slight hissing noise, gradually increasing in intensity and culminating with a sharp crack and a flash of blue light. The whole was strongly suggestive of the gradual charge and sudden discharge of a condenser. Observations were not made continuously, the writer being mainly interested in the installation of his radio, but five or six successive trials showed the phenomenon to last apparently continuously for a period of about four hours, from about four o'clock in the afternoon until about eight in the evening, well after nightfall.

The antenna was four-stranded, about one hundred feet long, of solid aluminum wire, and strung about ten feet above a thirty-foot house, the roof of which was of copper and grounded. The sky was overcast at the time; there was no wind and the atmosphere was heavily charged with moisture. The time of year was not one in which there are electrical disturbances in that locality, nor did any electrical storm precede or follow the observations for a period of many weeks.

The writer explained the phenomenon at the time as due to the gradual leakage of electricity from a highly charged layer through the moist air to the ground. The conducting antenna, being in an area of slightly higher potential, became gradually charged with respect to the ground. When this charge reached a sufficient magnitude, a brush discharge set in across the gap, increasing in intensity as the charge increased until it was able completely to overcome the resistance of the gap, when the whole escaped to the ground with the accompanying spark. The process was then repeated at a rate proportionate to the rate of leakage through the air.

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EDUCATIONAL SCIENCE!

DURING the last few days the freshmen in the college of arts and science at the University of Pennsylvania have been subjected to a series of achievement tests as part of the Pennsylvania state survey of relationship between secondary schools and colleges. This survey is in charge of the Carnegie Foundation for the Advancement of Teaching in cooperation with the College President's Association of Pennsylvania and the Pennsylvania State Department of Education. Similar tests were given to all freshmen in many other colleges and universities in the state.

Among the tests given was the Columbia Research Bureau Plane Geometry Test by Herbert E. Hawkes, Ph.D. (professor of mathematics and dean of Columbia College) and Ben D. Wood, Ph.D. (associate professor and director of Bureau of Collegiate Educational Research, Columbia College, Columbia University). Test Form B for High Schools and Colleges was employed in this examination. Part II is concerned with problems. A sample problem is worked out at the top of the page. This reads: "Sample. How many degrees are there in four right angles?—(180)." There is no chance of this being a printer's error inasmuch as "four" is printed out and the "180" is printed in script.

What I wish to raise is the question of marking the thirty-five problems involved in this part of the paper. The sponsors of this examination gave no instructions with regard to this error, hence we may suppose that it must be taken at its face value as a sample. This implies that all truly correct answers to the problems must be marked as incorrect! That is obvious. But what is to be scored as correct is not so apparent. Two possibilities present themselves: (1) All truly incorrect answers should be scored as correct; or (2) all correct answers must be divided by two in order to receive credit.

But seriously it seems inexcusable to me that such an error should not have been caught by either the authors or the publishers, especially when one considers that this alleged measuring instrument carries the copyright date of 1926. And the directions printed just above the sample question say in part: "This means that you must *check your arithmetical operations carefully* before putting down an answer." (Italics theirs!)

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SPECIAL CORRESPONDENCE

THE RECENT BONE-CAVERN FIND AT BISHOP'S CAP, NEW MEXICO

IT seems desirable at this time to make a brief preliminary announcement of what is believed to be an unusually significant bone-cavern find recently made in the lower slope of Bishop's Cap Peak in southwestern New Mexico by Mr. Roscoe P. Conkling, of El Paso, Texas.

Mr. Conkling, who for many years has been connected with the American Smelting and Refining Company, has had as a form of relaxation and recreation a very lively interest in the field study of archeology, coupled with a general interest in natural history, which in the course of his travels in connection with mining operations in remote fields has led him to examine and to study scores of burial

and bone caves in America and in various foreign lands.

