STATE OF OREGON
DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES

PORTLAND, OREGON

THE ORE.-BIN

VOL. 7 NO. 8 PORTLAND, OREGON July, 1945

STATE DEPARTMENT OF GEOLOGY & MINERAL INDUSTRIES
Head Office: 702 Woodlark Bldg., Portland 5, Oregon

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WHY STUDY FOSSILS?

by

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Pleistocene man was both a student of minerals and fossils. He early recognized the superior qualities of flint for the manufacture of his sharp-edged tools and he brought fossil specimens into his caverns.

Twenty thousand years later the Greek philosophers were puzzling over strangely marked stones which had some resemblances to the shelled life of the sea. Even Aristotle did not understand them. He seemed to have believed that fossil fish lived motionless in the rocks. Some of his contemporaries and followers expressed their wierd conceptions of the origin of fossils. For some fifteen centuries no one made a careful study of fossils, and all adhered to the ancient idea that fossils were formed by some plastic force of nature; represented some strange manifestation of the influence of the stars; were the unsuccessful attempts of the Creator to populate the earth; or that they were due to some other equally fantastic action. Finally men began to examine fossils more critically and realized that they represented animals and plants that once had lived on earth. Their study, however, was restricted to the mere description, for no scheme had been devised that would tell when they were living or the order of their appearance on earth.

As early as 1719 writers were showing the evidence for their belief in an orderly arrangement of the rocks of the earth's crust, and the idea of a succession of beds or "formations" was formulated. Among such writers was Linnaeus, (1768) and Justi, (1771). They introduced the time element, for they recognized that the bottom most bed in a geologic section was the oldest in the series. Werner emphasized this time conception and taught the necessity of precise description of the mineralogical characters of each "formation". William Smith advanced a step further by proving that the fossil content of a stratum would serve as a valuable aid for the identification of a given bed or formation. This made it possible to correlate fossiliferous beds outcropping at distant places. Thus fossils became a tool for correlation in the hands of that founder of stratigraphy, and geologic mapping of contemporaneous strata became possible. All stratigraphic geology is founded on these principles of superposition of strata and the contemporaneity of identical or closely similar faunas and floras.

Still another step was necessary before the study of fossils could be made to reveal the history of life. Cuvier described the fossils of a given formation, and recognized that those from one bed differed from those in a bed above. He attributed the difference to world catastrophes, as the Deluge, and a subsequent recreation of the life as represented by the fossils in overlying beds. Lyell in 1832 objected to such an interpretation but it remained for Charles Darwin to explain clearly such faunal differences on the basis of organic evolution.

Fossils then acquired an added interest. The biologists sought among fossil specimens the evidences of primitive ancestors of living types; and their colleagues, the paleontologists, discovered remarkable evolutionary sequences, such as the horse series, and described unimagined animals of past ages. The whole vista of life, thus was extended back for hundreds of millions of years, and the outline of the history of life became clearer.

Since the study of fossils was of interest to both the stratigrapher and the biologist, an extensive literature has been developed. Fossils found in innumerable localities have been named, described, and their geologic ranges accurately determined. This body of information so necessary to the identification and correlation of strata has become, in the hands of the trained geologists, an invaluable tool for all geologic work involving sedimentary rocks.

The economic importance of the study of fossils was first recognized some thirty or forty years ago when active exploration for oil began in this country. It was evident that the petroleum geologist must know sequences of strata through which the bit was passing. To do this he relied in part on the fossils which were brought up by the driller and which matched those in the sequences he had established from nearby surface exposures. Thus the correct identification of the index or key fossils from each horizon was of great importance. Trained paleontologists were therefore employed to build up faunal successions and to identify each fossiliferous horizon passed through by the drill.

This demand for closer correlations led to more extensive collecting, accurate determination, and the publication of faunas by federal, state, or institutional agencies. Universities and colleges were called upon to train paleontologists, who readily found employment with producing oil companies. Such studies led ultimately to an investigation of the long neglected group of minute fossils known as Foraminifera, whose clacareous shells, though abundant, had never been adequately studied. By the twenties, the importance of microfossils was recognized. Hundreds or thousands of specimens might occur in a cubic inch of rock taken from a well core. Micropaleontology laboratories were soon established in educational institutions and by the leading oil companies. Other groups of minute fossils were discovered. Consequently the microscope has become a necessity in the laboratories of the oil companies.

