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PHYSICS—GEOLOGY

Fabulous Fortunes at Earth's Center?

Old Mother Earth has a heavy heart.

But for all that it may be a heart of gold.

Geologists now tell us that instead of living on a thin crust of rock and earth, floating like slag on a sea of seething lava and molten rock, as we were taught a generation ago, we are living on the outer weathered crust of a globe as rigid as steel and heavier than any of the common rocks.

It is hot enough inside, geologists tell us, so hot that probably all the rocks are melted, but the pressures are so enormous that this molten rock behaves in many ways almost as if it were solid metal. It is now thought that the great bulk of the interior of the earth, all of it to within 1,800 miles of the surface, is a mass of heavy metal, principally if not wholly iron, or iron and nickel. So that Mother Earth has a heart of iron, heavy but strong.

Yet it may not all be common metal, such as iron or nickel. There are metals heavier than these, and rarer. If the core of the earth be conceived as a mass of melted metals, the heavier would tend to collect at the center, and among these heavy metals that are rare at the earth's surface are gold and platinum. So, some geologists have surmised that the center of the earth may be a huge nugget of incalculable value.

"Bosh," say other conservative scientists. "Sensational humbug, fit only for half-wits. Nobody knows that the gold is there, and if it is there it is probably mixed or combined with other substances and, anyway, it would be impossible to get it out.

"Don't quote me as saying there's a gold name at the center of the earth," said one eminent authority on the earth's insides. "If you did, there are a lot of fools that would be writing to the and asking how it would be possible to get at it."

But the fact remains that not a

few competent authorities think there is fair reason for supposing that for a short distance around the very center of the earth there may be amounts of the heavy metals, such as gold, lead, silver and platinum, not necessarily in the pure state, but there nevertheless.

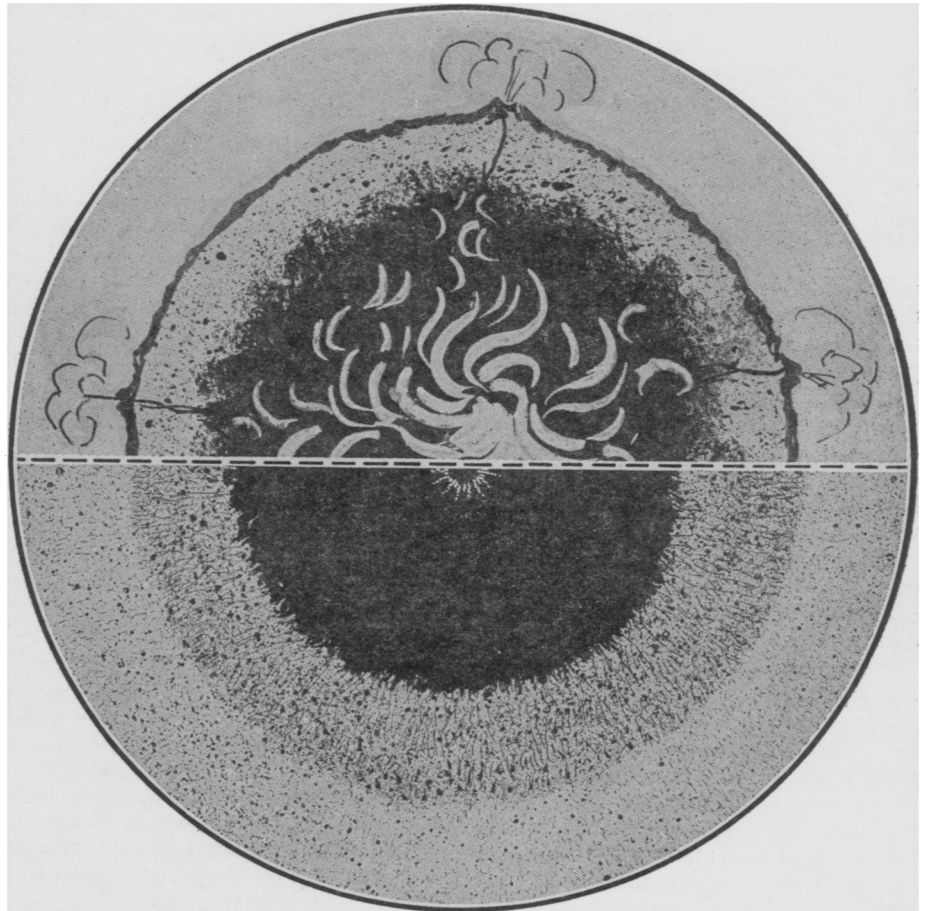
It is only a guess, or what the scientists more elegantly and exactly call a hypothesis, but it has something more than guesswork behind it.

