has been no recent immigration, may also be suspected of being potential goiter areas.

Adaptation to environmental conditions through natural selection is sufficiently well established. There is no great difficulty in assuming, tentatively, that a stock, glandularly maladapted to a given environmental condition, may become so in from fifteen to thirty generations. The selection may operate through decrease in fertility, or through greater mortality of adolescents; neither of which would be as operative in civilized as in uncivilized modes of life.

It is not credible that the only disturbance in individuals affected by endemic goiter is thyroid. On general grounds, it is rather to be assumed that the balance, or pattern, of the system of endocrine glands is disturbed. Growth is manifestly controlled by the endocrines; and the checking of growth is similarly controlled. That the head-form is a growth-characteristic has already been indicated by Wissler. It is possible, then, that brachycephaly is a result of glandular adaptation to an environment of a certain sort. This environment may be one which is characterized by iodine deficiency: the actual nature of the condition, however, is not important for the present point.

This assumption seems to clear up some of the problems of head-form. It complicates others. Where an ancient brachycephalic population is overlaid by a later dolichocephalic one, there may be an actual continuity of the stock. On the other hand, continuation of a brachycephalic type over a long period in certain areas would indicate a series of immigrations. The possibility that the assumption is true seems to me of far-reaching importance. The different Negro types in Africa and the different American Indian types would receive an interpretation differing from the conventional one.

In the case of immigrants into a goiter area, it would be suspected that long-heads would, on the average, be more susceptible than round-heads. There would not be a sharp separation on this point, however. I do not know of any report on goiter cases which would throw light on this point. Length of ancestral residence in a goiterous or potentially goiterous area would be the point of maximal importance.

When stocks adapted to goiter regions migrate into non-goiterous areas, they might or might not be maladapted to the new condition; but in either case the iodine factor (or whatever distinguishes a non-goiter area) might cause a change in the glandular pattern, and a lengthening of the head, among other changes in growth characteristics. Apparently, this change would proceed more slowly than the converse change, although Boas' investigations indicate that it may not be very slow.

There are other directions of investigation open, if our assumption is taken seriously. For example, psychologists are well aware that the feeble-minded class includes many different types, and that those of the same Intelligence Quotient or same Mental Age vary greatly in their actual intelligences as well as in other characteristics. Glandular bases for some of these types have been suggested. It would seem useful to have more complete anthropometric studies of the feeble-minded, with particular reference to cranial indices, which, however valueless ethnically, may turn out to be useful in the differentiation of these types.

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REPORTS

THE WORK OF THE WEATHER BUREAU. II

THE two most important recommendations of this committee are: (1) That provision be made at once for extending the so-called air-mass analysis method over the United States, through the cooperation of the Weather Bureau, the Army and the Navy, as outlined below. (2) That the whole system of recording and reporting meteorological data in aid of forecasting be consolidated under the Weather Bureau (except for the activities necessary to the Army and the Navy).

(1) During the last decade there has been very rapid progress in Europe in the development and general use of air-mass analysis methods. These require a knowledge of temperatures, humidities and pressures aloft as well as on the surface, but thus far no systematic attempt has been made to obtain at a given time upper-air measurements of these aerological conditions at a considerable number of stations scattered systematically throughout the country so as to make possible the drawing of a daily upper air map of the whole country similar to the surface maps now provided by the Weather Bureau. Hence, as a first step toward the general adoption of air-mass methods of weather analysis in the United States a network of aerological stations must be established at advantageous points throughout the country. The present pilot balloon network seems adequate. The number of these aerological stations for observing the temperature, humidity and pressure aloft should be increased to twenty or twenty-five. This might readily be accomplished through the cooperation of the Army and the Navy with existing Weather Bureau aerological stations, without greatly increasing present expenditures. This is possible because of the fact that the Army and the Navy are equipped with

planes, pilots and fuel and may make daily flights of the desired nature without exceeding their training budget.