The study of fossils, as we have seen, has through thousands of years, given man glimpses of the life of the past; furnished proof of the fact of organic evolution; given an outline of the history of life on earth through some 1800 millions of years, and unexpectedly developed into a tool in the hands of stratigraphic and economic geologists which permits precise identification of strata often containing a wealth of oil or other geologic resources.

The future of paleontology lies in the further development of that "pure" science: its future contributions to a number of biological sciences, and the further expansion of these practical aids to the economic and industrial life of the country.

How can we contribute to the advancement of "pure" and applied paleontology of this state?

1. By intensive systematic collecting, at all known fossiliferous horizons of the State.

2. By the establishment of adequately equipped and staffed laboratories at Oregon State College, the University of Oregon, and the State Department of Geology and Mineral Industries.

3. By the study, identification, and publication of paleontologic data in such a form that it may be easily available to the general public as well as specialists.

4. By the building up within the State a complete collection of carefully labeled fossils, and by so organizing the collection that it may be available to qualified persons for the identification or further studies of the ancient animal and plant life of Oregon.

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ATOMS AND THINGS

In September 1940 the ORE.-BIN contained a brief article commenting on the uranium isotope U 235. Because of the recent astounding development in bombing Japan, this article appears to have present-day interest and is reproduced herein.

Understanding of internal combustion engines was acquired by hundreds of thousands of people by intimate association with Henry Ford's Model T. Knowledge of radio circuits and vagaries of the ether became rather commonplace with the universal use of radio sets. Flying is becoming so ordinary that most schoolboys know their aeronautics better than their spelling. So what! Well, these are just thoughts in contemplation of how greatly scientific discoveries influence our existence and of how surely and simply scientific phenomena, at first understood by only a few Einsteins, may be brought into our daily lives and become common knowledge.

The stage being set, meet U 235, for this mysterious looking symbol (not a German submarine) is likely to be the cause of making physicists out of future generations and be the incentive for the boys and girls to get intimately acquainted with atomic nuclei, protons, neutrons, isotopes, atom smashing, gamma rays, and other of that ilk, now known or partly known to only a few of the members of the inner circle of top-flight scientists. Perhaps in the not very distant future U 235, or some of its robotian relatives, will be heating and lighting the house (or bomb shelter), cooking the food, driving the automobile and airplane, propelling ocean liners, and rocketing space ships out from Mother Earth to disturb the tranquillity of our neighbors of the solar system. (Who doesn't enjoy the role of oracle!)

But to get down to cases and atoms. In the early horse and buggy days, it was scientific gospel that the atom was an indivisible particle - the smallest particle of an element that could exist. That theory is literally shot to pieces. Now, an atom is believed to be a sort of blur held together by electrical forces. There is a central atomic nucleus made up essentially of particles called protons and neutrons. The proton has a positive charge; the neutron has none. About the nucleus is a gyrating bunch of negatively charged electrons, each spinning on its own axis and arranged in concentric layers about the nucleus. In a staple atom, there are as many electrons as there are protons in the nucleus in order to have the electrical charges balance. The number and arrangement of the electrons determine the chemical properties of the atom. But it is with the nucleus that we are concerned now. The various elements have various combinations of protons and neutrons and the total of the number of these particles in an atomic nucleus equals its atomic weight. Thus, hydrogen, the lightest element, has a single proton and an atomic weight of 1. Uranium, until very recently, thought to be the heaviest element, has 92 protons and 146 neutrons to give an atomic weight of 238. Thus, we have U 238 as a symbol of the normal uranium atom. The number of protons in a nucleus determines the charge, or atomic number of an element, and there exists an element for each number from 1 (hydrogen) up to 92 (uranium). (Recently, discoveries of heavier elements have been reported).

Physicists (and among them a number of Nobel prize winners) have discovered that by bombarding an atomic nucleus with high speed particles, such as obtained by using very high voltage apparatus, neutrons may be added or subtracted, thus changing the atomic weight. Such changed atoms are called isotopes. What concerns us most, however, is that, in this process of atom-smashing, energy is released in enormous quantities. The isotope of particular interest at the present time is U 235, which has 3 less neutrons than U 238.

