vessels is especially desired. Blank forms for meteorological observations, with instructions for taking the same, will be furnished upon application either by mail or in person to the Hydrograper, United States Hydrographic Office, Navy Department, Washington, D. C., or to any one of the branch offices.

The charts will be furnished free of charge to cooperating observers, irrespective of nationality.

The charts contemplated in the above notice will be gladly welcomed by meteorologists, who necessarily study the whole globe rather than any one small section. Of course they will at first be made up largely from the normal data already accessible, but after a few years the accumulated publications of current data will constitute a very important and convenient addition to our limited knowledge of the Southern Hemisphere. It is to be hoped that the whole Southern Hemisphere is to be included in the two charts entitled South Atlantic and South Pacific oceans. It certainly would be a great pity to omit the South Indian Ocean.

A DAILY WEATHER MAP FOR THE NORTHERN AND SOUTHERN HEMISPHERES.

In a recent letter from Sir John Eliot, Meteorological Reporter to the government of India and Director-General of Indian Observatories, he says:

Meteorology is a question of thermodynamics and aerodynamics. There are probably some general relations between sun spots and terrestrial magnetism and some of the broader and most general features of terrestrial meteorology. They can, however, only be of use as indications of large local variations of weather (such as are experienced in India) after we have investigated the problems from the hydrodynamical side, or as questions of variations of air movement depending upon variations of absorption of solar radiant energy, etc.

When I was in England recently, Sir Norman Lockyer, Mr. W. N. Shaw (the head of the Meteorological Office), and myself discussed the possibility of a daily weather report and chart of the British Empire. It is quite in the air at present, but I have already consulted the government of India and the present authorities fully sympathize and would be prepared to do their share. Perhaps if the United States and England joined hands in this, it might eventually lead to the world map which you suggest.

THE METEOROLOGICAL OBSERVATORY AT SAN FERNANDO, SPAIN.

A letter of October 15, 1903, announces that by royal decree of August 20, Captain Fuenoy de Azearote has been appointed director of the Marine Institute and Observatory at San Fernando, in the Province of Cadiz, Spain. This institution was established in 1753 by King Iorge Juan. It was then located at Cadiz, but was transferred to San Fernando at the beginning of the 19th century. It is at present conducted under the regulations laid down in 1873. It publishes a nautical almanac for the use of Spanish navigators, and a volume of astronomical, magnetic, and meteorological observations, and also examines the nautical instruments used by the Spanish Navy for the purpose of detecting errors.

EDUCATION OF METEOROLOGISTS.

The gradual development of meteorology has for two hundred years been due to the activity and faithfulness of innumerable observers throughout the world and it has not been supposed that the labor of reading instruments and making weather records required anything but ordinary intelligence, good habits, and perseverance on the part of the observers. Those who have tried to penetrate the laws of atmospheric phenomena generally found the problems too difficult and very few profound theories have, as yet, been accepted as satisfactory to the best students. At the present time, however, the so-called practical man is being very hard pushed in order to keep abreast with the progress that is being made by a new race of investigators who are applying to the atmosphere the best that is now known relative to all the laws of physics and mechanics. It will no longer do to say that the practical man is ahead of the theoretical or that the college graduate is inferior to one who is not a collegian. Whatever advance may be made in the practical business operations of the thirty or forty national weather bureaus now in existence; however much they may extend the telegraphic work, and the areas covered by the daily weather maps, or the accuracy and minuteness of the daily weather forecasts, yet, there will always be use for those who are delving deeper and searching further. There is a divine instinct that leads men to strive upward and forward in the realm of knowledge. We are confident that everything is governed by law and that these laws are not beyond our knowledge. Little by little we shall dissipate the ignorance around us; we shall unveil the arcana of the universe; we shall find the work of the observer confirming our theories; we shall honor those leaders of science whose fancies have not led them astray in their efforts to discover the laws of nature.

