A Bituminous Rock Quarry

By Joseph Anthony

THE WASTE TAKEN OFF THE LEDGE, SHOWS THAT PART OF QUARRY IS ABOUT WORKED OUT

TEN miles northwest of Santa Cruz, California, there is an interesting deposit of bituminous rock. Here fifty-five men work the year round to get out 40,000 tons of the best road making material known. Of all the mines and quarries I have seen, this seems to be the most pleasant one in which to labor. High up on the side of a hill, three miles away and a thousand feet above the level of the sea, with a fine breeze most of the time, and where it is never too cold and with but a few days in summer when it is warm—is situated this clean, safe and profitable "mine."

After taking off 125 feet of waste shale there is exposed a 40-foot stratum of bituminous rock, except for a 10-foot layer of waste near the middle.

By running this rock through a steam cooker or heater, and without the addition of any binder, such as tar or asphaltum, it is spread upon the rock foundation and makes a clean and lasting surface for a street.

Asphaltum is the "binder" or mineral that makes this outcrop of sand valuable. It is found in many parts of the world, sometimes in a pure state, but more often mixed with fine sand, earthy matter or pebbles. It melts at about 212 deg. F., and in this form is known as bituminous rock. California is the only State in the Union in which it is worked commercially.

Macadam foundation covered with two inches of bituminous rock will cost about 23 cents per square foot; concrete foundation with two inches of bituminous rock will cost about 32 cents per square foot. Sidewalk will cost about 10 cents per square foot. In all this paving work, one of the most important things to do is to make a good foundation; without this, no matter how thorough the cooking and the laying of the cover may be, the work will go to pieces.

The fresh broken rock is very tough and waxy and in color it is not black, but a fine steel gray. Black powder is used to blow off a great mass before it is broken up into small pieces with giant powder, and with wedges, picks and bars. It weighs 80 pounds per

cubic foot, and 10 tons make a load for a six-horse wagon to draw down to the railroad.

One of the stories told about this mine is that it was first worked in the '60's for the distillation of kerosene, and another is that later they tried to use it for paving material, but always got it too hard or too soft.

The man is still living near here to whom it was offered for little or nothing if he would take it off the owner's hands and make some use of it. He is poor and working for his living, while there is in sight 3,000,000 tons of rock worth \$3 per ton, F. O. B.

Some fossils, and bones and teeth of animals are found in the 10-foot stratum near the middle of the outcrop.

This bituminous rock has probably been formed by a layer of sand becoming charged or saturated with crude oil, the lighter parts of which dry out or are vaporized, leaving the heavy asphaltum bare to bind the grains of sand together.

Charles Darwin—III*

By AUGUST WEISMANN

Concluded from SUPPLEMENT No. 1844, page 275.

THE principle of selection shows us how the thousands of adaptations in living beings which arouse our constant admiration may have arisen in a purely mechanical way. And they must necessarily have done so if the evolution of the living has resulted from the same forces and laws as the not living; in other words, if, in explaining natural phenomena, we can leave out of account altogether any forces outside of or beyond nature. The principle of selection enables us to do this, and therein lies its far-reaching significance. It is, I believe, the discovery of this principle that will make the name of Darwin immortal. Wallace, too, deserves a full share of the credit, although he did not base his theory on such a broad foundation.

* An address delivered at the University of Freiburg on the occasion of the Centenary of Darwin. Reprinted from *The Contemporary Review*.

of facts, and did not apply it in so many directions.

This principle is fully developed in "The Origin of Species by Means of Natural Selection," as, indeed, the title of the book shows. It might be thought that the publication of this book finished the labors of the hermit of Down, but this was not the case; it was followed by the richest creative period of his life. Between 1860 and his death in 1882 he issued a whole series of works, small and large, each of them based upon numerous observations and experiments, and most of them containing wholly fresh associations of ideas, usually connected directly or indirectly with the theory of evolution, and sometimes extending and corroborating it more fully. I must at least give a few indications as to the nature of these books.

In 1862 Darwin published his book, "The Various Contrivances by Which Orchids are Fertilized by Insects." Orchids often exhibit the most special and diverse adaptations to the visits of insects, and they help to make clear to us how flowers may have been developed in all their manifoldness in relation to the needs of their insect visitors.

In the same year and those following there appeared several treatises on "Dimorphism in the Flowers of Primula." Darwin had discovered minute differences in the length of the stamens in the same species, and he demonstrated that these differences are not mere chance variations, but are adaptations which secure the crossing of individuals and prevent self-fertilization. He obtained the proof of this through many careful experiments.

This was followed, in 1864, by a treatise on "The Movements and Habits of Climbing Plants," showing the different ways in which they climb—another study in plant adaptations. In 1868 appeared the great work begun in 1860, "The Variation of Plants and Animals under Domestication," and this book greatly extended and strengthened the basis of his theory of selection. The phenomena and laws of variation and heredity are discussed and illustrated by a wealth of examples, and the work concludes with a theory of heredity which he called "Pangenesis."

QUARRY SHOWING THE BARREN SHALE ABOVE THE 40-FOOT STRATUM OF BITUMINOUS ROCK

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