In following this interesting avocation, he some time ago arranged with Nicanor Mestes, Richard Chapman and José M. and Lorenzo Benavidas to locate promising caves within reach of El Paso for him to leisurely explore and study. Their acquaintance from youth with the mountains in the country surrounding El Paso and the first-hand knowledge of a local tradition to the effect that Spanish gold had long ago been buried in the small dark cave on Bishop's Cap Peak prompted them, under Mr. Conkling's encouragement, to go there and dig—not for bones or Indian relics, but for buried treasure—with the happy result that in this indirect manner what appears to be an exceedingly important and convincing discovery in the prehistory of America has been made.

The cave, which is located in carboniferous limestone, opened on the easterly flank of the mountain through a jagged orifice about three by four feet (since enlarged) which led into a dark stone cavern formed by water erosion. The floor was about eight feet below the mouth and was of wind-blown sand some twenty feet or more in irregular diameter. Aside from a few unsuccessful attempts to use the cave as a storm-shelter by an occasional herder, the place had never been a human habitation. A previous unsuccessful attempt to locate treasure in this cavern was made about forty years ago by men still living, who since the discovery have been induced to revisit it.

The work of treasure hunting proceeded without much show of success until at a depth of approximately ten feet below the floor bones were unexpectedly discovered. These were thought by the excavators to be perhaps the bones of a mule that might have belonged to the owners of the supposed buried treasure. As a result the work of excavation went feverishly on, until a fragment of a human skull was exhumed! These bones were brought to the attention of Mr. Conkling, who at once recognized the possible importance of such a find under such circumstances. He then took active charge of the excavations and carefully supervised the further exploration of the cavern.

Early in the work he sent photographs and drawings of his finds to the Los Angeles Museum for verification, with the result that Dr. Chester Stock, curator of the department of vertebrate paleontology, identified certain of the bones uncovered under ten feet of sandy loess deposits as the well-preserved phalanges of a ground sloth; and, as these were found adjacent to and at the same depth as the human skull cap referred to, all excavations since have been made with a view to preserving all available data growing out of the association of the material uncovered, as well as the material itself.

The cavern during the past four months has been carefully excavated to a depth of more than thirty feet without encountering rock bottom, the inference being that it extends much deeper. Except for a slight amount of surface material, and material doubtless falling down from the roof, the entire space is uniformly filled with very fine reddish wind-blown sand which exhibits an ill-defined horizontal laminated bedding, indicating the nature of its slow accumulation.

Eight feet below the occurrence of the skull, *i.e.*, twenty feet below the surface, a hard, compact lens from two to four inches in thickness was encountered. This, while composed of the same material as that which filled the cavern, differed in that it was evidently water laid. Apparently it had settled out of water accumulated in the cavern, as a result perhaps of a cloudburst. The value of this circumstance, however, lies in the fact that it formed a definite undisturbed horizontal diaphragm completely flooring up the cave. The significance of this will be appreciated when it is understood that at about eighteen inches below this floor and more than twenty-one feet below the surface floor of the cavern additional human skull fragments were found!

From the twelve-foot level where the first skull was found, to the bottom of the excavation, *i.e.*, for a depth of eighteen feet, bones of extinct horse, cave-bear, camel and sloth have been excavated in such numbers as to fill five large table type museum exhibition cases, while a bushel or more of small animal and bird bones have been recovered. Practically the complete skeleton of a ground sloth was found in place midway down between the occurrence of the two skull finds, which were almost ten feet apart. The last bones recovered from the bottom of the excavations were the limb bones of a very large camel!

From the foregoing it would seem obvious that we have here the undisturbed occurrence of human remains in direct association with a number of animals regarded as extinct since the Pleistocene period, and all deposited in such a manner as to preclude even the suggestion of their later intrusive burial. It is, therefore, believed that the Bishop's Cap bone-cavern has been a den and trap for wild animals through countless centuries and is a find which fortunately settles conclusively the moot question as to whether man and the sloth, the camel and the cave-bear, for example, were coexistent in America.

At the invitation of Mr. Conkling, the writer visited the cavern during the latter part of April. After very careful study of the occurrence and having had the exhilarating satisfaction of assisting in the re-

moval of the pelvic and lumbar portion of the sloth specimen referred to and seeing its relation to the human remains, I do not hesitate to pronounce the find as probably the most important prehistory discovery ever made in America.