The map, provided in Appendix A, indicates existing facilities which include those of the Weather Bureau, the Army, Navy and the Massachusetts Institute of Technology. This will serve as a foundation upon which to build an efficient aerological network. The Army and Navy stations are more or less fixed, but those of the Weather Bureau may be shifted to fill in the gaps. For this work to be effective the Army and Navy should conduct soundings with the Weather Bureau instruments in accordance with Weather Bureau instructions and as a definite routine.

One ascent daily from the aerological stations would be sufficient, the data obtained to be filed for transmission with weather map signals at a specified time. Early morning flights are preferable in order to avoid radiation effects as much as possible; however, on the Pacific Coast this might prove impracticable during the foggy months.

At present only two master synoptic charts are drawn daily by the Weather Bureau, one at 8:00 A. M., E.S.T., and the other at 8:00 P. M., E.S.T. It would be extremely valuable to increase this number to four if possible, or to at least three. The latter could be accomplished without much additional expense, particularly if teletype communications are established. These additional maps might be drawn at 2:00 P. M., E.S.T. and 2:00 A. M., E.S.T. A 2:00 P. M. map would prove especially valuable and would probably be most convenient for the utilization of upper-air data. It is practically certain that the fourth map (2:00 A. M.) would eventually be found essential for satisfactory analyses. If not used immediately at 2:00 A. M. it could be used with the 8:00 A. M. map for the morning analysis of weather developments during the night. This practise is used in several of the best European meteorological institutes, where four to seven maps daily are found to be essential for detailed analyses. Consideration should be given to having the American maps synchronous with the European maps to provide a synoptic picture of the Northern Hemisphere in the general interest of future long-range forecasting.

For aviation forecasts, airways advices, etc., observations and reports are necessary every three hours or oftener over certain regions. This is a regional system, each region covering much less area than the general weather map area. Reports are collected and disseminated, each region for itself, allowing some overlap into contiguous regions.

If air-mass methods of analysis are to be undertaken more pertinent surface data must be made available and meteorological instruments at the various stations throughout the country should be given a more uniform exposure. Since urban exposures are rather unsatisfactory, due to radiation and turbulence effects, it is suggested that all instruments, the readings of which are to be used in the mapping, be placed at airports, since these are usually better situated for this purpose. At present the Weather Bureau has found it necessary to maintain a full staff at about fifty important airports in addition to the staff at the city offices. With removal of some of these instruments to airport sites this overlapping could be eliminated to some extent. Where present urban exposures are discontinued considerable change in existing climatological data might result. This condition could be remedied by retaining such urban exposures for a year or possibly longer in order to calculate a correction coefficient. Furthermore, the climatological value of urban exposures is doubtful, since the data are affected greatly by the growth of the cities.

The data now collected from Weather Bureau stations should be augmented to include the additional information required by the modern methods of analysis and forecasting. More frequent and more detailed ocean weather observations are highly desirable. The present telegraph code system will prove cumbersome for this purpose, and adoption of a modification of the International numerical code is recommended.

Aerological data should include: station, time of ascent, altitudes, temperature and humidity data at the ground and at each critical point. These data should be transmitted in a form which could be used without delay in the construction of a thermodynamical diagram which would present a picture of air-mass vertical structure. The evaluation of original data should be done at the aerological stations, thus eliminating similar elaborate calculations at all stations constructing synoptic charts. The metric system of units in the recording and transmission of all data is recommended in so far as it may be practicable.

(2) A modern weather service is impossible without a fast communication system by which frequent reports from a wide area may be collected, combined and redistributed for preparation of weather maps and forecasts by any system that is economical, rapid and efficient—by telegraph, telephone, teletype, radio or all these agencies combined. The teletype-writer now used by the Department of Commerce has proved extremely efficient both in speed and reliability and will need to be continued for the trunk-line services, but in so far as the meteorological service is concerned it should clearly be under the Weather Bureau. The combination of this service with the Weather Bureau's telegraph service would certainly eliminate much

present duplication and consequently reduce costs. The communications problem is intricate and an economical solution can be worked out, making use of all facilities, only under the direction of a single head.

