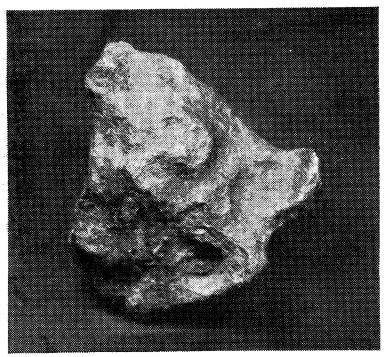
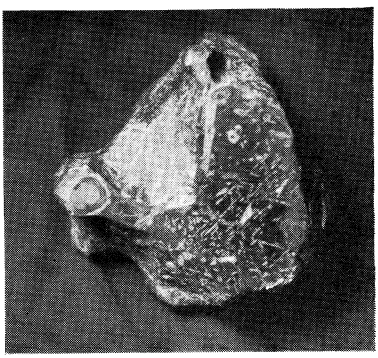
The Meteorite: A Lecture to Students of Elementary Geology

John D. Boon

I have at hand a chunk of iron that was found on the rim of Meteor Crater in Arizona. Whence came this mass of metal that is unlike terrestrial rocks, and what is the story it tells? How long has it been since it first became a part of the earth? Is it a fragment of the sun or of a disrupted planet, or did it come from beyond the Solar System? How long did it wander through the cold ways of space before it plunged into the earth and found a resting place? What changes in temperature and pressure has it undergone during the millions of years of its existence? Has its duration been coextensive with the stellar system? These are difficult questions, and yet it is possible that the answers are obtainable; that they are written within the very structure of the meteorite itself. Nature has a way of keeping records that man, as yet, knows little about.



The fused, oxidized surface of an iron meteorite, which has reached the earth from beyond our atmosphere.



A polished section of the same meteorite, showing characteristic Widmanstaetten characters.

One face of this body has been cut and polished, revealing the characteristic Widmanstaetten figures within. No new elements are detected, even though this is a part of another world, just iron, nickel, platinum and traces of

other substances that are found on earth. This is in keeping with the pervasive unity in the elementary composition of the universe, no new elements are found anywhere. However, some of the compounds are different from those in earth-born matter. It is these new compounds that tell the story of a past unique environment. This body is the product of a great chemical laboratory; a laboratory with temperatures and pressures far greater in range than any thing known here on earth; a laboratory where time was almost unlimited. Is it any wonder that strange new crystalline compounds are found?

Inanimate matter, as in living things, is being adjusted constantly to its environment, and since the environment is subject to ceaseless change nothing is stable in the world of matter. Even the atoms in the inorganic world are being rearranged continually to fit new environments of temperature, pressure, and contact. Deep within, this meteorite reveals a dense structure of space-saving crystals that tell of a time when it was under tremendous pressure. It may have been at the center of a world, like the earth, where pressure is measured in millions of atmospheres, or it may have been at the center of a more gigantic body. It is not likely that this meteorite was at the center of a sun for suns are hot gaseous bodies from center to surface. Over its surface, depressions, or thumbprints, are found, which were probably produced by the heat developed in passing through the atmosphere, an environment that lasted but a moment yet left its mark. On the outside a coating of iron oxide is forming, the final adjustment to its earthly existence. Soon every indication of its celestial life will be blotted out and it will become a brother to the clod that it penetrated. How many gigantic masses of celestial matter have fallen upon the earth and lost every vestige of the celestial structure, since the earth began, may never be known.

The range of man's vision has been enlarged greatly in recent years, and this has brought about a deeper understanding of the world of matter and energy. Slow changes that were once unseen, or disregarded if seen, are now

known to be the most significant in world transformation. For a long time man thought that atoms were stable, that they lived forever so that the run of time had no meaning for them. In recent years this view has been discarded, for it has been proven that many of the elements are subject to spontaneous disintegration. It is possible that stable units will be found at deeper levels in the structure of matter. On the other hand it is possible that no stable units exist, that at the lowest level energy flows back into matter and that the cycle of changes goes round and round.

