brought the total to over 90 percent. With the original 16 circles, there are 19 points on the globe at which three circles intersect. "All but five of these trisections occur at zones of major seismic or volcanic activity," says Dr. Ramon E. Bisque, a professor of geochemistry who is now helping Rouse with his research. "Most of the others are in ocean areas that could be or have been active."

Three of the multiple intersections are on continents. One is near Tashkent, Russia, and another north of La Paz, Bolivia—the two most active deep continental earthquake zones in the world, Dr. Bisque says—while the third is in the volcanic Mountains of the Moon region of east-central Africa.

Colorado School of Mines

Rouse, the world and Dr. Bisque.

The significance of the Rouse Belts began to grow when a member of the School of Mines' metallurgy department got a look at the circles and noted with some surprise that they pass through many of the world's major deposits of heavy metals. Since then, Rouse and Dr. Bisque have found that the circles also echo maps of the varying intensity of earth's magnetic and gravitational fields. "Every damn thing we looked at seemed to match," says Dr. Bisque happily.

Another old mystery that has been bothering scientists for years, according to the researchers, also fell right into the Rouse Belt deductions. Mountain ranges, ridges on the ocean floor and island chains all tend to lie in curved lines, Dr. Bisque says. "Everybody knew that, but nobody knew why. But they fit the belts too."

The theory seems almost too neat to be real. What can such a diversity of things have in common, that they should all fit so nicely on one set of lines? The most likely explanation, the Colorado team believes, is that they all are reflections of what is happening at the earth's core. The scientists theorize that the interplanetary magnetic field causes the heavy iron core of the earth to try to rotate on a slightly different axis from the rest of the globe. This creates stress between the core and the mantle surrounding it, which produces mixing of the soil and rock of the mantle with the core's metals.

The stresses of this mixing then would spread out from the point of contact between mantle and core, producing the planes along which earth tremors and volcanic disturbances spread. The metal deposits match because they would rise from the core in molten form to follow the stress lines. The magnetic field matches because of its relation to fluid motions from the core, and the gravitational field would be tied in with the changes in the distribution of the planet's mass. The islands and mountains curve right along with everything else, the theory holds, since they are simply surface effects of the radiating seismic waves.

Again, a neat theory—but almost too much so. If it holds up it is likely to prove valuable to everyone from companies hunting riches on the ocean floor to investigators trying to predict quakes in advance.

Dr. Bisque is a geochemist, however, not a geologist, and Rouse's doctoral thesis is completely unrelated to the subject (if anything can be said to be unrelated to such an all-encompassing hypothesis). So the idea will surely have to run the scientific gauntlet.

One possible chink is Rouse's basic assumption—that the deep Benioff zones do indeed descend at 60-degree angles. There is evidence that many deep quake zones are at much shallower angles, perhaps as low as 40 degrees. That makes no difference, however, according to Dr. Bisque. Even if Rouse was completely wrong, his assumption merely directed him in the placing of the planes. The fact remains that they are nevertheless tangent to the core, and a great number of observed effects do coincide with them.

Another puzzle, which Dr. Bisque admits, is that if the core is in liquid form, as many geologists believe, it may not produce enough force, when it turns against the mantle, to cause stresses all the way up to the surface.

But the theory has its strong proponents. "This may," says Dr. Linn Hoover, executive director of the American Geological Institute, "be the $E=mc^2$ of solid earth theory."

TECHNOLOGY GAP

Europe seeks causes at home

In a recent five-year period, sparked by a rapid growth rate in research-based industry, U.S. investments in Europe doubled. The return flow of European investment in the U.S., starting from a level half as high, increased only 24 percent.

It is a trend that has century-old roots. But as recently as 18 months ago, Western Europeans, increasingly uncomfortable under pressure from the technological behemoth across the Atlantic, coined the term "technology gap" to describe the phenomenon. And ever since—until last week—they have been probing the U.S. in search of some mystique of science policy or research organization to explain the phenomenon.

Now, after months of research, an exhaustive study of U.S. science policy and a series of confrontations and meetings with a Presidential committee on this politically sensitive subject, the search for a mystique has come to an end; the technology gap has gone the way of the other ultrasimplistic terms that, on examination, necessarily fail to explain complex phenomenon.

Last week the science ministers of the European members of the Organization for Economic Cooperation and Development returned to their capitals from a meeting in Paris armed with fresh insights—six months in the making and requiring, perhaps, as many years or more for implementation.