In addition to the two major recommendations made above—recommendations which involve much cooperation between Government departments and very considerable reorganizations but little, if any, additional expenditures—the committee further recommends that the number of daily weather maps and general forecasts be immediately increased from the present number of two to at least three and very preferably to four. The Weather Bureau has already taken action looking to the allotment of $350,000 from the Public Works Fund to cover the expense of this proposed expanded service. This need has long been felt and urged.

The committee further recommends a certain decentralization of the general forecast work of the Weather Bureau by the establishment of more numerous district forecast centers in place of the five now existing, with the ultimate assignment of a trained meteorologist to each of the principal airports to collect weather observations hourly from the airway stations, to maintain a detailed corrected district weather map, and to offer to aviation and local industry a short-range weather forecast service for his district.

The committee further recommends that, although the air-mass analysis method unquestionably makes short range forecasts much more reliable, there should be an extension of climatological work which looks toward long-range forecasting. Contributing to this end is a calculation of climatological data by the various stations through the country that takes into account the frequency of occurrence of the various air-masses at all stations, inasmuch as they form a major component of the climate. Up to the present time statistical methods have formed the basis for such forecasts, and although high correlation coefficients have been obtained in some cases for short periods of time, they have proved unsatisfactory for forecasting purposes. New developments in air-mass theory and practise should be followed closely with a view to arriving at a better understanding of this very important problem.

An effort should be made to obtain the cooperation of other countries in the northern hemisphere, particularly Canada, Mexico and Russia (Siberia) in securing appropriate meteorological data which will disclose the movements of major air-mass over all these areas, in the interest of increasing the time range of weather forecasting.

The committee further recommends that the transition from our traditional system of weather forecasting to a new one using methods of frontal and air-mass analysis be made with caution in order that the present valuable service may not be jeopardized. Personnel with the requisite training are not at once available and must be trained gradually and the change made step by step. For example, it is suggested that one of the five present forecast centers be started on frontal analysis methods, under direction of the most competent man, trained in air-mass analysis, who may be available, and that forecasters be tested and apprenticed there before practising elsewhere. About five years might be devoted to the extension of the new method generally to perhaps seven additional stations, resulting in the eventual development of twelve separate forecast centers.

The committee further recommends that a system of "postgraduate" training for Weather Bureau meteorologists be inaugurated. It is certainly true that the personnel of the bureau who are to be given the responsibility of forecasting for all lines of industrial and commercial activity should receive thorough instruction in the more modern methods, and some plan should be devised whereby those men who already have a good basic training in meteorology, physics and mathematics and have shown some proficiency in the actual work of forecasting are detailed for a period of six months or a year to an institution of recognized leadership in this field, for such instruction. The expense of this instruction would not be large. Also, a system of "exchange" with meteorologists of outstanding foreign meteorological institutes should be worked out, and an effort made to maintain a strong technical staff at Washington and at a few of the leading field stations, in order to keep fully abreast of important developments in the field of meteorology and to conduct original investigations designed to increase the effectiveness of the service to all lines of industrial and commercial activity.

The committee further recommends that closer contact be maintained between directing officials at the Central Office in Washington, D. C., and the personnel at the various field stations throughout the country than at present obtains. The benefits from such contacts, in maintaining a high standard of morale and in developing a common understanding of the diverse needs to be served and of the problems to be attacked in serving those needs, will repay many-fold the comparatively small cost involved in travel.

The committee further recommends that a permanent Weather Bureau Committee, composed of four or five of the outstanding scientists of the country, be set up, the functions of which shall be to keep continually in touch with the work of the Weather Bureau, to be called into conference at least once a year, and oftener if need be, to advise on matters of weather service and policy, and to assist in presenting

the claims of the weather service both to the Government and to the public. Immediate questions which should engage the attention of this advisory committee would be: (1) The proper location and distribution of aerological stations; (2) the training of personnel; (3) the testing, selection and development of the most suitable aerological instruments; (4) research projects, particularly those looking toward the development of long-range forecasting methods.

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WASHINGTON, D. C.
NOVEMBER 13, 1933

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE PNEUMATIC PULSATOR

THE apparatus here described can be used with any type of laboratory apparatus in which it is desired to (1) move a fluid into and out of a vessel, or (2) to intermittently move a liquid in a given direction. Both types of fluid movement are used in the gas analysis apparatus at Davis[1] (the pneumatic pulsator has replaced the water-wheel pulsator formerly used).

