OU's New Frontier

Dr. Robert DuBois (*above*) leads us into a field with significant implications for mankind

For the last half-century it has been suspected that the earth's magnetic field periodically reverses. The polarity of the invisible protective barrier which prevents the deadly radioactivity in space from descending upon us and destroying life on this planet is now centered about the north pole, where it has been for the past 700,000 years. Before this, if the compass had existed at the time, its needle would have pointed in the direction of the south pole. It has been only within the last decade, however, that scientists have been able to prove this theory.

"The concept of field reversal is a recent one," says Dr. Robert L. DuBois (De BOYS), a professor of geology and geophysics who brought his world-wide reputation as one of the leaders in the field of earth science to OU in July from the University of Arizona. "We had known there were rocks which were reversely magnetized, but we didn't really know the origin completely. It has been in the past five years that work has been done to document clearly the reversal of the earth's magnetic field and to set its chronology. After new, highly sophisticated equipment was developed, we were able to study well-dated rocks and discover when the reversal occurred."

The implications are important to man's survival. "We know that the field changes in intensity, and when we examine the idea of field reversal, we can propose two possibilities. One is that the field just wanders about rather rapidly, shifting from north to south, and vice versa, and giving us a field at all times. The other possibility is that the field simply decreases in intensity to zero, and then eventually a reverse polarity occurs, a gradual development of a field at the opposite pole.

"For theoretical reasons, it is generally believed that the field does not simply shift all the way around, but actually changes polarity by decreasing to zero. Since this means that earth loses its force barrier against radioactivity, we would logically expect mutations and such to occur at this point. When this theory is presented, one immediately says, 'Well, if this has happened, we ought to go back to the last reversal and see through the paleontological record what happened to certain species.' Lo and behold, upon doing so, we find that many species died out at this particular time 700,000 years ago, and others began about that time, which suggests that mutation did occur.

"Another fascinating question that arises is 'How did man make out?' It's about this period that we start discovering early man, so we don't know how the human being managed to get through this reversal. Some have wondered if reversal was a factor in the evolution of man. We don't know, but it's an intriguing question.

"We are talking about things which are today's science, things that were unknown as late as five years ago, so this is an area of inquiry about which we don't know much as yet. We have a lot of work ahead to test these ideas, to show that the changes we've recognized so far in the fossil record are in reality saying that such things will continue to occur.

"We are aware now that the earth's magnetic field has decreased in intensity by 50 percent over the last 2,000 years. You can project this fact and say that it is possible that we won't have a magnetic field in another couple of thousand years. Well, some of us are concerned, and we have an obligation to humanity to find out what is likely to happen and to develop a means of protection from the radioactive energy. A way must be found to allow us to survive by generating a force field ourselves or whatever. We need to prepare to defend ourselves if we find that this will happen. Personally, today I'm not certain that it will. The decrease in intensity could be a cyclic feature. It could mean that we are simply in a low cycle and are about to enter a period of increase, but it's only through studies we're conducting now in archeomagnetism, and paleomagnetism that we'll find the answer."

Dr. DuBois, a six-foot four-inch westerner who earned his bachelor's degree and his doctorate at the University of Washington (Seattle), was attracted to OU by its Earth Sciences Observatory, which contains more than a half-million dollars worth of equipment which measures and records a wide range of data about the earth. It was given to the University by Humble Oil in 1964, and it was not until this year that a man of Dr. DuBois' stature could be found to direct its activities. Dr. DuBois holds the newly endowed Kerr-McGee chair in geology and geophysics.

The observatory is located near Leonard, Oklahoma, which is twenty or so miles east of Tulsa. Leonard is a very small town, no more than 200 inhabitants, and the observatory is situated two miles from it, off the main highway. The remoteness and isolation are calculated to protect its delicate equipment from man-made interference found in or near large cities.

"The observatory is a chief consideration for my coming to the University," says Dr. DuBois. "I think it is unusual in that it is one of the very few places in the world where as many parameters of variations of the earth are being recorded at the same time in the same place. We are looking at the earth's gravity field there, and earth's electric field in the lower atmosphere. We are measuring wind velocity, solaric currents, and characteristics of the pressure of the atmosphere through a microbarograph. We have short-period and long-period seismographs, which record the intensity, location, and length of phenomena like earthquakes. From the intercorrelation of the data we hope to learn much about the earth, its interior and its atmosphere.

"Most of the information will eventually be computerized, then we will study it, perform harmonic analyses and various other types of mathematical treatments to try to interpret something from it. We will make comparisons, correlations, for example, from the data we receive from from the magnatometers with that from the microbarograph. Specifically, there are large disturbances in the upper atmosphere when a large mass, a comet or something of this nature, enters the earth's atmosphere. This causes a change in the microbarometric pressure on earth which shows up on the graph. At the same time there is a certain amount of changes in the electrical or magnetic fields, so there is a correlation between these two when this occurs. It's interesting to see if we can use this as a means of detecting the presence of these bodies."

