

ring in the rocks which they will study. Those geologists who do wait to become paleontologists stand in the same relation to the geologist that the student of ancient history who can read its picturesque language does to the student of ancient history who can not.

Paleontologists are forced by the broadness of the subject, however, to specialize and usually confine themselves to certain groups of animals or certain groups of rocks, the usual unit of animals being some such group as snails, crabs and crablike animals, corals, or sponges, or even lesser groups. The usual unit in rocks is one covering a period of several million years, a unit which is perhaps best described as a tenth, roughly speaking, of the time since life began to leave its traces in the rock.

If the story of the changes which have taken place in the life on our earth is complicated, so is the story of the changes through which our earth has passed, and the one could not be read without the other. But having observed the order in which the rocks were laid down in favorably located places we are able to study life as it has existed from age to age, and we arrive at evolution, or the idea of a progressive change in life forms as we go from the earlier to the later. Knowing the history of these life changes on our earth and being able to recognize their different stages in the fossils which fill so many of our rocks we are able to trace rock horizons from place to place in unfavorable places, across lakes or seas and underground.

Most of our mineral deposits: coal, iron, oil, salt, etc., etc., occur in such rock horizons, layers whose position in the general order is known, layers which either have fossils peculiar to themselves or lie between layers which do. For example, and space will permit us to give only one: Sands in a certain section of California are found to contain oil. Similar sands show at the surface in many other places, are mapped by the geologists, and wells are bored wherever the sands occur in the hope of striking other oil wells. The sands are thick and boring is expensive, roughly \$10,000 for every well sunk, yet the return on the few which reach oil is sufficient to induce private capital to go ahead. A paleontologist is sent out to the field by the official survey and finds that the supposed sand horizon is not one but two, that these are separate and distinct, each with its own particular group of fossils, that

they are thousands of feet apart vertically, one being much older than the other, and that only one of them carries oil. He visits the various sand showings, or outcrops as they are called, and maps the distribution of the oil-bearing sand. He is thus able to cut down the absolutely useless drilling, or "wildcatting" as it is called, by one half. If the sand is the oil-carrying one conditions of internal or external structure will affect the location of oil pools but drilling has a chance of success; if it is not the time and money used in drilling are absolutely wasted. A man on a nominal salary, as a part of his regular work, saves the expense of drilling hundreds of useless wells, any one of which would have cost four or five times his salary for a year. The error which private industry is somewhat prone to fall into is the hiring of poorly trained geologists, or men who merely call themselves such, a poor policy in spite of the fact that almost any geologist or pseudo-geologist is better than none. The paleontologist mentioned, for example, and his case is not unusually exceptional, was worth ten times his government salary to any one of the oil companies in California and of course his real value to the country at large, or to the government which employed him, could be measured by the same amount.

For the reader who should question the dispatch of a government geologist for the saving of large sums of money for private industry we shall have to say that the present development of our mineral resources depends in large part upon the far-sightedness and public-spiritedness of private industry; that every dollar which they take out of the ground adds to the sum total of the wealth which we all share, to however small a degree; and that every dollar which they are kept from wasting is left in that same sum total. If they pay it out uselessly it might better be thrown away, because the drilling of the useless well wastes also the time of labor which might have been engaged in productive work. This is elementary economics, not paleontology, but fossils have a dollars and cents value which is sometimes lost sight of. To place it before you in a general statement: Geologists and paleontologists take from mining, second only to agriculture as the leading industry of North America, a large part of its luck or chance, and give it an element of certainty which is of inestimable value to it and to the country at large.