ENGINEERING

Volcanoes Go to Work

Volcanic steam from the Valley of Larderello is converted into cheap power for the Italian people. Such areas all over the globe are promising sources of power.

By EDWIN MULLER

See Front Cover

➤ THE approach to the "Valley of Hell" is through an earthly paradise.

From Florence you drive for hours through the lovely hills of Tuscany. Over the terraced slopes the slender spires of cypress rise above the soft green of the olive trees. Age has mellowed the blue and rose tints of the farm buildings. A quiet and peaceful countryside.

The first intimation of the Valley is a muttering growl of which you are aware two or three miles away. It rises in volume as you approach.

You top the crest of the last ridge and the famous Valley of Larderello lies beneath you.

Seething Action

Here the earth—as much of it as you can see through the clouds of steam—is raw and ugly. On its surface—twisting and crawling like the tentacles of an octopus—are miles of pipe line. Each group of them comes to a focus at one of the big powerhouses. The valley is dotted with oil derricks and with strange, unfamiliar structures like hour glasses 20 stories high.

Everywhere jets of steam are puffing out of the earth, hundreds of them. They rise and merge in great, billowing clouds, as shown on this week's cover of SCIENCE NEWS LETTER. A strong smell of sulfur comes to you.

The growl has increased to an almost deafening roar. It comes from a jet much bigger than the rest, one that is shooting out a column of steam with an overwhelming force that makes the works of man look puny.

This is Larderello, a valley sitting on top of an unborn volcano—a volcano which supposedly never erupted through the outer crust, but might. At Larderello, the white-hot interior of the earth comes closer to the surface than is normal—so close that the steam generated by the molten lava can be reached.

That is actually what men are doing here. They are boring down, tapping the live steam, converting it into electric power which is supplying a rapidly increasing part of the industrial and transportation needs of Italy.

The big jet is the last well to come in—two days ago. Although they have already capped it, they haven't yet been able to harness its power.

You drive down to see it. When you get out of the car 100 yards away they give you cotton to put in your ears. Otherwise blood might start from your eardrums, as when a big gun is fired close by. This is like the firing of a big gun—but going off continuously. The earth around you is shaking.

Going closer you see that the jet is about two feet in diameter. When it comes out of the earth it is clear and transparent, it condenses and whitens high above. They tell you that it is shooting out at a speed of more than 1200 feet per second, and a temperature of nearly 400 degrees.

This, the newest of the 50 wells at Larderello, came in before they meant it to. They had been drilling several weeks—a crew much like an oil crew in Texas or Oklahoma. Indeed this rig comes from an Oklahoma supply company.

The process is much the same as drilling for oil. As the drill grinds its way down a stream of water is poured into the hole. It is pumped out again as mud, bringing up the crumbled rock excavated by the drill.

When the drill was down 600 yards they got the first signs that something was about to happen. Instruments showed that the temperature at the bottom of the hole was rising rapidly. Then the mud coming out was boiling. Soon after that the drill ceased to descend. That meant that steam was beginning to come in below, was holding up the drill.

The pipes for conducting the steam were not quite in place, so they pulled out the drill and filled the hole with water. A column of water 600 yards deep exerts a tremendous pressure at its base—ordinarily enough to keep the steam down.

This time it didn't. One day at sunset, as the crews were changing shifts, the well let go.