Through the courtesy of Mr. Conkling, the Los Angeles Museum has been made the repository for all the material recovered. The specimens may now be seen in Los Angeles. The museum has also been given charge of the cavern by its discoverers and will continue the excavation and study of the occurrence.

A number of competent geologists have already examined the deposit and are unanimous in their appreciation of its authoritative, far-reaching significance. While the cavern will not be open to the public, for obvious reasons, during its continued study, qualified investigators will be welcome to examine both the material and the occurrence, but should arrange with the Los Angeles Museum in advance in order that proper facilities can be arranged.

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SCIENTIFIC BOOKS

Statistical Mechanics. By R. H. FOWLER. 570 pp. Cambridge University Press. 1929. (New York, The Macmillan Company.) 35 shillings.

THE subtitle of this monumental book is "The Theory of the Properties of Matter in Equilibrium," and this is a fairly descriptive characterization of the wide range of phenomena which it covers. Any number of books have been written on the application of modern physics to individual atomic systems, especially on the quantum theory of spectroscopy. There has, however, been a dearth of up-to-date literature on the statistical properties of an assembly of an enormous number of atoms or molecules. Such properties embrace a wealth of phenomena of great interest to the physicist, mathematician, astronomer and chemist. Of course there are standard classical treatments of statistical mechanics, notably those of Gibbs, Boltzmann, Jeans and Ehrenfest, but these use only the pure classical theory. The introduction of the modifications required by modern quantum theory is not merely necessary to secure agreement with experiment, but also is vital for logical consistency, as the negatively infinite potential energy at coincidence of a proton and electron makes the classical Boltzmann distribution formula inapplicable to any real atomic system. Professor Fowler has done wisely to introduce the quantum theory at the very beginning, and to regard classical theory as a limiting case thereof, rather than to adopt the too common procedure of adding on quantum modifications as a nondescript appendage of an otherwise classical treatment. In short, he has done a great service in writing a quantum statistical mechanics more comprehensive than the existing books by Herzfeld, Smekal and Uhlenbeck.

When the reviewer is confronted with the prospect of appraising the 570 large pages of this book, with their 1,607 numbered equations, he feels that he has set himself a Herculean task. His only consolation is how infinitely much more of an ordeal it must have been for Professor Fowler to write the book itself. Even though in the preface Professor Fowler acknowledges the aid of many collaborators, one still is astonished at the accuracy and thoroughness with which he has handled a tremendous diversity of physical, chemical and astronomical phenomena.

After an introductory chapter, the second chapter develops the mathematical scheme which is the backbone of the whole book. This is the derivation of the Maxwell-Boltzmann distribution formula by an ingenious and elegant method which was originally given by Darwin and Fowler in the *Philosophical Magazine* and which should especially interest mathematical readers. In evaluating the sum of factorial products encountered in statistical mechanics, the common procedure is to resort to Stirling's theorem, thereby introducing an approximation whose degree is a bit obscure. Instead, Darwin and Fowler identify this sum with a certain coefficient in a multinomial expansion and evaluate this coefficient as a contour integral by means of the residue theorem of complex variable theory. The integrand is large only in the vicinity of a "col," and so the integral can be evaluated by the method of steepest descents. The average properties of an assembly in the sense of averages over the phase space can thus be calculated. Both as regards physical significance and mathematical rigor, it is far more satisfactory to use such an average property than the "most probable property" so frequently encountered in elementary books on statistical mechanics. In statistics a property which is the most probable has little significance unless it is infinitely the most probable; *i.e.*, what Jeans terms a "normal property." Otherwise it might, loosely speaking, be likened to a weak plurality rather than a dominating majority in an election. To be truly representative, a property must be shown to be normal rather than merely the most probable. Even the average properties are not necessarily the normal ones, and it is only when one calculates the fluctuations, as is done in the