An article by Prof. Edwin G. Dexter, published not long since in the "Popular Science Monthly," shows very clearly that the high grade college graduates also attain a high grade in subsequent practical life in the world at large. He concludes by saying:

The statistical evidences that the high grade man maintains his status in after life, which are here presented, though open to all the criticisms of the statistical method are nevertheless in accord with our general belief of what should be. If the college course is a true preparation for life, it is but natural to expect that he who best fulfils the requirements of the former is best fitted for the latter. Were this not so we should pronounce the preparation a failure.

May we not add that if education is good for the business man it may also be good for the meteorological observer. Shall we not make better observers in proportion as we study meteorology more thoroughly and learn to appreciate all the fine points that have been brought out by centuries of records and studies? Shall we not make better climatologists by having regard to the rules that govern the legitimate methods of studying statistics, rules that are as rigid as the laws of chance or the play of roulette or cards at the gaming table? Shall we not make better meteorologists by familiarizing ourselves with the laws of physics that pervade the whole atmosphere. The winds and clouds, heat and cold, rain, storm, and drought can not vary, except in obedience to the laws of nature.

COOPERATION IN GOVERNMENT WORK IN SCIENCE.

In its issue of April 16, 1903, Nature, London, prints in full the resolutions recently promulgated by the government of India, with the purpose of so directing the energies of the various departments as to promote an effective cooperation and prevent useless duplication in scientific work.

Steps in this direction were taken six years ago, when the policy of the government in establishing departments of scientific research was clearly set forth and the desirability of coordinating the labors of the different departments was pointed out. The broadening and development of scientific work in pursuance of the policy then outlined has but served to emphasize the necessity of the cooperation suggested at that time.

The work of many members of the scientific staff covers fields in which experiments of a similar or cognate character are being independently conducted. Thus in chemistry we have several investigators following parallel lines of research; in economic botany there are two departments working independently of each other; in economic entomology there have been two specialists, each charged with investigations similar to character.

It is therefore proposed to appoint a board of scientific advisors, which will review and advise generally upon the work of the departments, and will endeavor, not only to effect such consolidation as may be expedient, but also to direct the sci-

entific work of the government along practical lines. The board will consist of the heads of ten scientific departments, "together with such other scientific authorities as may from time to time be invited by the government of India to serve upon it." The Secretary of Revenue and Agriculture, who is the official head of the departments represented, will be ex-officio president of the board. It is the function of this body to—

Annually receive and discuss the proposals of each departmental head in regard to the programme for investigation in his department. In cases where interdepartmental cooperation is necessary, it will rest with the board to advise as to the lines on which mutual assistance should be given and the department to which the inquiry should primarily appertain. Where the proposed investigation falls exclusively within the domain of a particular department, the function of the board will be confined to examining and criticising the proposals. It is not intended that the directing influence of the board should, in any way, weaken departmental executive control or responsibility, and the precise manner in which, and the agency by which, any required information is to be collected or investigation carried out must be left to the heads of the deparments concerned. The board will submit annually to the government a general programme of research which will embody the proposals of departmental heads in so far as its subjects are to be exclusively dealt with in one department, and its own proposals in cases where two or more departments are to cooperate.

This experiment should be observed with great interest in this country, where a duplication of work exists, not only between different departments, but, in some cases, between different bureaus of the same department. Cooperation or consolidation has at times been suggested. Perhaps the chief obstacle lies in the fact that works apparently identical may be prosecuted for such different purposes as to necessitate an essential difference in the details of their execution. Thus the departments of Agriculture, War, and Interior are all three engaged in measuring the heights of rivers, but for different purposes, and no one of the three could depend entirely for this work upon either of the others. Or again, the bureaus of statistics, soils, weather, crops, irrigation are all interested in rainfall, but the Weather Bureau alone is expected to gather and publish the precipitation data. However, as each bureau needs a record of observations prepared in the special manner best fitted for use in its own studies, it would seem wise to have a board representing these five bureaus devise some system of work that will harmonize the various requirements and save any unnecessary labor. Some years ago similar committees, representing several departments and bureaus, did good work in reference to seismology and magnetism, respectively. Why may not suitable departmental committees be more frequently appointed as occasion arises? The board of scientific advisers for India appointed by the governor and council includes 10 persons, representing every branch of government work in applied science.