They found in the U.S. no centralized science policy, in contrast to their own relatively rigid structures. They found highly mobile, highly motivated researchers, well supported privately as well as publicly, in a broad range of research environments and a massive market for technological innovation, a market unfragmented by national boundaries or traditional inhibitions to creativity—all in contrast to what they see at home.

"If anything came out of the so-called technology gap discussions," says a member of the U.S. delegation to the string of meetings, "it was a new look at Europe's own fragmented economy and research structure, by the Europeans themselves."

"They're not only coming around," says another. "They've already come."

Though the OECD science ministers won't admit it, and U.S. officials won't take credit publicly, the Europeans have by and large accepted U.S. explanations of disparities in research utilization among nations, and the U.S. view that only Europe itself can do

OECD/J. J. Salomon

Dr. Hornig (center) and members of the U.S. delegation at an OECD Paris session on the technology gap.

anything about closing an array of technology gaps.

"There are all kinds of gaps," Presidential Science Adviser Donald F. Hornig, head of the U.S. delegation, quipped during the Paris meeting of science ministers, "including the gap between the advanced shipbuilding nations like Japan and the Soviet Union and lagging nations like the United States."

Out of the massive review has come a new identification of the reasons for the dominance of many markets by U.S. research-based industry, and a new determination in Europe to deal with its own archaic and tradition-bound research structures in an effort to improve:

- The mobility of researchers among European nations.
- Internationalization of research on the European continent as well as unification of now fractional European markets for the fruits of research.
- Levels of interdisciplinary research, now restricted by hidebound and archaic domination of university research centers by traditional designations.

"The range and content of these disciplines," concluded Prof. Joseph Ben-David, in an OECD study on "Fundamental Research and the Universities," "reflected the state of science about the beginning of the 19th century."

Even after German breakthroughs in research organization more than a century ago, says Prof. Ben-David, professor of sociology at Hebrew University of Jerusalem and a specialist in the evolution of European universities, "The new research institutes in Germany were carefully subordinated in prestige and, in the case of university institutes, also in power, to the corporation of university professors representing the traditional disciplines.

"Since only the universities possessed autonomy, this arrangement eventually constricted scientific enterprise and has probably had an adverse effect on creativity too."

Major differences between Europe and the United States, Prof. Ben-David suggests, along with Dr. Hornig and, now, many of the European science ministers themselves, were less in quality of the scientists than the management of science and the place of utilization in its orientation.

In the communique following the Paris meeting, the science ministers noted that, for their nations, "There is thus a need to relate science policy to the general economic and other policies of governments. This implies a new relationship between governments and industry in making use of science for social and economic progress."

This implies as well a massive reshuffling of institutions and relationships which have refused to change in generations.

Steps are already being taken and progress is being made in France, Italy and elsewhere.

France is spending research money in adjacent countries, and, internally, its organizationally modern nuclear research center at Grenoble, where Franco-German cooperation is developing, is already the equal in physics of the more traditional University of Paris.

In Italy, an international graduate school in molecular biology is developing at Naples on an independent footing, with U.S. encouragement and assistance and the support of the Italian Government; it is expected to become a model for others. Along with such institutional changes, the European science ministers endorsed an international matching fund for support of four-or-five-year, pilot interdisciplinary research programs, as well as establishment of reserve funds in each participating nation for projects approved by international committees.

Also being sought now is an accelerated program of patent harmonization among nations and a massive program aimed at increasing the flow of scientific and technical information across national boundaries, beginning with an organization similar to that within the U.S. Office of Science and Technology.

Elsewhere, U.S. and European negotiators are wrestling with nontariff barriers to international trade. These include such questions as differences among patent systems and the lack of uniformity among technical and industrial measurements and standards.

MAGNETOOPTICS

A technique to fingerprint solids

When an engineer sets out in search of a specific material to do a job no material has yet successfully done, it would be helpful if he could characterize the materials he meets.

Gases today can be rather neatly catalogued, but the engineer is usually in search of a solid. He knows what he wants to find—or create—but recognizing its complete signature has been a built-in problem.

By combining supercold, extreme magnetic fields, laser light and extremely pure crystals into a technique called quantum magnetooptics, researchers can now achieve such identification.

They may even turn materials engineering into an exact science.

Up to now, at least, a problem has been the difficulty of applying to solids investigative techniques that work in gases.

An electron in a free atom of a gas has certain set energy levels that it is allowed to occupy. When it changes from one level to another, the electron