# DISCUSSION

## INTERNATIONAL COOPERATION IN GEOMORPHOLOGY

THE progress of research in the science of land forms has been carried on without the help of special journals devoted to its development. In the United States most of the papers on the subject have been published in geological serials and a few in geographical serials. The science has also been unfortunate in the lack of agreement as to name. In America it is usually called physiography—an indefinite term. The more appropriate "geomorphology" suffers the disadvantage of length.

Through the enterprise of Austrian geologists and geographers an international journal for the publication of papers on land forms was established in 1926. The *Zeitschrift für Geomorphologie* is edited by Professor Andreas Aigner, of the University of Graz, Austria, and is published by Gebrüder Borntraeger in Berlin at a price of 36 reichsmarks for each annual volume. It is now in its fifth volume and is highly creditable to its sponsors.

Planned as an international journal, it will accept papers dealing with the origin and development of land forms in the principal languages, German, English, French and Italian. Because the initiative has been wholly in the hands of Austrian and German scientists, nearly all the papers so far published have been in German. Contributions in other languages will be welcomed and papers which present material on the larger features of North America or which set forth the American view-point on geomorphological problems are especially desirable.

The four volumes of the *Zeitschrift* that have appeared are particularly noteworthy in quality and in the range of subject-matter. The minor phenomena of erosion, under differing conditions of climate and location, are the subject of articles by von Seidlitz on "spouting holes" due to wave erosion, by Paschinger on "double ridges" in mountain areas, by Bryan on niches and cavities in sandstone, by Stiny on a landslide in Spain, by Brandt on the channel phenomena of streams in an area of low water table, and by other notable authors. Observations in arid regions are set forth by Schultz on the eastern part of the Karakorom desert, by Machatsek on Central Asia and by Passarge and Mortensen on the Inselberg problem. Several articles deal with the Mediterranean region of seasonal aridity, such as that of Winkler on the Island of Mallorca. There are a number of thoughtful articles which make plain the German view-point on general questions of morphological development now so largely influenced by the work of Walter Penck. Among these may be mentioned an article by Braun, once a follower of Davis, who now repudiates the "Cycle of Erosion" as impossible. The short article by Serge von Bubnoff on the piedmont steps of the southern part of the Black Forest is an interesting comment on the work of W. Penck in which it is shown that he confused resurrected pre-Triassic surfaces with more recent partial peneplains.

In addition to original papers the *Zeitschrift* contains reviews of current literature by the editor, Professor Aigner, and also by a distinguished list of associates including Brandt of Prague, Creutzberg of Danzig, F. Jaeger of Basel and Panzer of Berlin. Reviews of the geomorphological literature of North America will be prepared by the undersigned and the geomorphologists of the country are invited to cooperate by sending him separates of their articles in order that no worthy work may be overlooked. Reviews and notices of North American literature began to appear in the April issue of the *Zeitschrift* (Vol. V, Pts. 1 and 2). Articles by American authors intended for publication in the *Zeitschrift* should also be sent to him for transmission to the editor. It is desirable that these articles should deal with principles or with questions and problems of general interest.

KIRK BRYAN
DEPARTMENT OF GEOLOGY AND GEOGRAPHY,
HARVARD UNIVERSITY

## THE PARAGOULD METEOR AND METEORITES

ON the morning of February 17, 1930, at 4:08 A. M., C. S. T., a meteor, hereafter referred to as the Paragould meteor, fell about fourteen miles southeast of Paragould, Arkansas. A large stone whose weight has been determined as 820 pounds and a smaller stone weighing about 80 pounds have been recovered. A third small stone, weighing a fraction of a pound, which was found the day after the fall of the meteor, may be an authentic meteorite. Only a hasty inspection of the little stone was made, however, as the finder would not part with it at the time he was interviewed.

No computation of the path of the meteor through the atmosphere has as yet been made, but a preliminary examination of reports from several states shows that it came from the northeast at a rather low angle. Its velocity was less than that of the average fireball which we have investigated. Its brilliancy was such that at the distance of St. Louis more than one observer reported that he thought an airplane was going down in flames near the local airport. The meteor burst, and one observer at a distance of sixty

or seventy miles claimed he had distinguished three distinct pieces. It became invisible very quickly after bursting, the height of disappearance being about five miles, an unusually low altitude, even where meteorites have been recovered.