AQUEOUS VAPOR LINES OF THE SOLAR SPECTRUM.

A general method of determining the total quantity of moisture in the whole atmosphere or any large portion of it has long been a desideratum in meteorology. It is probable that the colors of the sky are due to the action of the mixture of gases and vapors; a comparatively few molecules make a a particle that affects the transmitted waves, both as to their intensity, their wave length, and their planes of vibration. Larger groups of particles of moisture, such as form mist and fog, give rise to the colored rings known as glories and anthelia; larger groups form fog bows and halos and the still larger raindrops form rainbows. Our ordinary pyschrometric observations tell us of the tension and amount of atmospheric vapor, properly so called, but nothing of the condensed moisture; they tell us of the vapor that is near us, but nothing of that which is far away, and especially nothing of what is in the upper strata. Observations of sky color and of the polarization of the blue skylight tell us of the presence of the smallest particles, but not much as to their absolute size or quantity. Quantitative measurements of the general intensity of the light or heat received from any source may be made to tell us the sum total of the effects of absorption by gases and vapors and of reflection or dispersion by small particles of water or dust; but they do not separate the effect of absorption from that of reflection. Finally, quantitative measurements of the intensity of special wave lengths, when observed visually, may give us the effect of the absorption proper. Twenty years ago the observation of the dark band was thought sufficient, but we may also confine ourselves to the observation of specific moisture lines in the spectrum, and they may be observed either visually, bolometrically, or photographically. The visual method was quite thoroughly carried out by Mr. L. E. Jewell, of Johns Hopkins University, in 1892 and 1893, and the results were published in Weather Bureau Bulletin No. 16. The bolometric method has been developed by Professor Langley and has given excellent results; an equivalent thermoelectric method has been developed by Angström. The photographic method of recording the location and intensity of the atmospheric lines in the solar spectrum has recently been developed by Prof. E. C. Pickering, Director of the Harvard College Observatory. This depends upon the measurement of the widths (as being synonymous with the intensity) of the photographs of the dark lines in the spectrum, and is described in Circular No. 72 of that observatory; the results of the first year's work, are given in volume 48 (1903) of the Annals of the Observatory. To begin with, photographs of the spectra of the sun are taken when the latter is at various altitudes. Each line in the spectrum has its width measured; some of these are found to grow broader and darker in proportion as the sun stands nearer the horizon. These are the atmospheric lines, due to absorption in the earth's atmosphere. Others do not appreciably vary, and these are due to absorption in the sun's atmosphere. Some vary with the amount of moisture in the air and are due to absorption by it. By comparing the intensities or widths of an atmospheric line, as photographed when the sun is high and when it is low, with the corresponding computed thicknesses of the layer of air, it appears that there is an outstanding variation, due to the moisture in the air, namely, according as it is dry or moist. Professor Pickering collates the observations of the atmospheric moisture lines, namely, wave lengths 6267.8, 6273.7, 6276.6, 6282.1, 6293.2, 6305.5, all of which are near the alpha line. These were photographed on 16 different plates by Higgs at altitudes varying from 1° to 49°, for which the path of the beam of light varied between 18 and 0.3. The intensity of the six dark lines, and especially of the average of all, increased steadily with the decrease in the sun's altitude, except only for two cases where the atmosphere was unusually dry. The computation for low altitudes give very constant results from different photographs taken on different days, and Professor Pickering concludes:

It, therefore, appears that the total moisture in the atmosphere along the line of sight can be determined more accurately by this method than by any other as yet proposed.

This conclusion is fully confirmed by the laborious work of Mr. Jewell above referred to. Possibly the bolographic method may yet surpass both the visual and the photographic.

SEICHES IN LAKE GARDA.

Dr. J. Valentin has published in the Anzeiger or early notes of the memoirs presented to the Academy of Sciences in Vienna, a preliminary report on the periodic variations, commonly known as seiches, in the level of Lake Garda, as observed at Riva. The length of Lake Garda, from Riva at the north to Desenzano at the south, is about 52 kilometers; the maximum depth of the lake is 346 meters; the mean depth is 136.1 meters, and the altitude above sea level is 65 meters. From