DISCUSSION

THE PROBLEM OF EARTHQUAKE PREDICTION

CORRELATIONS between the occurrence of deep and shallow focus earthquakes presented by the writer at the Easter meeting of the American Geophysical Union have been interpreted in the public press[1] as a hint to earthquake forecasts. It has, however, to be said that our present knowledge of the phenomena of earthquakes does not permit any prediction of location and time of occurrence of a major earthquake with scientific precision.

Such a statement is certainly unsatisfactory, and it seems to be very necessary to discuss this matter, considering all the facts. We know that earthquakes are in many regions of the world an ever-impending menace to life and property. We may estimate the average number of people annually killed by earthquakes to be about 40,000. Such a number compares almost with the number of men killed in wars if we consider that major wars occur only three or four times in one century. People make frantic efforts to avoid wars, arrange costly conferences and maintain large international bodies for that purpose. All other natural and environmental dangers for human beings are fought with all the intelligence and means we possess. A large army of physicians fights diseases, which in earlier times were taken as acts of God and insuperable to mankind. Many large research institutions sharpen the weapons of these physicians in their fight. In the case of earthquakes, on the contrary, we accept the situation as our ancestors did, as inevitable fate. It is certainly true that we can not prevent them, but it is also true that an effective earthquake forecast system could insure against the worst consequences of quakes, namely, losses of life. The number of scientists and institutions engaged in research to create such a system is exceedingly small. We have perhaps some 400 seismologists in the world and about the same number of earthquake observation stations. The majority of these experts, however, concentrate their efforts on questions which are far from the problem of earthquake occurrence. The research on earthquake wave-velocities and similar questions is their main target, firstly, because the economic results of such research in application to geophysical prospecting are uncontestable, and, secondly, as many believe that it is futile to make an attempt to attack the question of forecasting earthquakes. The fields of earthquake-geography-and-geology as well as the field of earthquake-statistics, which may pave the way to the prediction of these disasters, are obsolete and only a very small number of people, certainly not exceeding 50 in the whole world, are more or less active in these fields. What we need is first of all a more complete survey of earthquake occurrence. Our best observational statistics go back to prewar-times, when A. Sieberg[2] numbered 9,000 earthquakes of all kinds per year, while other investigators believe to-day that there might be as many as 40,000 annually.[3] These numerical values and their geographic distribution have to be much more closely surveyed than heretofore.[4] But besides these surveys which would base an earthquake forecast on a probability extrapolation of statistical data, we have to investigate into the few merely physical phenomena which supposedly are forerunners of earthquakes. These are the earth tiltings, which occur within some months prior to major earthquakes, as observed on Mt. Tukuba;[5] furthermore, the occurrence of gravity changes as observed by Tomaschek and Schaffernicht to precede earthquakes by several hours, and the appearance of electromagnetic wave disturbances which were recently discussed by V. Piatti.[6] All these lines have to be followed up to prove whether they enable us to forecast earthquakes.

Summarizing, it has to be said that we have to admit "ignoramus," but there is no reason to believe in "ignorabimus," and the only conclusion which we have to draw is that more research is needed to attack the problem of earthquake prediction successfully.

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[1] See SCIENCE, 81: 2105, supplement p. 11, 1935.

[2] A. Sieberg, "Erdbebengeologie," in B. Gutenberg's Lehrbuch d. Geophysik, Berlin, 1929, p. 172.

[3] Wm. Bowie, *Jour. Wash. Acad.*, 21: 103–175, 1931.

[4] N. H. Heck, *Geographical Review*, 25: 125–130, 1935.

[5] W. Inouye and T. Sugiyama, *Bull. Earthquake Res. Inst.*, 8: 362, 1930.

[6] V. Piatti, *Bollet. Soc. Sismol. Ital.*, 33: 22–42, 1935.

THE WORD "ALLELE"

FOLLOWING the lead of Johannsen, who contributed so much to brevity and precision in genetical terminology, the Batesonian term "allelomorph" is being rapidly replaced by the word "allele." So far as the writer is aware, this abbreviated form was used in English for the first time in a paper prepared by the undersigned for the Fifth International Genetics Congress, held in Berlin in September, 1927.

With the beginning of the current volume of *Genetics*, the editorial board of that journal officially adopted *allele* and its derivatives *allelic* and *allelism* as standard usage for articles published in its pages.

In certain recent articles on Drosophila genetics, published in other journals, the word appears in the form "allel," which is not correct philologically for use in English. The purpose of the present note is to urge