in the South without a corresponding change in the North are based upon facts, and if so, it no doubt has formed theories regarding the same.

What mainly interests us is to know whether any conclusion has been reached as to the probable course the climate will take in the near future, that is to say, if it is at all likely that we have to deal with a fluctuation in the climate of which this is only the beginning, and which may extend over a considerable period, or if the climate may at any time return to its normal state.

In this connection it also occurs to us that we are in reality quite ignorant as to what may be considered the normal climate of South Carolina, and that there is a possibility that we are now returning to it, the preceding ten or twenty seasons being in reality abnormal ones.

If you will kindly give us the fullest information possible on this subject, which is of vital interest to us, and refer us to whatever literature may have a bearing upon it, we shall esteem it a great favor.

To the above letter the Chief of Bureau sent the following reply treating of the climatic question alone:

The subject concerning which you write is of transcendent importance; one that has been fruitful of much discussion during late years. It was brought to the front by the orange growers of Florida who, after having suffered from repeated disastrous freezes, naturally conceived the idea that the climate must have permanently changed. The pioneers of the middle west some years ago, in the belief that the rainfall to the westward was increasing, pushed out over the plains far beyond the borders of the humid region. After a year or so of abnormally heavy rainfall the natural conditions prevailed; conditions, it is needless to say, inimical to success in agricultural pursuits. Hundreds of persons were forced to abandon their claims and return to more humid regions.

Thus it is there arise from time to time, not only in this country but throughout the civilized world, apparently well grounded beliefs that the climate, either in respect to temperature or rainfall, has changed materially, or is slowly changing. That there have been marked changes in climate during the ages that have passed is clearly evidenced by the results of biologic and geologic surveys, not to speak of the results of equally important investigations that have been prosecuted in other branches of physical science. Such changes, however, occurred for the most part during the formative period of the earth's history and generally before it was inhabited by man. The occurrence of the Great Ice Age, the last important climate change, has been referred to purely astronomical causes, such as the secular or long periodic changes of the eccentricity of the earth's orbit and of the obliquity of the ecliptic, but there is not unanimity of opinion as to its probable cause.

The evidence of material change in climate during historic times is fragmentary and inconclusive. Strange as it may seem, instrumental data are not available in any part of the civilized world for a period longer than three hundred years, and even these are subject to an uncertainty of several degrees in the case of temperature, owing to the imperfections of the earlier instruments and methods. Then, too, the probable effect of man's occupancy of the earth is practically an unknown factor. Through his agency large portions of the earth's surface have been deforested and placed under cultivation. Water has been diverted from the streams and spread over the soil, thus transforming deserts into fertile plains. The latter in turn, through the varying fortunes of dynasties and empires, have again become arid and, with the onward march of progress, other portions of the desert regions of the globe have been brought under cultivation. While the total effect of such changes in the earth's surface as man has wrought is probably small, who can say that it has been absolutely nil?

It is the general belief in scientific circles that the radiating energy of the sun, upon which climate for the most part depends, has not altered within historic times, yet we can not argue constancy of climate from this fact alone, since the atmosphere becomes heated, not from the direct rays of the sun alone, but in great part from the ground by means of radiation, contact, convection, etc. The absorbing power of air for heat radiations is variable, depending somewhat upon the quality of aqueous vapor, carbonic acid, and dust that it contains. These, especially the latter, may have changed materially since the earth was inhabited by man. If we grant that the absorbing power of the atmosphere is subject to small variations from year to year we would still have an effect that would hardly be appreciable to the senses.

Passing now to the consideration of the facts named in your letter, I would say that the records of the Weather Bureau show that during the last fifty years there have been three marked cold periods in the South Atlantic States, viz, from 1852 to 1857, both inclusive; from 1871 to 1875, both inclusive; and from 1892 to 1901, both inclusive, a total of twenty-one years out of fifty. All of the years within the above-named periods were not uniformly cold; indeed, in the last-named period there were at least two normal winters, viz, those of 1894 and 1898. On the other hand, there occurred throughout the remaining periods of years cases of single cold winters, as that of 1878–79, and of two consecutive cold winters, as those of 1885–86 and 1886–87.

The damaging cold in the recent term of cold winters appears to have occurred, with but few exceptions, in February, and that fact may have impressed you more than would a continued cold in December or January. You have also unconsciously fallen into error in referring to the winter of 1889–90 as a standard of comparison. That winter was extraordinarily warm for the latitude of Charleston. In fact, the temperatures you experienced that season were appropriate to central Florida. There has not been another such winter as that of 1889–90 east of the Rocky Mountains since Weather Bureau observations began. You may remember that both November and December of 1889 were warm, pleasant months, and that there was practically no severe weather at Charleston during the entire winter. The warm weather was due to the fact that substantially all of the storms of the season passed across the country far to the north of Charleston, thus inducing warm southerly winds over the South Atlantic States. In cold years the interior of the country is covered by an area of high pressure, around the southern edge of which are found the conditions of heat and moisture necessary to the development of storms. You may recall that in cold winters the storms that visit your section generally approach by way of the lower Mississippi Valley or the Gulf of Mexico, and that they are almost invariably followed by cold northwesterly winds and several days of low temperature.

