He points to the immense variability in the human stock:

> How hard it is to believe the polymorphism of man . . . How few of these could have changed parts with each other. . . . In no wild species, not even among the ants do we find any polymorphism approaching to this. I never cease to marvel that the more divergent castes of civilized humanity are capable of inter-breeding and producing fertile offspring from their crosses. Nothing but this paradoxical fact prevents us from regarding many classes even of Englishmen as distinct species in the full sense of the term. . . . The problem that confronts the political philosopher is to find a system by which these differentiated elements may continue together to form a coordinated community while each element remains substantially contented with its lot.

Bateson's conviction that many of the observed physical traits that distinguish individuals trace back to genetic differences will be applauded by students of human heredity, and his contention that a mixed population may better serve the purposes of modern civilization than a homogeneous one, may not be contested, but there may still be grave doubt as to whether these observable differences play as important a rôle in the advance or retardation of a social group as do the traditional and economic influences that determine the behavior of the group as a whole. It is noticeable that the rigorous standard that he demands in others dealing with Darwin's theory of natural selection scarcely warrants some of the bold prophecies he makes concerning the future of the human race under present conditions. "The essential difference between the ideal of democracy and those which biological observation teaches us to be sound, is this: democracy regards class distinction as evil; we perceive it to be essential." Aside from the view as to what democracy is or is not, it must be questioned, I think, whether "biological observation" has anything authoritative to say on the matter, since the fabric out of which political systems are made and transmitted from one generation to another involves mental processes about which at present biological observation has little if anything that is worth while to contribute.

In 1910 Bateson accepted the directorship of the John Innes Horticultural Institution, which became a center of research in genetics. Here in collaboration with associates and students he turned out year after year a series of important papers dealing with several difficult problems in heredity. The more significant of these contributions deal with (1) the inheritance of "rogues" in peas whose peculiarities Bateson was inclined to believe could throw light on the problem of the time of segregation of characters; (2) the variation shown by root cuttings, probably a periclinal phenomenon; (3) the inheritance of double flowers and sex characters in begonias; (4) studies on variegation; and (5) on the genetics of Primula, etc. Bateson was attracted by these problems partly because they were puzzles, partly no doubt because they did not seem to conform to the then current methods of genetic analysis and might therefore open up new fields of adventure.

Bateson brought to his work an exceptionally wide and first-hand familiarity with plants and animals. He had also an extensive knowledge of the literature of his subject at command and an ability to express himself fearlessly in classical and clear English. His personal interests extended far beyond the immediate fields of his researches. His deep interest in painting and other forms of art must have surprised his scientific friends when they discovered it for the first time, and his artist friends would no doubt have been equally surprised to have discovered his far-reaching influence on the biological science of his time.

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THE RELATION OF MAPPING TO MODERN CIVILIZATION[1]

WHEN the pioneers, with their covered wagons, started west from Kansas City and other points in Missouri, they felt little need for maps except those of the crudest type. They had imagination or they would not have started forth; but like every other age, they did not see much beyond the present and could not visualize what was coming. Railroads, hydroelectric developments, growth of modern towns and cities were beyond their imagination. Accordingly, when the time came for establishing boundaries and making maps, they, like men of every other age, met the present needs and were little concerned about the future. The division of land was their first concern. As the land had little value, moderately correct surveys were considered quite sufficient. In many places the points were marked temporarily, rather than for permanent use, and were lost in a few years. One of the results has been a great deal of litigation, and in the case of lands which later became of great value, such as oil fields, the cost of litigation has undoubtedly been greater than good maps would have cost if made in the first place.