Well Explodes

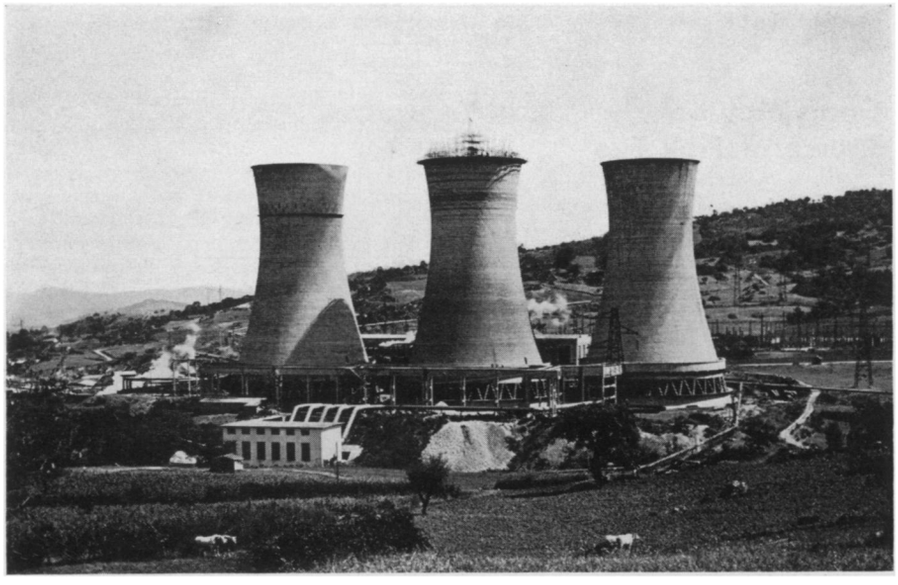
The explosion was heard plainly in a town 15 miles away. First the whole column of water was shot out in an instant, to a great height. Then the terrifying jet of steam. At first it was black. It hurled red-hot rocks into the sky. The crew cowered to the earth as the rocks came crashing down among them. By good fortune nobody was hit.

That night no one in the valley could sleep, not even with cotton in the ears and mattresses over the windows.

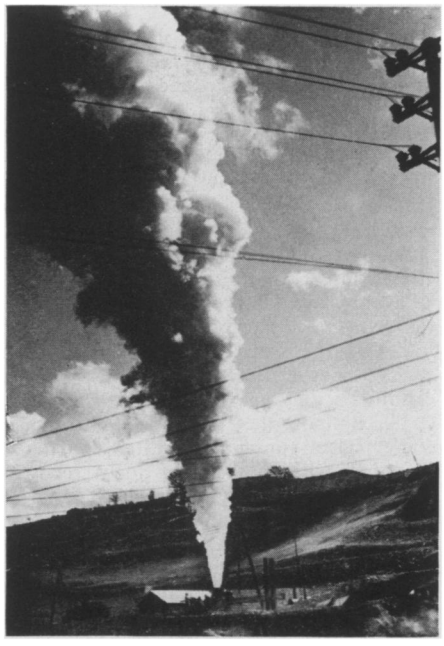
They'll manage to harness it in a few days—in spite of its apparently irresistible power. The jet will go roaring off through the long lines of pipe to the generators.

The power plants are half the size of a city block. So far there are five in the valley. Inside are the rows of big turbine generators, into which the steam roars. The boiling water of the condensed steam is conducted into the hour-glass buildings, where it is cooled and carried back to use in the generating process.

Outside the plants are the transformers. From them the power lines, on their long stilts, go marching away across the hills, carrying the power to the State Railways, to factories, to a variety of uses.



SKYSCRAPER COOLING TOWERS—Pipes carry steam to these 20-story-high condensation towers. Structures such as these and oil derricks dot the Valley of Hell.



BABY BLOWER—A jet of steam puffs from a small "steam well." Volcanic power is largely an untapped resource.

A sixth plant is nearing completion. It alone will supply one billion kilowatt hours per year.

Origin of Volcanic Steam

What is this volcanic steam and how does it come into being? We don't know precisely. But this much seems probable: The interior of the earth is a white-hot mass, its temperature enormously high, possibly above 7000 degrees Fahrenheit.

In most parts of the earth we are protected from this superfurnace by a crust 40 or 50 miles thick. But in some places this covering has weakened and cracked. That happens because the crust is still settling. A stratum of rock miles thick may crack, one part of it slip down. Then the surface of the earth shivers and trembles in earthquakes.

This cracking and shifting of the crust may lessen the pressure on the white-hot mass beneath. If it lessens enough the mass partly liquefies, becomes a gluelike substance that we call lava. The pressure from beneath may squeeze this up toward the surface of the earth, like toothpaste from a tube. If it gets close enough to the surface it bursts its way out, tearing aside anything in its way. Then a volcano is formed.

