points will be chosen for the maintenance of continuous observatories will depend somewhat on the number of fixed magnetic observatories already maintained by universities and other institutions. With continuous records in Washington, Toronto, one point in the Northwest, Mexico and Havana, the magnetic fluctuations over the continent of North America ought to be fairly well followed. In addition to these a magnetic observatory will be established by the Coast Survey on one of the Hawaiian Islands, where its situation will not only supplement the data furnished by the observatories in the mainland, but by reason of its position in an isolated island may well be expected to add new facts to our knowledge of one of the most interesting, but one of the least perfectly understood, branches of physical science.

HENRY S. PRITCHETT,  
*Superintendent.*

*THE JESUP NORTH PACIFIC EXPEDITION.*  
ETHNOLOGICAL WORK ON THE ISLAND OF  
SAGHALIN.\*

THE following report has been received from Dr. Berthold Laufer, who is in charge of the ethnological work of the Jesup North Pacific Expedition on the Amoor River and on the Island of Saghalin. The expedition is being carried on under the auspices of the American Museum of Natural History, the expenses being borne personally by President Morris V. Jesup. Dr. Laufer left New York in May, 1898, and went to Saghalin by way of Japan and Vladivostok. He spent the time from the summer of 1898 until March, 1899, among the various tribes inhabiting that island. He writes under date of March 4, 1899, as follows:

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In the collections which I made on the Island of Saghalin there are a number of very interesting specimens. On my journey made in the course of last winter I succeeded in obtaining from the Olcha Tungus a collection of wooden idols and amulets made of fish-skins, which are quite new to science. I obtained from the Ainu of southern Saghalin a very interesting collection of ethnographical objects. I have had very good success in using the phonograph, and have obtained songs of the Gilyak and Tungus. The only difficulty is that the instrument cannot be used in the winter, owing to the effect of severe cold.

I intend to leave Saghalin the beginning of next week and continue my work on the Amoor River. It is my intention to devote a good deal of my time to the study of linguistics, since this part of my investigations has been least satisfactory. There are no interpreters on Saghalin capable of translating texts. There is no one who knows more than the most common phrases of Russian. Among the Ainu, Russian is entirely unknown, and for the purpose of interpreting I had to use Japanese, with which, however, they are not very familiar either. My knowledge of the Japanese language facilitated my work among them very much, since they like the Japanese very well. I succeeded in obtaining a great deal of ethnological material and information, traditions, and a large amount of grammatical and lexicographical material, although a short time only was available for this purpose. I collected most of my material among the Ainu during the night time, because it is only at this time that everything is astir. I have no detailed translations of this material, but expect to be able to make translations with the help of my lexicographical material and comparisons with the Ainu dialect spoken in Japan. There is a great difference between these two dialects. The Ainu of