the monument now is 36,918 acres. The new area contains many features of scientific interest which will be easily accessible to visitors upon the completion of the bridge which the National Park Service plans to build across the Rio Puerco. This bridge is necessary for the convenience of visitors to the Petrified Forest and the new addition contains the most feasible site for its construction. In the past, flood conditions in the river have frequently made impassable the road leading into the forest. The age of the petrified trees, whose fragments cover the ground over an area of over 100 square miles, of which more than half is included in the monument, is estimated at 200,000,000 years. None of the trees is standing. The petrified trunks, more or less fractured, dismembered, and lacking branches, all lie prostrate on or in the ground. Where a trunk or stump is found in an upright position, it is due to tilting of the already petrified log by natural forces. The ancient living forests which supplied these logs did not grow in the location in which they now are found. When the trees fell or were knocked over, they drifted down some prehistoric stream, became waterlogged and sank. Sand and pebbles gathered around and over them and finally thousands of feet of sandstone settled upon them. Changes then took place in the trees, turning them from wooden trunks into a mass of agate and carnelian, still in the shape of the original trees. Then, as the ages went on, there was a slow upheaval of the land, and erosion finally exposed the now thoroughly petrified logs and the innumerable small fragments. In the Petrified Forest National Monument there are three principal forests. Although they are the same geologically, erosion has produced different results in the three areas, and the color and texture of the "wood" also varies considerably.

INVENTIONS made in carrying on research work in the Engineering Experiment Station at the Ohio State University may, at the discretion of the trustees of the institution, be patented either for the benefit of the university or for the benefit of an individual, firm or corporation for which the research work was done, according to a ruling of the Attorney General, Gilbert Bettman, given in response to an inquiry from Dr. George W. Rightmire, president of the university. Persons with whom the university cooperates in experiments have not, by mere force of the relation of the parties, any exclusive rights under the law in inventions made possible as a result of such experiments, the attorney general held, even though such work is financed by funds contributed by them.

DISCUSSION

METEOR BUTTE

THE origin of the geologic formation in Arizona called Meteor Butte (formerly known as Coon Butte), near Sunset Station on the Atchison, Topeka and Santa Fé Railway, has long been considered something of a mystery, although in recent years it has positively been ascribed to the impact of a giant meteor—hence the change of name. The dimensions of the huge basin are: diameter about 4,000 feet, depth 570 feet: a truly remarkable hole in the ground.

In SCIENCE, November 7, 1930, Professor H. L. Fairchild expounds most learnedly his explanation of the origin by collision with a meteor as well as the reason why no vestige of the colliding mass is found either in the butte or anywhere near it.

Inasmuch as no evidence is discoverable of a meteoric body capable of excavating such a large basin, notwithstanding long, competent and diligent examination, and as my poor intelligence sees nothing reported that substantiates in the slightest degree the meteor theory, I venture to disbelieve that theory in toto.

For my part I have always been skeptical in the matter, but I have patiently waited for the drillings and investigations to turn up some credible evidence. No evidence has come that appears to me at all competent.

Mr. D. M. Ballinger, some years ago, caused numerous drillings to be made to considerable depths. He reported the results in an admirable paper read before the National Academy of Sciences in 1909; later printed. This paper he accompanied with a number of very clear diagrams and some excellent photographs of the "butte" taken both inside and outside the so-called crater.

All this drilling and investigating proved one thing *definitely:* that the underlying rock strata are in "continuous and undisturbed position." They also developed the fact that there exists copious ground water. This latter fact is to be specially noted with reference to what follows.

According to Professor Fairchild, whose competency in geology is unquestioned, the topmost continuous stratum is the Kaibab Permian limestone,

250 feet thick, with all the other regular beds below it in position.

Now the key to this problem—the origin of Meteor Butte—seems to me to rest, not in a mythical meteor, but in the presence near the surface of this Kaibab limestone.

It is well known that every rock formation possesses certain peculiarities—certain individual characteristics which we might call "personal" features. One exhibits cross-bedding; another has a tendency to chon-coidal fracture and presents arches and natural bridges; still another yields towers, pinnacles, and so on. This is all too well known to require more than mention.

The peculiarity or "personal" quality of the Kaibab formation is that it has a sponge-like character. On the Kaibab Plateau, whence comes the name of this limestone, there are no brooks or streams flowing on the surface. Instead there are circular drainage basins without apparent inlet or outlet. These basins are of varying size and they are numerous. Their diameter and depth range from an almost imperceptible slope from circumference to center, to several hundred feet in diameter and a hundred feet or more in depth. Some hold water; some do not, most in fact do not.

These sinkholes appear to be the individual feature of the Kaibab limestone. On my first visit there, many years ago, they struck my attention immediately as being something unusual. Dutton was there about the same time and noted the sinkholes as something new.

The explanation seems simple. It is merely a broad downward drainage through porous rock. The Kaibab, of wide extent, is devoid of surface streams, even of the smallest rivulets, yet there is a considerable rainfall, while snow is deep, owing to an altitude of 8,500 feet. The water goes off, of course, but it goes *down* all over the plateau forming these sinkholes.

Doubtless this feature occurs elsewhere but not so prominently as on the Kaibab Plateau. The dissolved rock and other débris is carried down and deposited below where the water reappears as it does in Havasu Canyon and along the breaks of the north wall of the Grand Canyon in the Kaibab Division.

These sinkholes of the Kaibab, some of them at least one fifth as large as Meteor Butte, being in the same limestone that forms the upper structure of Meteor Butte would seem to offer a perfectly reasonable explanation of the origin of Meteor Butte.

That is to say: *Meteor Butte is entirely the work of erosion* and no meteor has had anything to do with its formation. The interior cliffs of the circumference appear, from the photographs, to be cliffs of erosion, for they have every characteristic. The exterior slopes of the circumference appear to be slopes of erosion, for they have every characteristic. The down inside drainage undoubtedly is into the near-by Canyon Diablo.

Where there are local tiltings and dislocations as they occur in the circumference they are doubtless due to washing out of softer portions or some other well-understood freak of erosion.

Meteor Butte, then, seems to be merely the reverse of a solitary mesa which preserves itself by a hard roof against erosion. The Meteor Sink had a soft spot where its hat ought to have been.

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DIASTROPHISM AND DISCOURTESY

IN youthful days the writer regarded geologists as supermen, devotees of the most inclusive and inspiring of all the sciences. But membership in the guild, for lo, these many years, reveals that we are ordinary mortals, with the common frailties of human-kind.

In his address to Section E, American Association for the Advancement of Science, as reported in this journal of January 17, page 53, Dr. Frank Leverett stepped out of the path of his address to make an ungenerous and unjust personal reflection, as follows:

> In this connection attention is directed to an erroneous map prepared by a leading American glacialist, in which isobases of postglacial uplift are made to correspond to an estimated thickness of the ice-sheet in the region east of the Mississippi River, thus disregarding the results previously published of observations showing that there is no such correspondence. No progress can be made where office speculation is substituted for or given more weight than field studies.

A perusal of my description and discussion of the "erroneous map" (Bulletin of the Geological Society of America, 29, 1918, 201–205) will convince the reader that the implied discredit in "office speculation" is not justified. It would appear as if the speaker had merely looked at the map and neglected the accompanying explanation. Evidently he ignores it, and regards "previously published observations" as final and sacred.

The following excerpt from my paper (page 203) is only part of the tentative and suggestive matter which was, and is, wholly justified, as will be shown later.

> The map shows that the postglacial land uplift of northeastern America is fairly proportionate to the area and thickness of the latest ice-sheet, and it appears legitimate to suggest similar relation in the Mississippi