The force which bursts out is super-heated steam. As to the origin of that steam, scientists are not certain. It may be from water that seeps down from the surface of the earth. Or from ocean water that flows through newly-formed cracks. Or from the water, in molecular form, which is a part of nearly all solids, even of rocks.

When the water comes in contact with or even near the lava, it is changed to steam at a very high temperature and pressure. Supercharged steam was the most powerful explosive known until man began to deal with the forces of the atom. It is far more powerful than TNT.

The first man to make any commercial use of Larderello was a Frenchman, the Count de Larderel, son of a family ruined by the French Revolution, who went to Italy as a young man, and in 1814 settled in Livorno, where he became a prosperous merchant. He noted that the steam bubbling up from the mud pools of the valley left a deposit of boric acid as it condensed. He got a concession and exploited the deposits. His descendants for three generations made money from them. Even today, Larderello is the only source of boric acid in Europe.

Experiments Began in 1894

Experiments to utilize the natural jets of steam for power began in 1894. Ten years later the first results were obtained. Not very spectacular results—they managed to light five electric bulbs from power generated by the steam.

An Italian, Prince Ginori Conti, was now owner of the Valley. He continued experiments, began to drill for steam of higher pressure at deeper levels. He tried to devise ways of harnessing the steam when it was tapped.

The first big well came in in 1931. Before they were able to cap it the great jet of steam roared on for weeks, deafening the valley.

The development of Larderello continued. It came under the control of the Italian State Railways. For the first time substantial amounts of capital were available. More big wells were drilled, new generators installed.

With the end of the war came a crushing setback. The retreating Germans smashed the whole installation. Drilling rigs were destroyed, generators were blown into a mass of useless junk. The wells were uncapped and all roared together, wasting their power.

But within two years all the damage was repaired.

Aid from ERP

With ERP the development went forward more rapidly than before. The most modern American drilling equipment was installed. Generators of greater capacity were put to work.

Larderello begins to meet an urgent need of Italy, long handicapped by a shortage of power. It has no coal, until recently no oil. Its hydroelectric power, though substantial, is not enough to meet industrial demands. According to the latest figures, although Italy leads Europe in the production of hydroelectric power, it produces only one-fourth as much of it per capita as the United States.

Larderello is already producing about eight percent of Italy's power. The new power plant, when completed, will produce an additional five percent. And the significant fact is that Larderello is apparently producing power cheaper than by any other method.

True, it will be necessary to keep drilling new wells. The volume of steam delivered by a well slowly decreases. The production of the 1931 well has, in 19 years, decreased to 28 percent of its original volume. Not because the reservoir of steam is decreasing. Rather it's because the crack which conducts the steam from the subterranean furnace to the well is being slowly encrusted by the impurities in the steam.

There is no evidence that the amount of steam available is diminishing. On the contrary, it will be renewed as long as there is water in our atmosphere and as long as that water comes in contact with the hot interior of the planet.

There is no apparent limit to operations such as Larderello. They have drilled a new well within 100 yards of an old one. The new well brought in a big volume of steam. The volume and pressure of the old one did not change. And there are other volcanic areas in Italy which, the engineers believe, would produce just as well.

Untapped Resource

So are there in other parts of the world—New Zealand, Iceland. The "Valley of Ten Thousand Smokes" in Alaska could possibly supply an enormous volume of power. And there are areas in California and other parts of the West which could be used. American engineers have recently been inspecting Larderello with such operations in mind.

We in the United States worry sometimes about our sources of power, the coal and the oil that we are using up at such a rapid rate. While we are waiting for the atom to take their place it might be a good idea to use some of that vast reservoir of steam that is waiting down below.

This article was prepared for the SCIENCE NEWS LETTER in cooperation with the READER'S DIGEST. It will appear shortly in that magazine.

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PLANT PATHOLOGY

Pine Tree Insect Pest Discovered

➤ SUDDEN death to a grove of pines in southern Connecticut led to the discovery in New Haven of a new insect pest. Dr. George H. Plumb, entomologist at the Connecticut Agricultural Experiment Station, identified the culprit as a new member of a scale insect family known as *matsucoccus*. It causes the needles of infected trees to turn yellowish, then brick red as the tree dies.

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