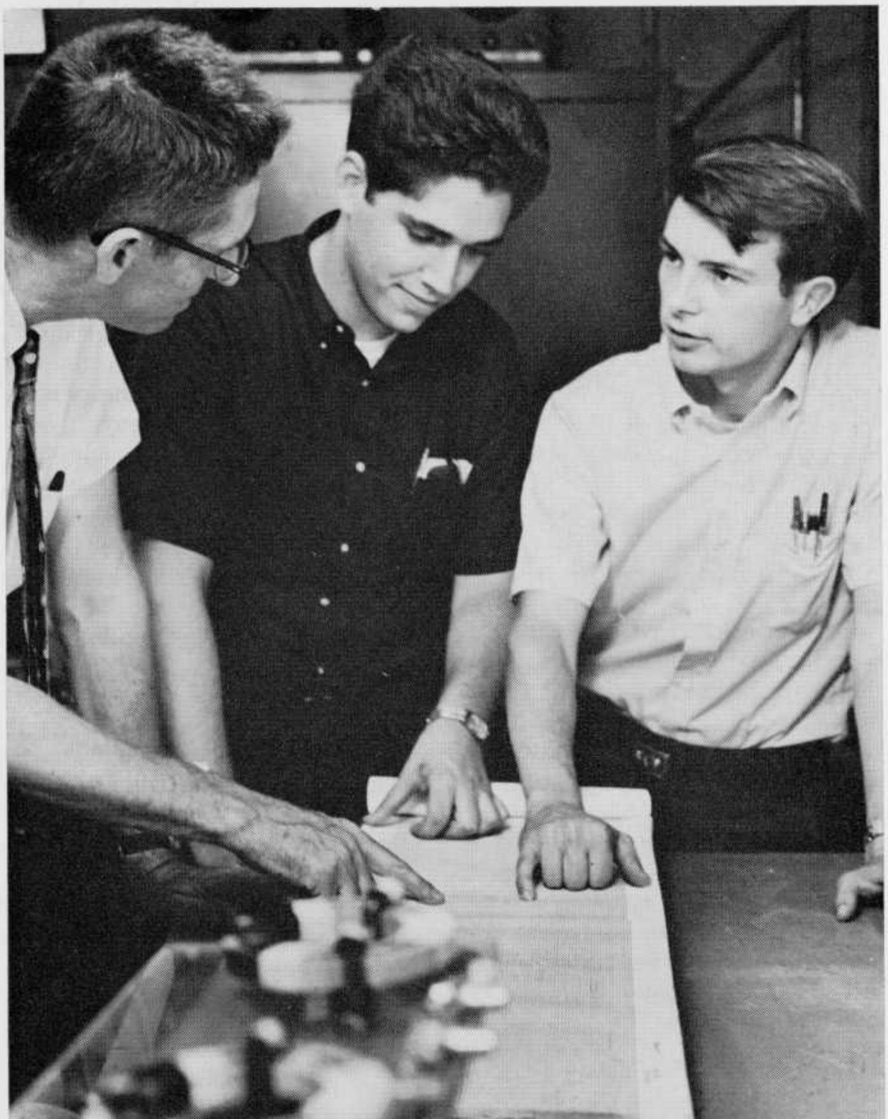
Dr. DuBois entered the field when it was largely virgin territory. "U.S. Steel asked me to conduct some research on magnetism. It was quite a kick for me, and the more I studied the less I found was known about the magnetic properties of rocks. In the early 50's there were just a few isolated people doing any work in the field. It was about this time that equipment began to be developed. An organized study requires the development of adequate instrumentation. It is only now, in the last two years, that instruments can be bought commercially capable of measuring the types of properties we've been measuring. All the instruments I've had I have made myself. We are now making some here at OU to do some things that no off-the-shelf instruments can do. It takes a little knack."

One of the instruments Dr. DuBois and his assistant, Al Shaw, a doctoral candidate who followed Dr. DuBois to Oklahoma, are building will measure the prehistoric magnetic field of the moon and of other planets as well as present fields. Says Dr. DuBois, "It is important to our knowledge of the origin of the magnetic field, its behavior in the past, whether another planet has or ever had a magnetic field. In time we hope to be able to put this equipment on Mars to record a series of experiments."

Some of this work is being done through the Astrogeology branch of the U.S. Geological Survey, which is directly connected with NASA and space research.

At present Dr. DuBois is attending a series of scientific conferences, giving papers on his research and exchanging information with other men in related fields. The first of these was the Pecos Conference, held in Tuscon in August, dealing with arch-

Dr. DuBois and students Larry Gillespie (center) and Al Shaw study data at the observatory.