While atomic nuclei may be smashed with release of energy, the energy required is usually greater than that obtained as a result of the smashing. But the isotope U 235 is, at present at least, unique in that it may be readily smashed with the resulting release of a stupendous amount of energy. Various estimates of the quantity of this energy have been made, all showing, by comparison with our present sources of energy, the tremendous amount of released power potentially available. These figures are something of the order of comparing the force of a boy's air-rifle with that of a battleship's 16-inch gun. The picture is disturbing to the imagination, but we may as well take it calmly. U 235 hasn't been tamed as yet.

There are various hurdles to take before this atomic energy can be utilized. The present problem is how to isolate a sufficient quantity of U 235 so that it may be tested. Various methods have been tried without much success so far, but it seems rather inevitable that the problem will be solved eventually, for it is reported that over 300 scientists are at work on this and related problems. Probably other usable isotopes will also be found and put to work. Then a few ounces of U 235 or a brother isotope would be capable of driving your car or plane to New York and back and still have some power left over.

The question of control of such concentrated power naturally arises. As far as this writer is concerned, he'd prefer a nice safe dynamite factory in which to work rather than a laboratory containing a couple of grams of U 235. At this distance, investigating isolated U 235 appears to be something along the lines of jiggling a can of nitroglycerine.

F.W.L.

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URANIUM NOTES

by

John Eliot Allen

In 1896 Henri Becquerel discovered that phosphorescent salts of uranium emit radiations capable of passing through black paper opaque to ordinary light and of affecting the silver salts of a photographic plate. These radiations are called Becquerel rays and substances which emit such rays are said to be radioactive. All uranium and thorium minerals are radioactive - that is, their atoms are unstable, and slowly undergo spontaneous disintegration to form substances some of which may be separated and identified. Mme. Curie, one of Becquerel's pupils, discovered that one uranium mineral, pitchblende, was much more strongly radioactive than could be accounted for by its uranium content, and after months of work she succeeded in identifying two more highly active elements, radium and polonium.

Since that time it has been shown that both thorium and uranium successively disintegrate into one after another of a long string of elements and their isotopes (varieties of the same element with different atomic weights).

In 1939 it was discovered that an isotope of uranium with an atomic weight of 235 (common uranium has a weight of 238) could be split in two by bombarding it with electrical particles in a cyclotron, and when this breakdown occurred there was a release of tremendous amounts of energy. The application and control of this energy suggested the possibility of a revolution in power production. Workers then were unable to separate the isotope 235 from uranium 238 but the potentialities of the discovery were so great that after this war broke, the allied governments devoted all available scientific talent - some 300 or more of the best chemists and physicists in the nations - and all of the available uranium supply - some hundreds of tons from the mines in Colorado, in northern Canada, and in the Belgian Congo - towards the solution of the problem. Their success has ended the war with Japan within one week of the time the first atomic bomb was dropped, and the cost of the project, although amounting to more than two billions of dollars, has been repaid many times over in shortening the war and saving lives of our service men.

Radium is always present as an impurity in uranium minerals in the ratio of about 1 (radium) to 3,000,000 (uranium); in other words, it takes 5.2 tons of metal to produce 1 gram of radium. Uranium 235 is much more abundant, with a ratio of only 139 to 1 which gives 6,500 grams or over 14 pounds per ton, if the recovery of the rare element could be made 100 percent, which is doubtful.

Uranium occurs most abundantly in two minerals, carnotite and pitchblende. Carnotite is a mixture of uranium, vanadium, and potassium oxides. Theoretically the pure mineral contains over 67 percent uranium oxide, but in nature impurities reduce this percentage. Analyses of two samples of carnotite from Montrose County, Colorado, are given in U.S. Geological Survey Bulletin 770, page 726, as 54.89 percent and 54 percent uranium oxide (UO_3) respectively. Pitchblende, or uraninite, is an indefinite mixture of uranium oxides. Analyses given in the bulletin cited above range from 65.06 percent to 83.91 percent uranium oxides (UO_2 and UO_3). At least 40 rarer minerals contain uranium.

Thorium is a constituent of monazite, a not uncommon mineral, found chiefly as one of the heavy minerals in some sands, although the primary sources are in granites, gneisses, and pegmatites. The principal commercial sources of monazite have been Brazil, India, and Ceylon, although deposits are known in the Carolinas and Idaho. Some 9 other minerals contain thorium.