In the early work the magnetic compass was much used, and this fact has been blamed for a great deal of inaccuracy. Recent investigation has shown that in most cases it was quite as much the use of careless methods that was responsible for the defects of the survey. The magnetic compass is an easy instru-

[1] Presented before Section M, American Association for the Advancement of Science, Kansas City, December 30, 1925.

ment to use, but to secure good results it must receive quite as much care as the engineer's transit. The changes in the earth's magnetism were not understood, and many errors resulted from this. In some cases an early survey was extended and the same declination was adopted, disregarding the change during the intervening period. In the early survey chains were used for measuring distance and these quite frequently were in error or changed their length considerably with use. It must be recognized, however, that in many cases the value of the land did not warrant the cost of accurate surveys, and in some parts of the country this condition still holds. However, as we can not tell what is coming in the future, there is scarcely any part of the country where we can be absolutely sure that accurate surveys will not be of future value. In one region of active development in Texas, the original survey, according to reports of local surveyors, was made on horseback, at times under Indian attack, and the unit of measurement was the horse's pace, estimated at a vara or Spanish yard.

The day of the pioneer has passed, not only in our country, but practically throughout the earth. Land values have grown greatly, and many engineering projects relating to steam and electric transportation, road building, power development and transmission, reclamation of lands, etc., require, not the approximate idea of the early explorer, but the most accurate surveys that can be made. The state of Massachusetts early decided on accurate determination of all boundaries, and of points to which surveys could be referred. Various cities, among them New York, Cincinnati, Rochester, Richmond and others have felt the need of precise determinations and have executed geodetic triangulation.

No accurate mapping of any extended area is possible without taking into account the curvature of the earth. The early mapping of this country was defective, not only because there were no accurate surveys, but also because there was a lack of methods of taking into account the shape of the earth. The problem has not been entirely solved, but some of the modern projections meet all practical requirements. In the public land surveys the method of using a rectangular system with offsets at suitable intervals to provide for the convergence of meridians was adopted. This is a simple method, and yet one which leads to serious difficulties if not carefully executed. The chief difficulty is an instrumental one —that of running a continuous straight line without changes of direction creeping in. It has been found that the only sure way to run a straight line is to execute triangulation and thereby determine the exact relation of a number of points to the straight line desired. It is for this reason that accurate mapping of large areas is possible only if there has been a triangulation with astronomical determination of certain points. It is interesting to know that the topographic maps of the Geological Survey are based on accurate triangulation and leveling, in every case the framework being the result of triangulation and precise leveling of the Coast and Geodetic Survey.

The recent passage of the Temple Act by Congress, which contemplates the completion of the topographic mapping of the United States within twenty years, strongly emphasized the importance of the framework of triangulation. An illustration of the difficulties resulting when the triangulation is accurate but not connected throughout is given by an experience of the Coast and Geodetic Survey. In Alaska a great deal of triangulation has been executed in different regions. As the work extended these schemes were connected, but in every case discrepancies were found sufficiently large to interfere with the accuracy of the maps and charts. In order to meet this situation an arrangement was made with the Canadian government whereby the precise triangulation has been extended within the last few years from Tacoma, Washington, to Skagway, Alaska, each government carrying on the work in its respective area. From Skagway it is proposed to carry it into the Yukon territory, and thence into the interior of Alaska, to connect with the triangulation which has already been executed in that region. When this scheme is complete, all the detached triangulation will be connected and will be referred, like all other triangulations in the United States, Canada and Mexico, which have already been connected, to the same standard known as the North American Datum. One of the essential features of the North American Datum is that all points in the whole triangulation, whether in Canada, the United States or Mexico, can be directly connected to a selected point, which is the triangulation station at Meade's Ranch in Kansas, about 275 miles west of Kansas City.

One of the provisions of the Temple Act is to extend the present triangulation scheme so that there will be triangulation points every fifty miles throughout the United States. With such control it will be possible to have the desired accuracy in the topographic maps.

Not only are horizontal positions necessary for good mapping, but it is necessary to know the elevation of points. The precise level nets of the United States will also be extended so that there will be points whose elevation is accurately determined within easy reach of all parts of the United States.