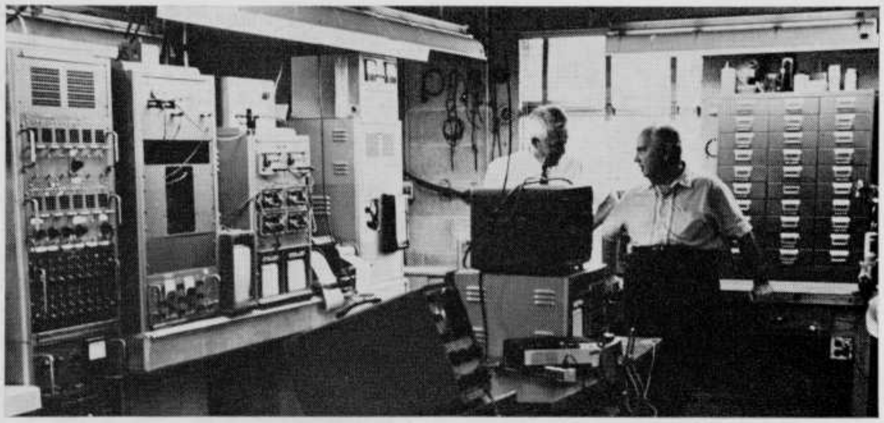
eology. Dr. DuBois presented a paper on the dating of materials at archeological sites through magnetic instruments and on variations of the earth's magnetic field. Through dating of rocks (see the article which follows on the dating procedure developed by Dr. DuBois), the observatory record will in reality be extended back through time. Man has only recorded characteristics of the earth's magnetic field for the past few tens or few hundreds of years. In order to gain knowledge of the field, a much longer record must be discovered. Dr. DuBois and a handful of his colleagues in the scientific community are now measuring materials back to 5,000 years ago. Continuous records have been developed to a few hundred years B.C.

After the Pecos Conference was a meeting in Reno at the NASA University Research Center, on the magnetic exploration of the moon. "We'll arrive probably at a basic plan as to what's to be done, how it's going to be done, and who's going to do it. It's very important to be there," he said before attending.

Another conference on archeomagnetism in Arizona and a geophysicists meeting in Houston followed before Dr. DuBois departed for Europe and the International Conference on Geophysics, held in Zurich and several other Swiss cities. "This meeting is held only every few years. At it the leading world geophysicists get together, exchange data, present materials and findings. There is a lot of new work and much correspondence back and forth before and after. Both sides of Europe attend, and many of them are aware of our work at OU, are interested in it, and want to know more about it. The meeting lasts two weeks, from the latter part of September until Oct. 10, and it's full and complex.

"It's important that as fast as the scientific field is moving in this area that we don't lose any time and that we keep a full research effort in progress. In many fields of science, if you lag for four or five years, you practically have to start over again.

"Things are moving so fast. That is why it is critical for us to attend these meetings. First, we're passing on to other scientists what we're doing, so they won't duplicate our effort, thus wasting years. Also, we



H. O. Harder (right), chairman of the OU Foundation, visits with an observatory staff member.

want to find out exactly what it is they're doing. The medium of publication is almost too slow to exchange information at the rate at which this science is advancing.

"If you want to stay a leader in a field, you must move with it. It means effort on the part of many to keep these programs going. The ways for doing it ten years ago are not aplicable today. We learn too much too fast.

"The work we do leads to interpretations which are useful in the discovery of petroleum and ore and in finding the chronological record of man. The University of Oklahoma is a leader in this field. I should hope we shall continue to be."

Dr. DuBois will spend three days a week at Leonard. The remaining time he will teach and conduct research on campus as he leads OU into the forefront of an expedition into a new territory of science, a frontier important today and invaluable to future generations.

Paul Galloway

Magnetic Clues Help Date the Past

By Kenneth F. Weaver, National Geographic Magazine

The compass needle, contrary to popular notion, does not point true north. Moreover, its aim today differs from that of a century ago, or of Columbus's day. And, if the compass had existed in the time of Christ, its direction would have been still different then.

In fact, what geologists call the "virtual" or apparent geomagnetic north pole, toward which the navigator's compass points, wanders about the Arctic like a lost child. It may move as much as 700 miles in a century.

This curious and little-understood drifting offers an ingenious key to riddles of the past. Today's archeologist, when he uncovers the kilns, hearths, or fire pits of ancient man, may search for faint traces of magnetism. These traces serve as a "fossil compass." From them the scientist can determine the age of the remains, using a new dating technique called *archeomagnetism.* In the past several years it has dated Roman pottery kilns in Britain and France and ancient hearths in Japan.

In the pre-Columbian Snaketown ruins in the Arizona desert, archeomagnetism has helped clarify a long-standing controversy about the Hohokam Indians. "When we first excavated Snaketown 30 years ago," says Dr. Emil W. Haury, University of Arizona archeologist, "we became convinced that the Hohokam had devel-

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