What do we know of the inside of

the earth anyway, and how do we know it?

When the nebular hypothesis of the origin of our solar system held sway, about 50 years ago, it was believed by scientists that all the inside of the earth below a depth of about 10 or 20 miles was liquid rock, like the lava that flows from volcanoes. Volcanoes themselves were thought to be safety valves for the superheated boiler inside, so that when the pressure got

(Just turn the page)



Upper—THE EARTH was once thought to be liquid rocks under pressure with volcanoes as safety valves. This theory has now been exploded. Lower—THE EARTH'S interior is now believed to be made of heavy rock and metal, with perhaps a huge nugget of gold and platinum at the center.

INDEX TO THIS ISSUE

Advancement of Science, The..... 207	Earth's Center, Fabulous Fortunes at..... 193	Man and Woman..... 207	Rock Carving, Largest Indian..... 207
Aigrette Exterminator..... 195	Ellis, Havelock..... 207	Man, Early History of..... 207	Rubber Shoes for Horses..... 195
Airplanes, Building and Flying Model..... 203	Epilepsy, Starvation for..... 201	Man, Nature of the World and of..... 207	Science, The Advancement of..... 207
Animals, Seashore, of Pacific Coast..... 207	Eyes, Mouth Tells More Than..... 205	Marriage Record of College Girls..... 205	Seashore Animals of the Pacific Coast..... 207
Ashman, Richard..... 205	Fabulous Fortunes at Earth's Center?..... 193	Metcalfe, K. M..... 201	Snook, Harry J..... 207
Atmosphere, Composition of..... 201	Field, Henry..... 207	Mexico's Giant Tree..... 197	Stars in October..... 199
Auto Crankshafts Honed..... 195	Garber, Paul Edward..... 203	Model Airplanes..... 203	Starvation for Epilepsy..... 201
Becker, L. A..... 195	Germes Succumb to Perfume..... 205	Moriarty, Margaret E..... 201	Talbot, F. B..... 201
Bliss, George S..... 207	Girls, Phi Beta Kappa, Marry..... 205	Mouth Tells More Than Eyes..... 205	Texas Red Wolf on Rampage..... 205
Bolin, J. S..... 205	Gold at Earth's Center..... 193	Nature of the World and of Man..... 207	Thompson, C. J. S..... 205
Classics of Science..... 201	Holmes, S. J..... 205	Nature Ramblings..... 207	Tree, Mexico's Giant..... 197
Corn, Beetle Dangerous to..... 195	Honey Locusts, Prizes for..... 195	Newman, H. H..... 207	Venus Visible in Daylight..... 199
Crankshafts Honed, Auto..... 195	Horses, Rubber Shoes for..... 195	October Star Story..... 199	Whiteman, Paul..... 205
Cypress Tree, Giant..... 197	Japanese Beetle Dangerous to Corn..... 195	Pacific Coast Seashore Animals..... 207	Winds Not Prophetic..... 207
Dance, Evolution of a..... 205	Johnson, Myrtle E..... 207	Palmer, Theodore Sherman..... 195	Wisent..... 207
Davenport, Charles B..... 205	Landon, C. R..... 206	Perfume, Germes Succumb to..... 205	Wolves, Red, on Rampage..... 205
Diagnosis Revised..... 201	Lavoisier, Antoine Laurent..... 201	Petroglyph, Largest..... 207	Woman, Man and..... 207
Dunlap, Dr. Knight..... 205	Locusts, Prizes for Honey..... 195	Phi Beta Kappa Girls Marry..... 205	World and of Man, Nature of the..... 207
		Quaintance, A. L..... 195	Science News-Letter, Sept. 24, 1927
		Race Mixture, Danger in..... 205	

Gold at Earth's Center?

(Continued from page 193)

too great they popped off and maybe killed some tens of thousands of people in so doing, but saved the whole world, or at least large sections of it from blowing into fragments. The crust of the earth was thought to be just a sort of scum on the surface of the liquid.

But investigation developed facts that did not square with this theory a bit.

For example, the attraction of the moon and the sun on the waters of the ocean produces the tides; and if the interior of the earth were a rather thin liquid, the same pull of the moon and sun would raise tides there, speedily raising havoc with the exterior landscape. Furthermore, it has been found that earthquake waves travel through the inside of the earth in just about the same way and at the same speeds that they would through a solid sphere of highly tempered steel.

Evidently, then, the inside of the earth is made of something very tough and very rigid. Have we any clues as to what it might be? We have two fairly good ones. Take the weight of the earth, for example.