Why the storms of one year move in much higher latitudes than those of another year is one of the unsolved problems of meteorology.

We may add that inasmuch as the temperature and moisture of the soil is the primary consideration in the production of early spring crops, therefore the gardener must keep a record of the temperature at 3, 6, 12, and 15 inches below the surface of the soil if he wishes to understand the variations of his crops with the seasons. Such thermometer records should give indications as to when mulching and shading are needed, and enable one to predict quite closely the progress of development of roots, tubers, and sprouts.—*C. A.*

SEISMOMETERS IN METEOROLOGY.

Mr. F. Napier Dennison, of the Canadian Meteorological Service, stationed at Victoria, Vancouver Island, read a paper at the British Association at Glasgow on the seismometer as a weather forecaster. His paper in Symon's Meteorological Magazine for 1901 defends the idea that the seismograph can be used as a sensitive barometer. The seismographic pendulum points from the low barometer toward the high pressure. The enormous pressure taken off of the earth's surface within areas of low pressure and added to the pressure or weight over high areas, seems to make the crust of the earth bend like an elastic shell. Mr. Arthur Harvey, of Toronto, suggests that if at any station there be two good-sized seismometers of the pendulum type, oscillating at right angles, with perhaps a third between them, and if for convenience of observation the pens at the points of the swinging bars come close to each other, one would probably be able on the Pacific coast to tell the direction of an approaching low area.—*C. A.*

THE OBSERVATION OF SHOOTING STARS.

It is a very common matter for both regular and voluntary observers and occasional correspondents to mention the occurrence of a shooting star or bright meteor. Such events occur every day in many parts of the globe. Millions of meteors daily strike the earth's atmosphere and are burnt up, thereby adding a little to the mass of the earth and to the heat within the atmosphere; but the sum total of these effects is apparently inappreciable in meteorology. The real interest that attaches to the bright meteors is the effort to classify them according to the directions whence they come in space and the altitude and velocity with which they move. It is hardly worth while to mention the occurrence of a meteor unless the observer will add some approximate statement giving, as precisely as he is able to do it, the angular azimuth and altitude of that point in the sky where he first saw it and

where it finally disappeared. Some persons are accustomed to estimate angles so that they can give this data directly, others know the names of the stars and constellations and can describe several points in the meteor's path by mentioning the neighboring stars, but in this case the exact time of day must also be given. Occasionally a bright meteor will cast the shadows of buildings and trees on the ground or of window sashes on the floor or of the observer himself, and by marking at once the location of such shadows and by measuring subsequently the observer may determine the altitudes and azimuths of several points in the path of the meteor. These angular measurements give us the apparent altitude and azimuth of a portion of the path of the meteor, and are the data of most importance. When several observers at different stations report such measurements as these, they are easily combined together and give us a fair determination of the true altitude and motion of the meteor.

If the meteor is a very bright one, the observer is almost certain to hear a noise—it may be a very loud one—within a few minutes after the meteor disappears, but not, strictly speaking, at the time of the meteor, as some observers mistakenly imagine. It is therefore best for the observer to hold his watch before him as soon as the meteor appears and record the minutes and seconds of its appearance; then wait a few minutes until the sound is heard, when the minutes should be again recorded. If the watch has no second hand, the observer has but to look sharp at its face, and he will see that he can subdivide the spaces between the minute dots into small fractions and can record the minutes and fractions of minutes, which will be almost as good as the seconds themselves. With very little practise, one may accustom one's self to making the records in minutes and tenths of minutes in the ordinary decimal style.

Photographs of meteor tracks, showing also the stars in their proper relations, are made at Yale College Observatory during the important showers of meteors. Those who desire to do similar work should consult the director, Professor Elkins, as to the apparatus and methods.

As meteors become luminous at 50 to 150 miles above the earth's surface, where the gaseous pressure is inappreciable, it is plausible that the heat is produced by the collision of the meteor with minute particles of matter that attend the earth in its annual course and correspond to the upper atmosphere, whose existence is made plausible by the recent studies of Prof. R. S. Woodward. From these particles we may receive the reflected sunlight that is observed as the zodiacal light.—*C. A.*

THE SOUTH POLAR EXPEDITIONS.

We quote the following from an article published in the National Geographic Magazine for October, 1901, by Dr. Georg Kollm, Editor and Secretary of the Geographical Society of Berlin:

The object of the German Antarctic Expedition is the scientific exploration of the south polar regions, particularly on its Indo-Atlantic side.