With this system of horizontal and vertical control extended to the area to be mapped, the Geological Survey is able to prepare the topographic maps which have already won a most important place, even

though only 35 per cent. of the country is at present covered by adequate maps. The Board of Surveys and Maps has prepared a statement in regard to the need for and use of topographic maps, and I am indebted to this report for the following résumé of the advantages to be derived from complete mapping of the country.

The use of the maps in connection with the development of various utilities has been important. They proved invaluable in the development of the New York water supply. Many business enterprises which deal with natural resources find them of great use. Enormous development of highway construction has found the maps of value where they exist, and in other places has required the making of detached surveys which are of no especial value in mapping and which would have been unnecessary had the maps been available. Even though railroads are not now making the great extensions that formerly were common, they are giving great attention, especially in the western mountain country, to changes in route which will reduce grades and curves, and where topographic maps are available the project can be studied in a much more satisfactory way than if a series of detached surveys has to be made.

Water resources is a subject of increasing importance, and with many ramifications. The demands for power, for irrigation and for city water supply are steadily increasing. Accurate maps are of very great value in estimating the amount of available water and they are also useful in laying out the necessary canals or other water channels. This of course applies not only to irrigation systems but also to drainage systems, which in many regions are quite as important as irrigation systems are in others.

The soil maps, which meet an important need of the farmer, and geological maps can not be made until the topographic maps are available. It was this fact that led the Geological Survey to take up topographic mapping. Some oil field investigations can not be made in turn until the geological maps are available. Timber and grazing resources can best be treated as a whole by laying out the areas on maps, and in many places adequate maps are not available. The use of maps by travelers, especially those by automobile, is to be encouraged. While route maps may be sufficient to get through the country, those which tell something of the country passed through have educational value. The maps also are of great value for use in teaching geography. In many cases a lesson based on a local topographic map will make a strong impression on a child and will arouse interest in the study of geography which would otherwise remain unstimulated. Also the development of a habit of using maps will make sure that there will be a full return to the country of the cost of preparing them.

The use of accurate topographic maps in connection with the national defense is so obvious that it is not necessary to go into detail. The report names thirteen bureaus of the government concerned with many of the activities mentioned above, which will benefit directly by these maps; and this is only another way of saying that the whole people benefit. A government bureau must serve the people in order to justify its existence.

I have attempted to bring out the vital relation between the completion of the mapping program and the further development of many activities which have been outlined which underlie and form an essential part of what we know as civilization.

There is another form of map which is scarcely in existence as yet, but it is going to be more and more important as time goes on. This is the earthquake map.

During the past year the earthquake problem, which is always with us, has taken on a new significance. It has been brought home that earthquakes can occur anywhere in the United States, since they were felt in twenty-two states during the first nine months of 1925, not including some in which the St. Lawrence earthquake of February was felt. There were earthquakes in three different regions in Canada, in several parts of Alaska and in parts of Mexico adjacent to the United States during the same period. The St. Lawrence earthquake was felt strongly in New England and New York, and the Montana and Santa Barbara earthquakes were severe enough to call attention to the fact that cities in earthquake regions which are not built to stand earthquakes are in a dangerous condition. The fate of the cities of Tokyo and Yokohama is too recent to be forgotten.

Some of the utilities which, as I have stated, are facilitated by topographic maps, are jeopardized by earthquakes. These dangers are now being recognized and much effort is being put into the designing of buildings and all types of structures to resist earthquakes. It is true that these should be well built everywhere, whether there is earthquake danger or not, but at the present time this is scarcely practicable; nor is it possible to tear down old, weak buildings except in the case of real danger. It is important, then, to know where special precautions should be taken.