A competent physicist or astronomer, with the proper instruments, can weigh the earth, if not quite as accurately as the grocer weighs out a pound of butter, yet with sufficient accuracy for all practical purposes.

Sir Isaac Newton pointed out the way when he discovered the laws of gravitation. This depends on just two factors—the mass of the two or more bodies involved and their distances from one another. If the distances and gravitational pull are known, the mass can be calculated, and for all earthly purposes mass and weight amount to the same thing.

The density of the earth has been measured and found to be just 5.52 times that of water. But here is an odd thing: Taking everything on the

surface of the earth, including the waters or the seas; adding to all this the rocks as far down as we know anything about them, or a matter of a few miles, and lumping it all together we find the average density to be only 2.8 times that of water, or about half the density of the earth as a whole. If the surface of the earth is so much lighter than the earth as a whole, evidently there must be something rather heavy as we get toward the center. We have already seen that it must be rigid. The qualities seem to be approaching those of a metal.

Here is another clue: Everybody has seen meteors, or "shooting stars." A few people have seen what the biggest of them really are after they have fallen to earth—irregular, pitted masses, the surface fused from the intense heat generated by their rapid fall through our atmosphere. What are they?

They are thought to be fragments either of a planet like our earth which was disrupted by some immense catastrophe or, more probably, fragments of the parent substance of which our solar system and all the planets are made. Either way, these meteorites are good clues as to what our own earth is made of.

We find there are, in general, two kinds of them. One resembles in composition the deeper rocks of the earth's crust as we know it; the other kind is made of metal. This metal is iron mixed with nickel and cobalt and a few other metals in very small amounts. These metallic meteorites are more numerous than the stony sort. Hence it is thought likely that the earth is composed in part of rock, but mostly of iron or nickel-iron. In what proportion are these substances divided in the earth's insides?

That is a question which modern geologists have made much progress toward answering. They have done it by a study of the time it takes

(Turn to page 197)

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Gold at Earth's Center?

(Continued from page 194)

earthquake waves to go around the surface and through the inside of the earth, much as sound waves do through the air, and the rate they travel depends on the substance they are traveling through. The denser, the faster.

Every time there is an earthquake there are two sorts of waves sent out through the earth. One travels around on the surface; the other takes a short cut through the inside, and if the point of origin and the point of final observation are both known, the path of the waves may be calculated through the earth and just how deep they went at the deepest. Then from their speed a calculation may be made as to the density of the interior.

From all these and other considerations it has been found that the earth probably exists as three principal layers, something like the skin, the meat and the pit of a peach. What we know as the outer crust is the skin. It probably extends to a depth of about 35 miles. Below this the meat of the fruit corresponds to a thick layer of rocks of somewhat different chemical composition from those on the earth's surface and resembling more that of the stony sort of meteorite. This layer extends downwards for about 1,800 miles. Then we come to the pit of the fruit, an inner metallic core some 4,400 miles in diameter, and from inferred observations of its density and properties, of about the density of iron or nickel-iron, although much more rigid. Unlike the fruit, these layers are thought to blend gradually with each other.

The question still more undecided is whether the inner pit, to complete the analogy, has a kernel of gold and other heavy metals right around the inner core. It is quite a safe question to guess about, for with the instruments at hand nobody can ever find out, and if they were to find the earth had a golden center, nobody could ever get the gold out.

The earth is a little more than 7,900 miles through at the equator, a few miles less at the poles, so that from any part of the surface to the center it is close to 4,000 miles. A tunnel that long through the outer crust of the earth would be a huge undertaking. To the center of the earth it would be an impossible one.

To begin with, before two miles deep was reached it would have become impossibly hot. The rocks in the lowest levels of the San Juan Del Rey mine, in Brazil, the deepest mine

in the world, have a temperature of 117 degrees at a level of about a mile beneath the surface. The rate of increase varies in different parts of the earth, but averages about 50 degrees Fahrenheit for every mile of depth. At that rate the temperature at a depth of 50 miles would melt all the rocks.

Then there is the pressure existing at these great depths. At the center of the earth it is calculated to amount to 25,000 tons to the square inch, and long before that depth is attained it is so terrific that no sort of construction could withstand it.

So it looks as if we should have to remain in ignorance some time yet of just what is at the center of the earth.

There is, however, a possibility that we may some day find out what is in the center of the earth without the bother of attempting the impossible and trying to perform an explanatory operation. Science is just really beginning to learn the trick of seeing through things with invisible rays. The art is young.