In pursuance of this object, it left Germany on the 11th of August, 1901, and is proceeding to Three Island Harbor, Royal Sound, in the Kerguelen Islands, where a base station will be established. In December, 1901, it is expected that the expedition will be ready for its real work of exploration and will push on toward the south as far as practicable. Should land be reached, a station will be founded and maintained for a year and the ship wintered there. Whether any later attempt to push still farther south will be made is not yet determined. It will not, at all events, be undertaken unless the conditions should prove particularly favorable.

The expedition has general orders to remain until its tasks are satisfactorily executed, but in any case not to remain beyond June, 1904, at which date it must report at some harbor in communication with home. Should no news be received of the expedition by the first of June of that year, it will be in order to consider the expediency of fitting out a relief ship.

The leader of the expedition, Dr. Erich von Drygalski, of Berlin, was appointed by His Majesty the Emperor, and has thoroughly studied the problems of the south polar regions. He has been placed in absolute control of the south polar ship *Gauss*, its personnel and equipment. All the arrangements for the work to be carried on from the time the ship left Germany are under his direction and subject entirely to his control. Marine laws regulate the position of the ship's company toward its leader.

The expedition is an undertaking of the German Empire and is fitted out through the Secretary of State for the Interior, Herr Dr. Graf von Posadowsky-Wehner. It sails under the Imperial Service flag, and its officers and men bear special service designations authorized from the highest quarters. It is thoroughly well equipped, both scientifically and practically, for its mission. In addition to the funds provided by the Empire, about 40,000 marks ($10,000) in small amounts have been contributed by private societies. The interest aroused in the expedition throughout the Empire has been very great, and has led to the presentation of many gifts and offerings which will add much to the efficiency of the equipment.

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The scientific members of the expedition are Prof. Dr. E. Vanhoffen, Kiel, for zoology and botany; Dr. H. Gazert, Munich, physician and bacteriologist; Dr. E. Philippi, Breslau, for geology and chemistry; Dr. F. Bidlingmaier, Lauffen, for terrestrial magnetism and meteorology.

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The personnel selected for the Kerguelen station consists of Dr. E. Werth, from Munster, as biologist; Dr. K. Luyken, from Munich, as meteorologist, and two seamen.

The Kerguelen station is chiefly intended for magnetic and meteorological observations, which, as well as similar work conducted by the German chief expedition, will be carried on in accordance with the international program agreed on with England. This program has been sent to all States having magnetic-meteorological stations, as well as to the stations themselves, with the request for cooperation. Many have already signified their readiness to do so. It will also be followed at the station established by the Argentine Republic on Staten Island. Cooperation in all other sciences with the English expedition and all other expeditions to be sent out by other States has been regulated in the best manner by the division into departments of work.

Mention has already been made of the kite work that will be undertaken by this expedition.[1]

On August 6, 1901, the *Discovery* sailed from Cowes carrying the British National Antarctic Expedition under command of Com. Robert F. Scott, R. N., with Dr. George Murray as scientific director.

The proposed work of the party has been carefully outlined by the presidents of the Royal Society and of the Royal Geographical Society, and we quote from sections 1, 2, 10, 11, and 19 of their instructions to the commander of the expedition.

1.—The Royal Society and the Royal Geographical Society, with the assistance of His Majesty's Government, have fitted out an expedition for scientific discovery and exploration in the antarctic regions, and have entrusted you with the command.

2.—The objects of the expedition are: (*a*) To determine, as far as possible, the nature, condition, and extent of that portion of the south polar lands which is included in the scope of your expedition, and (*b*) to make a magnetic survey in the southern regions to the south of the fortieth parallel, and to carry on meteorological, oceanographic, geological, biological, and physical investigations and researches. Neither of these objects is to be sacrificed to the other.

10.—You will see that the meteorological observations are regularly taken every two hours, and, also, in accordance with a suggestion from the Berlin committee, every day at Greenwich noon. It is very desirable that there should, if possible, be a series of meteorolcgical observations to the south of the seventy-fourth parallel.

11.—As regards magnetic work and meteorological observations generally, you will follow the program arranged between the German and British committees, with the terms of which you are acquainted.

19.—If, on the other hand, you should decide not to winter, you will bear in mind that it is most important to maintain scientific observations on land throughout the winter, and therefore, if you are able, in consultation with the director, to find a suitable place for a landing party between Cape Johnson and Cape Crozier, and decide that such a party can be landed and left without undue risk, the following instructions will apply:

(*a*) You will land a party under the command of such person as you may appoint. Such party shall include the director, the physicist, and one of the surgeons, and such other persons as you may consider desirable, but no person is to be left without his consent in writing, which you will be careful to obtain and preserve.

(*b*) You will give every practicable assistance in establishing on land this party, which you will supply with all available requisites, in-

[1] See MONTHLY WEATHER REVIEW for April, 1901, p. 177.