Carnotite is found in lode veins in metamorphic rocks (in South Australia), and in ancient sediments associated with vanadium minerals near Placerville, Colorado, and in adjoining regions. There it is probably derived from veins nearby by solution and re-deposition. Much of this deposition appears to be governed by presence of organic matter in the sediments, since extremely rich concentrations are found in petrified tree trunks. According to "Ore Deposits of the Western States" two petrified logs at the San Miguel River yielded 105 tons of ore, which contained $175,000 in radium, $27,300 in uranium, and $28,200 in vanadium. The ore averaged 1.25 to 1.5 percent U_3O_8. Carnotite has a characteristic bright canary yellow color, not the reddish yellow of iron oxides. The common occurrence is as a yellow powder in sandstones. It coats cracks in the sandstone and fills cavities between the grains. The sand is also commonly cemented with calcite near the deposits. Fossil wood, leaves, and reed fragments, as well as fossil bones are nearly always associated with carnotite, which sometimes replaces the organic material. In some places the ore is green, occasionally showing a little black in the richer portions. It varies from medium to a light green, but usually has a yellowish tinge.

Pitchblende occurs in gold-bearing quartz veins in granite, often associated with silver, cobalt, nickel, and other metals. It occurs in a number of localities in the United States, but these are relatively unimportant in comparison with the deposits discovered in 1930 by Gilbert La Bine on the shore of Great Bear Lake near the Arctic Circle. These deposits, developed by the Eldorado Gold Mines, Ltd., produced in 1940 nearly 40 percent of the world's radium, and yielded 1,100 tons of concentrate during 1939, with a radium content of 8 grams monthly. This would mean that the uranium production was of the order of 3,000,000 times this amount, or about 3 tons of uranium metal per month, or over 30 tons per year.

The pitchblende ore from which Mme. Curie first produced radium came from mines at Joachimsthal in Bohemia, which formerly were operated by the Czechoslovakian government, and were taken over by Germany in October 1938. The deposits were estimated to contain 300 grams of radium yet unmined, which in proportion would be associated with 1000 tons of uranium. In 1938 they were producing at a rate of about 5 grams of radium per year, less than that produced per month in Canada. Before the mines were acquired by Germany the Reich's only other source, besides imports, was from radioactive silt at Bad Kreuznach. This source yielded about 20 metric tons per year, containing about 1.75 milligrams of radium per ton.

Portugal also produces small amounts of radium but the largest mines in the old world are in the Belgian Congo which, beginning in 1925, have shipped to the United States several hundred thousand pounds of uranium oxide, according to reports in "Mineral Resources of the United States," published by the U.S. Geological Survey, and "Minerals Yearbook" published by the U.S. Bureau of Mines. In 1939, 1,439,324 pounds was imported by the United States from this source. In 1940 several thousand tons of crude ore was imported, since the refineries at Oolen, near Antwerp, had fallen into German hands.

The analyst can determine radioactivity in minerals by means of the electroscope and the Geiger counter apparatus. Both instruments have a high degree of sensitivity. Amounts of uranium as low as 0.1 percent can be determined by the spectrograph. Uranium will darken a photographic plate if left near it overnight; this is a reliable and inexpensive field test.

Pitchblende is a heavy black mineral, heavier than common black sand minerals and almost as heavy as tin ore or cinnabar, and hence the black concentrates from the tried and true panning method of prospecting will include pitchblende if it is present. It is usually massive, and can be scratched with a knife although it is hard enough to scratch a copper penny. It has a pitchy lustre, hence its name.

Pitchblende is found in granitic and metamorphic rocks in quartz veins, nearly always with sulphides of other metals such as lead, iron, copper, cobalt, and zinc.

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NEW CHAMBER OF COMMERCE BOOKLET

"Let's Look at Portland" is the title of a new booklet issued by the Portland Chamber of Commerce and sponsored by the Industries Department, Chester K. Sterrett, Manager. Although this booklet is aimed at furnishing basic industrial information on metropolitan Portland and tributary communities, in so doing, it contains a large amount of worth-while information on the natural resources of the whole state and region. Factual information is supplemented by many illustrations throughout its 48 pages. This booklet is a valuable report, in condensed form, on Oregon resources and industries.

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