Following the disappearance of the brilliant meteor, residents of northeastern Arkansas and the adjoining territory in Missouri and Tennessee were startled by the crash of an explosion followed by a roll like thunder. In the immediate vicinity of Paragould the explosions were severe enough to awaken practically every one from sleep and to stampede stock on the farms. About seventy miles from the point of the fall, at Poplar Bluff, Missouri, the night officer on police duty visited all the banks, thinking that one of them must have been dynamited. Few appear to have been awakened by the explosions at that distance, but an observer of the meteor, at Ripley, Tennessee, reports that her mother was awakened from sound sleep by the explosion, which sounded like a blast of dynamite or a sharp clap of thunder.

Interviews with persons in the immediate vicinity of the fall indicated that the direction of the sounds could not be determined as definitely as when detonating meteors fall in broad daylight. At this hour, 4 o'clock in the morning, nearly every one was indoors, and consequently the reports were less definite as to the direction from which the explosions and sounds came. They do, however, determine reasonably well the location of the two big meteorites which have been recovered and suggest a third large stone which has not been found.

The large meteorite struck in a pasture and went down in rather stiff clay soil to a depth of $8\frac{1}{16}$ feet. This figure is the depth of the hole after the meteorite was removed, that is, the depth to which the bottom of the stone descended. In going down this distance, the stone deviated about one foot to the southwest, the direction of the travel of the meteor. The impact threw a few scattering clods of clay as far as fifty yards. At a distance of thirty feet from the hole the clods were fairly numerous. The eighty-pound stone also struck in a pasture, and the hole from which it was removed was measured as being thirty-four inches deep by a competent civil engineer who also assisted in measuring the hole made by the larger stone. The farmer who found and removed this stone reported that it had entered at a low angle from the southwest, but the civil engineer believed that he was mistaken—that he had been deceived by the way the dirt had fallen into the hole about the stone. From an examination of the marks made by the stone in its descent, the civil engineer reported that it had come from the northeast. As it is known that the meteor came from the northeast, this seems more probable, but from general considerations, we would expect the descent of the stone to be nearly vertical at the time of striking.

The general color of the broken surface of meteorites is, in most cases, a dark, slightly greenish gray. There is, however, much material of a lighter gray. The crust of the larger stone is unusual, and the pitting is not as distinctive as for most meteorites. The smaller stone has a well-developed "brustseite," quite smooth and light-colored. This surface shows scarcely a trace of crust and has hardly a suggestion of pitting. The opposite side, however, shows a strong black crust and is characteristically pitted. An examination of the surface of the larger stone shows grains of nickel-iron standing in relief, while the troilite is depressed. In thin section, chondri can be seen with a microscope. A preliminary chemical analysis has been made by Dr. K. W. Ray, of the chemistry department of the University of Iowa.

The smaller stone is now in the possession of Stuart H. Perry, of Adrian, Michigan, and the large stone is in the possession of the Field Museum of Chicago. A preliminary description of the smaller stone by Mr. Perry appeared with our announcement of this meteor in the April, 1930, issue of *Popular Astronomy*. The 820-pound meteorite is the largest stony meteorite which has been recovered intact. It is exceeded in weight only by the Long Island, Kansas, stone which weighed more than 1,200 pounds, but was broken by striking on a rocky ledge at the time of its fall. The date of fall is not known for the Long Island meteorite. The big Paragould meteorite is exceeded in weight by many irons, but for only one of these is the date of fall given in catalogues of meteorites. This is the Bezerros iron which is listed as having fallen in Pernambuco, Brazil, on May 9, 1915. The estimated weight of this big iron is twenty tons. The second iron in size for which the date of fall is listed is the Boguslavka, which fell on October 18, 1916. The larger iron in this fall weighed about 438 pounds. The third iron for which the date of fall is known fell near Cabin Creek, Arkansas, on March 27, 1886, and weighed 107 pounds. This Arkansas meteorite has for many years held the record as the largest iron for which the date of fall is known, and most recent books still list this as the record for dated irons. It appears that Arkansas has lost the record in dated iron meteorites but now has the record in stone meteorites for which the date of fall is known as well as for stony meteorites recovered intact.