Whatever conclusion may be reached concerning the stability of subatomic particles, atoms are subject to radioactive disintegration, even the atoms of a meteorite, and herewith they tell a story of their age. The laws of radioactive disintegration are strange laws, indicating clearly that their decomposition is not a matter of age, but rather of chance; that an atom a million years old is no more apt to explode than one that has just been formed. However, some kinds of atoms have a much longer life probability than others. Radioactive atoms are the time keepers of the inorganic world, time keepers that never lose a beat, no matter how the environment may change. Those that best serve this purpose are the heavy atoms like uranium that disintegrate slowly. When a uranium atom explodes, radium and lead are two of the products of the explosion, and these elements may be used to find the age of the matter in which they are embedded.

Iron meteorites contain uranium that can be used in determining their age. Professor Urry compares the meteorite to a pop-corn machine. "By counting the unpopped corn and the popped corn or the husks, and knowing the rate of popping, one can calculate the time that the machine has been running. The unpopped corn represents the uranium atoms, parents of the familiar radium—the popped corn represents the lead atoms, and the husks, the helium atoms, which are the ones counted in the method used." According to Professor Urry's measurements twenty-five meteorites show ages ranging from 100 to 2,900 million years. Thus this meteorite is keeping a

calendar that marks the run of time, and writes its age in terms of its own structure.

Night and day for eons the earth has pursued its journey around the sun, and the disintegration of the uranium found in its ancient rocks tell that its age is slightly less than 3,000 million years, a story strangely in harmony with that of the oldest meteorites. What great cataclysm occurred about 3,000 million years ago? No answer can be given, but numerous fingers point to that date suggesting its significance in celestial affairs. H. N. Russell has cited evidence showing that no less than five great astronomical events took place 2,000 or 3,000 million years ago. This meteorite is a small body, yet it is related to great things, for it tells a portion of the history of the universe. It may have been born out of the same cataclysm that formed the galaxy. Radioactive evidence indicates that some meteorites are much younger than the earth, hence they must have been born of later catastrophes possibly the wreck of a planet and the formation of asteroids.

The chemist plays with atoms taking them out of the molecules and putting them back again. Nature has supplied him with models of many different kinds of molecules and from a study of these he has learned not only how to build new molecules, he has also learned the characteristics of the atoms. He has found that carbon atoms are the cornerstones of the organic world, strange carbon atoms that offer the infinite possibilities of things that live and grow and sometimes think. In spite of the fact that carbon is very active it is often found uncombined as an amorphous carbon, or the beautiful crystalline diamond. The microscopic diamonds found in this meteorite are exceedingly old, and the atoms they contain may have been the cornerstones of things that lived when the world was young, or they may be virgin atoms that have never known the union that makes life possible.

Silently the nine planets, with attendant satellites, move eastward around the sun. Add to these the asteroids, comets, meteors, meteorites, and the sum is the Solar System. Such order, as is here found piques the minds of

thoughtful men. How did this remarkable system originate? Does this meteorite have any thing to say in answer to this question? The oldest meteorites are as old as the earth, and the earth is as old as the Solar System, hence the events that formed one must have formed all. Planets, many of the meteorites, and perhaps other members of the Solar System are products of one great cataclysm. What forces brought about this cataclysm? At present no definite answer can be given to this question, but undoubtedly they were of such nature that small bodies as well as large were formed, meteorites as well as worlds. Perhaps the best guess that can be made today is found in the Planetesimal Hypothesis. What of tomorrow? Who knows what revelations this meteorite will make when its language is better known?

The Hesperiidae of Dallas County, Texas

Avery Freeman

Little is known concerning the Hesperiidae of the Southwest. In Texas, various early naturalists made extensive collections of insects, but none specialized on Lepidoptera. Among those who collected Lepidoptera in Texas are Jacob Boll, an early naturalist, and Dr. Eugene Murray-Aaron of Chicago and his brother. Dr. Murray-Aaron's findings were published in *Papillo,* volume 4, 1886, and Jacob Boll's in *"Preis-Verzeichniss uber Naturalien gesammelt 1875 in Texas von Herrn J. Boll."*

This family of butterflies is significant in the interpretation of the phylogeny of the Rhopalocera and the Heterocera. Certain morphological characters of the Hesperiidae —shape of the antennae, and pronounced development of tibial spines and tongue—closely resemble the structural features of the sphingids. They are also stout-bodied, with large heads and prominent eyes, and have hooked or pointed antennae placed wide apart at their bases. The labial palpi are short, thick and hairy, giving a clumsy appearance. In