Essentially, the pulsator has but one moving part. This is the valve mechanism, which is, in effect, two three-way stop-cocks so arranged as to operate simultaneously. This part of the apparatus is made of a steel-jacketed bronze bushing and snugly fitting shaft. The bushing is drilled with six holes, four of which are tapped and fitted with metal tubes. The shaft is drilled to correspond with the bushing, the holes having the same relative positions as those of the plugs of three-way stop-cocks. The bushing is stationary, while the shaft is movable, like the plug of a stop-cock. The construction of the valve mechanism is shown in the sketch.

To a metal arm fastened to the shaft are suspended two leveling bulbs, connected together by rubber tubing and partly filled with mercury. The arm A is prevented from rotating too far in either direction by rubber-cushioned metal bumpers (not shown in sketch), which are located just above the ends of the arm.

A metal weight is mounted at center of arm so that it shifts the center of gravity with each partial revolution of the arm, thus assisting in bringing the valve into correct position at the end of each partial revolution.

Suction is furnished by an ordinary filter pump attached to a water faucet. Both the pulsator and the filter pump are connected to a five-gallon bottle which is in turn connected by glass tubing to a second bottle twelve feet below, in such a way that an excess of suction pulls water up into the first bottle, whereas insufficient suction is compensated for by the pull of the water column which tends to run down into the lower bottle. The battery of bottles compensates for continuous small variations which occur in water pressure, and at the same time makes possible a smaller stream of water through the suction pump than would otherwise be required.

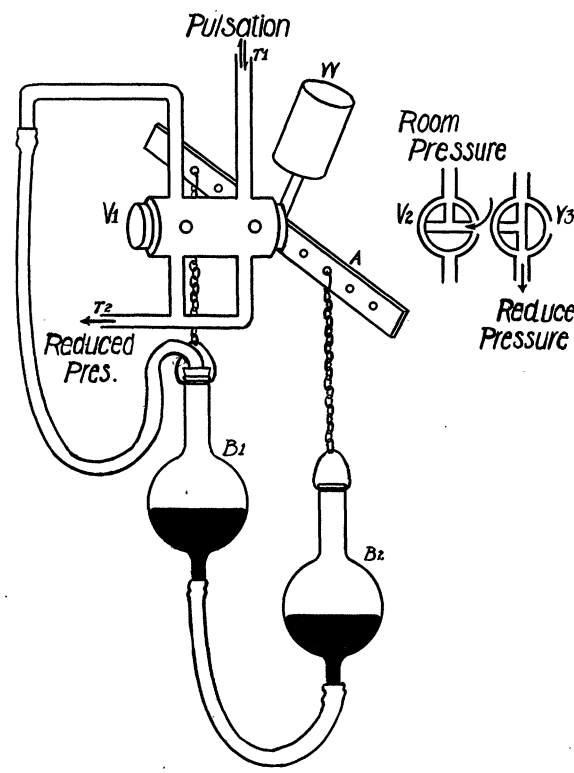

FIG. 1

EXPLANATION OF SKETCH

V_1 Projection of valve. Reduced pressure is drawing mercury into B_1 as shown in section of valve V_3

V_2 Cross-section of valve. B_2 is in its upper position. B_1 is open to room air and mercury is allowed to flow back into B_2

V_3 Cross-section of valve. B_2 is in its lower position and B_1 subjected to reduced pressure drawing mercury up into B_1

T_1 Tube carrying pulsations. Connection to be made here to tube leading to apparatus.

T_2 Reduced pressure connection.

W Weight mounted on moving arm to assist in bringing holes in shaft opposite holes in bearing.

A Arm fastened to shaft-supports leveling bulbs.

B_1 and B_2 Leveling bulbs.

[1] M. Kleiber, "Contribution to the Method of Gas Analysis for Respiration Trials," *Jour. Biol. Chem.*, 101: 3, p. 583, August, 1933.