For much information on this meteoric fall, the writer is indebted to W. R. Heagler and Rupert C. Wright, of Paragould, Arkansas. Mr. Heagler, a civil engineer, gave four days of his time to driving over the territory with the writer and securing

interviews with persons who had heard and seen the meteor. He also investigated the hole made by the small stone immediately after the fall and assisted the writer in examining and measuring the hole made by the large stone. Mr. Wright, the editor of the Paragould *Daily Press,* cooperated fully, especially in securing information to supplement that obtained by the writer at the time of his visit.

The last fall of meteorites in the United States, so far as is known to us, was at Tilden, Illinois, on July 13, 1927. The November 11, 1927, issue of SCIENCE carried our announcement of the Tilden meteor and meteorites.

*Note added July 3, 1930:*

The report of the fall of a big meteorite near Bezerros, Brazil, has not been verified. Among definitely authentic meteorites, iron or stone, the big Paragould is the largest for which the date of fall is known.

C. C. WYLIE

STATE UNIVERSITY OF IOWA

## OCCURRENCE OF MAMMOTH AND GIANT BISON IN GLACIAL MORAINES IN THE HIGH MOUNTAINS OF COLORADO

IN June, 1929, the writer, accompanied by Professor J. Hansen, of Western State College, Gunnison, Colorado, and Mr. L. Q. Coffin, examined a reported fossil deposit which had been cut into during the course of the construction of a large ditch in the mountains between Gunnison and Montrose, Colorado. This ditch was built along the west side of the mountain valley of the Little Cimarron, and the deposits are found at an elevation of about eight thousand feet.

The principal formation here is Graneros beds of the Colorado group of the Upper Cretaceous, and they here contain some beautifully preserved fossil fish, with iridescent colors. So far as the writer is aware, these have never been collected and studied from this area.

Pleistocene deposits of coarse gravel, silt and boulders of all sizes lap down over these beds, and most of this appears to be old glacial moraines. In the limited time available for examination of these beds, so far as observed the spots where the fossils were found appeared to be clearly in beds of this origin and near their lower termination.

At Montrose, Colorado, the writer saw some of these bones which had been removed from the deposit. Portions of teeth and a tusk were preserved, not distinguishable from the mammoth type commonly referred to *E. columbi.* With this material was a molar tooth of a very large fossil bison, of the size found in the immense *B. latifrons* and similar species. The writer has had occasion the past year to study several of our extinct bison types, and it is evident that much individual variation exists in many characters, so that, at least until critical studies of all known material has been made, it is unsafe to attempt to identify these species by a single molar tooth.

While scattered, these fossils had been in a good state of preservation when found, and were well mineralized; but the rough handling they had received, with nothing done to preserve them, had naturally resulted in a good deal of damage being done to them.

Mr. L. G. Coffin, the father of the young man who accompanied the writer, was constructing the ditch and discovered the fossil bones. When in Denver recently he assured the writer that the large bison horns he found there were longer than, but not quite so robust as, an immense set of *Bison latifrons* horns now in the Colorado Museum of Natural History, Denver, which were found in the early Pleistocene of Nebraska. These horns are of almost the known limit in size, though not so long as in *Bison regius.* While the writer did not see the specimen, Mr. Coffin is known to be a man of reliability and the finding of one of these immense bisons, agreeing in size with the above mentioned molar, in association with *Elephas cf. columbi,* conforms with their known occurrence, save for being found at such a high elevation and in local glacial deposits.

So far as the writer is aware this is the first known occurrence of such fossils under these conditions in these mountains, and it brings up some interesting problems which should be studied.

To reach the spot where these fossils were found, one turns off at Cerro, about seventeen miles east of Montrose, on the main highway to Gunnison, and drives twelve miles up from Cerro to the Tripler camp. The Pleistocene fossils were found about one fourth to one half mile above this camp, in the ditch cut.

The Cretaceous fish mentioned are also found near here, in a slide near the nearby Cold Hill camp, in a dark sandy shale and in sandstone.

These localities seem well worth noting for record for the benefit of any specialists who may be interested and have the opportunity to work at this location.

HAROLD J. COOK

COLORADO MUSEUM OF NATURAL HISTORY

## ZOOPHARMACOLOGY VERSUS PHYTOPHARMACOLOGY

I HAVE read with great satisfaction the appreciation of my contributions to phytopharmacology expressed by Professor Edwin H. Shaw, Jr., published in the first May number of SCIENCE, page 460; and I was especially interested in the writer's suggestion that