Fifty years ago it would have been thought impossible that we could see the safety pin after the baby swallowed it. Now, by means of the X-ray, it is as commonplace as for babies to swallow pins. Perhaps in another 50 years we may be able to see the gold nugget Mother Earth swallowed when she was but an infant.

One interesting fact does appear, however, that confirms the opinions of many travelers in Europe. The Old World is sitting on a hotter part of the earth's crust than the New. Whereas, in central and western Europe the temperature rises one degree centigrade for every 32 meters of depth, it is necessary to go down 42 meters in most of America to get the same rise of temperature. Europe seems to be nearer the internal fires. Comments are superfluous.

How did the earth get that way? What makes it hot? How was it made?

Science used to say that all of what is now the space occupied by the solar system was once a vast nebula, a mass of exceedingly rare gases. It began to condense. So doing, it got hotter and hotter. It began to revolve as it condensed. As it revolved, a central core was formed. This became the sun, which was vastly larger than it is now. As it revolved it threw off masses of material which condensed to form planets. These in turn revolved, threw off satellites and condensed into solid bodies, or bodies

(Just turn the page)

Mexico's Giant Tree

Greater perhaps than any other single growing thing and reigning queen of the vegetable kingdom is a giant cypress tree in Santa Maria de Tule near Oaxaca in southern Mexico.

The tree is so old that it is the subject of many semi-religious myths, but it blooms vigorously every spring and drops its seeds in the fall. Hernando Cortez described it in a letter to his king 400 years ago, and Baron Humboldt in his famous scientific travels through Mexico in 1803 visited the famous cypress and is accused of having carved his name and sentiments on its bark.

Its great size has struck many with awe, and one colonial history claims it is 6,000 years old, or as old as the Flood, but Professor Conzatti of the Mexican Ministry of Education made a scientific study of the tree and its physical surroundings and gave it 2,000 years. This would make it a contemporary of Christ and of the famous Maya civilization which flourished there many centuries ago. The ancient Maya ruins of Mitla are but a few miles away.

The giant sabino or ahuehuate, as the tree is called in Oaxaca, rises to a height of 140 feet and has a trunk 110 feet around. Its top branches stretch 200 feet across, and its trunk is knotted and gnarled from age. The bark is cracked and rough, and roots stick out of the ground like elbows.

The tree is a close relative of the cypress of Florida and Louisiana, and like that member of the family, it requires a great deal of water. But the giant tree of Santa Maria is nearly a third of a mile from the nearest river, and even that is very low in the dry season. But Professor Conzatti solved the mystery of the water supply and found that the tree tapped the same water-bearing strata of earth five to eight feet under the ground that the villagers of Santa Maria did with their wells. Two other sabinos, believed to be child and grandchild of the great mother tree, grow nearby, and would be considered giants themselves if they stood alone. By measuring the rate of growth of other cypresses in the vicinity and studying certain of their characteristics, Prof. Conzatti was able to form an estimate of the age of this colossal tree.

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Gold at Earth's Center?

(Continued from page 197)

with a solid crust and molten interior as our earth was conceived to be under this, the nebular hypothesis, first promulgated about a hundred years ago.

The new theory, the "planetesimal" theory, starts with the sun, a mighty orb much larger than that of today. Some time in the abyss of the past another star approached it. Its attraction was so strong that tidal action was set up in the sun, its crust was broken and vast masses of gaseous matter issued with frightful velocities and to incredible distances. This matter cooled into relatively small chunks of solid matter, such as meteorites are. They coalesced to form planets and satellites. In so doing they also heated up to a great degree, but essentially they built the earth on a solid, not a liquid foundation. Volcanoes, according to this latest theory, are merely local boils on Mother Earth's complexion, and are not a constitutional complaint.

By this theory it is relatively easy to account for the heavy metallic core of the earth, for it was there to start with and grew by gravity. A spectroscopic study of the sun shows few heavy metals in its outer atmosphere. Presumably, the subsiding process has already begun there.

And so, Mother Earth has a hard, heavy heart. As for a golden one? What says a conservative scientist, such, for example, as Dr. Henry S. Washington, volcano specialist of the Geophysical Laboratory of the Carnegie Institution of Washington? In cold type he declares:

"We may conclude that the metal-lagenic elements (those of the heavy metals) are rare on the earth's surface and do not show intense spectrum lines on the sun because they are too deeply buried in both. One might recall, to pass from science to fiction, that the idea was, in a way, foreshadowed by Jules Verne, who in one of his stories describes a comet or meteorite composed of telluride of gold."

The fancies of Jules Verne have so many of them come true that one hesitates to scoff. Perhaps in spite of all her manifold infirmities and distresses, Old Mother Earth still has a heart of gold.

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