If accurate earthquake prediction, both as to time and place, were now possible, we should know exactly what to do. But it must be admitted that in spite of many predictions we know very little as to just where and when earthquakes are likely to occur. We should, then, for the present, be content with de-

termining accurately the areas where earthquakes have occurred and mapping them so as to indicate the intensity. Such maps would bring out clearly the evidence available from the past as to the need for special precautions, and by keeping them revised new regions of activity would be adequately mapped. There is also a demand for regional information from the insurance companies. At present, in view of the lack of knowledge as to earthquake probability, they have little on which to base their rates. Too high rates or too low rates are disadvantageous, both to the companies and to the public; as in the former case insurance will disappear with a decrease of earthquake activity, and too low rates will be disastrous to the companies should a great earthquake occur. The kind of maps indicated would be of great value in averaging the probability, based on past occurrences over a region. While these maps would not be an entirely satisfactory guide, they would give the only information we have at the present time.

It should not be forgotten that earthquakes may occur where none have been observed before in this country, as our knowledge covers a very short period, geologically speaking, and earthquakes are geological phenomena. Experience in Europe points to the recurrence of earthquakes in places where they have occurred before, and this must be our best guide for the future. There is a great deal of information available, but the task of putting it on maps has yet to be undertaken. The Coast and Geodetic Survey has been gathering material for such maps and hopes to begin their production before very long, and then revise them from time to time. The geologist will find it necessary to reconcile these maps with the geological formations, so that we are again brought back to the need for the topographic map. This illustrates how all these problems are tied together, and emphasizes the fact that mapping based on accurate control is becoming more and more necessary as time goes on.

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SCIENTIFIC EVENTS

DUTCH EXPLORATION IN CENTRAL BORNEO[1]

AN expedition has been at work in East Central Borneo during the past summer under the leadership of Captain D. W. Buys, with a view to exploring the only important area in the great island still remaining unknown. The undertaking has been promoted by the "Indisch Comité voor Wetenschappelijke Onderzoekingen," formed some years ago for the furtherance of scientific exploration in the Dutch East Indies, which has already much work to its credit in Ceram and elsewhere. The field chosen lies between the upper course of the Kajan river in the north and the headwaters of streams flowing southwards to the Mahakam, and falls mainly within the administrative subdivision Beraoe. The upland region which gives rise to numberless tributaries of the above great rivers, as well as to the smaller Kelai on the east, has hitherto been quite untouched by white men, lying considerably north and east of the routes of Nieuwenhuis, Molengraaf, and Lumholtz, though its eastern and southern fringes have recently been touched by a military patrol under Lieut. Soeratman and the American Gilbert, as well as by the Dutch geologist Witkamp, who is a member of the present expedition. It was hoped to carry out an accurate survey of as large a part of the area as possible, besides geological, botanical, zoological and ethnological researches. Under the last-named head a search was to be made for archeological remains from the Hindu period, and also for cave-dwellers of whom some rumors have been heard. After a full consideration of the best line of approach to the unknown area, that by the Telen river, the largest northern tributary of the Mahakam, was decided on, and the first report of progress describes the ascent of this river in canoes under considerable difficulties due to heavy rains and the obstacles caused by the many rapids and the rock-strewn bed of the river. Efficient service had however been rendered by the Dayak boatman under the energetic direction of the native chief Beng Wung. By the end of June the party had ascended the Telen almost to its source, and had thus reached the threshold of the unknown area, while various side trips had been carried out by the geologist Witkamp and the botanist Endert, the former of whom had ascended the Wahau, a northern tributary of the Telen, to its source. To the east was a flat or gently undulating massif of eruptive formation, with a series of Tertiary rocks resting against its western edge. West of the river no elevations of importance were seen. Emanations of marsh-gas were observed, but no sign of oil. Above the Wahau the Telen has a widening course through a level plain, with cut-off bends connected with the river only at high water. Here the surface is formed of recent alluvium and sand, but higher up the Tertiary strata come to light in the form of shales, grits and conglomerates, with beds of lignite interspersed.

[1] From the *Geographical Journal.*

THE AMERICAN MUSEUM EXPEDITION TO GREENLAND

CAPTAIN ROBERT A. BARTLETT, who commanded the steamship *Roosevelt* in which Admiral Peary