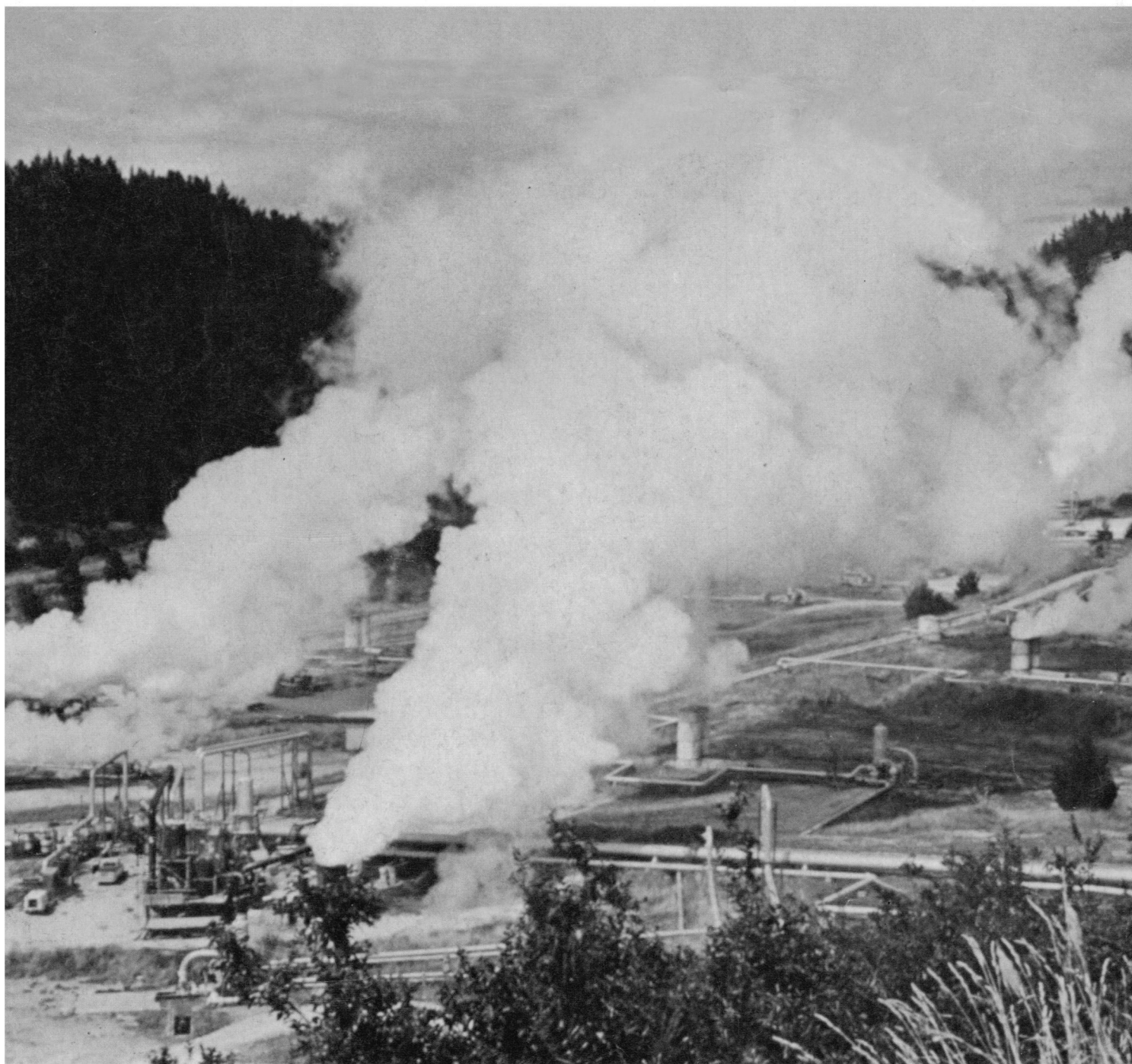


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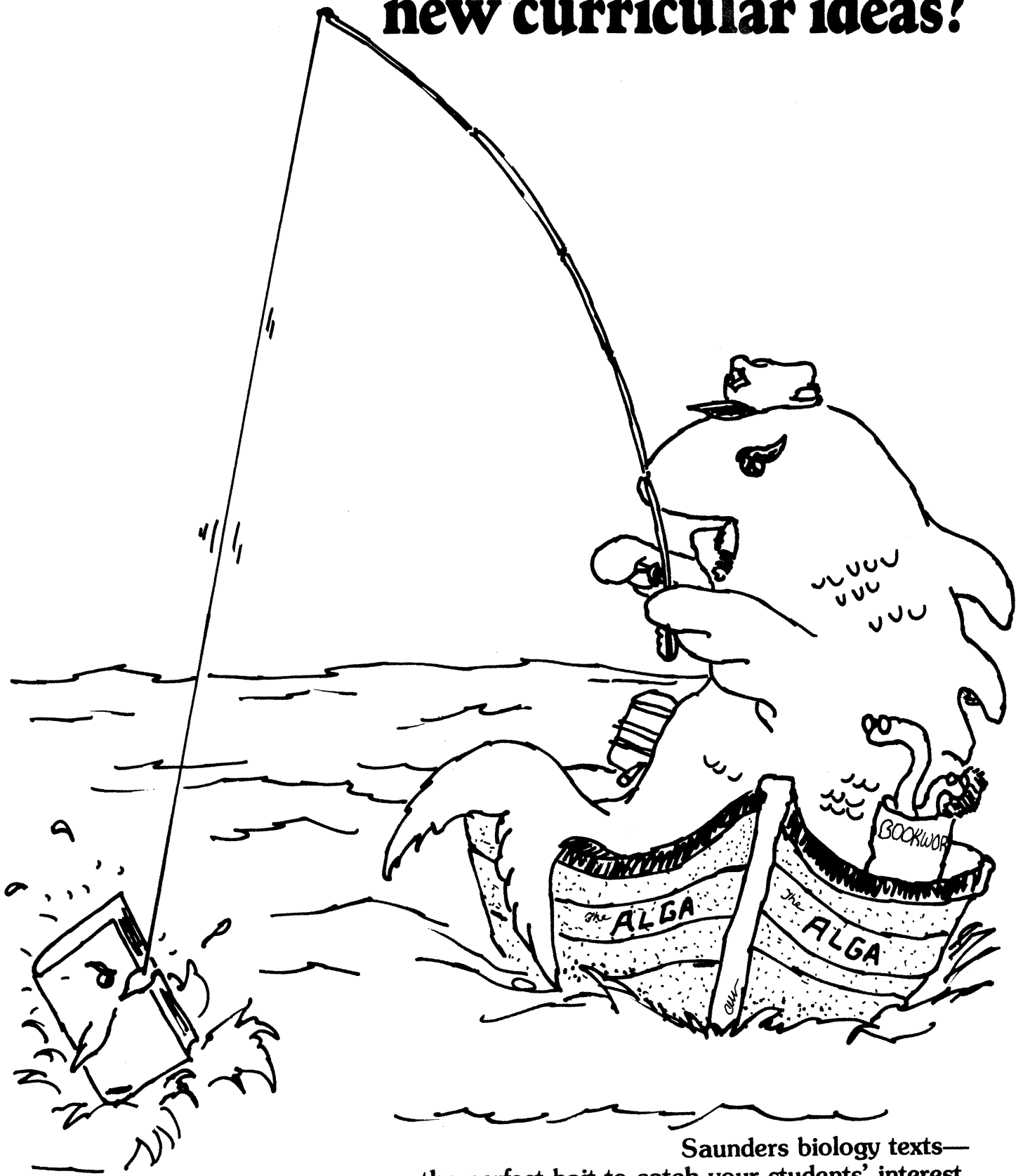
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COVER

Borefield (steam wells) at New Zealand's geothermal power plant. See page 795 [Robert C. Axtmann, Department of Chemical Engineering, Princeton University, Princeton, New Jersey]

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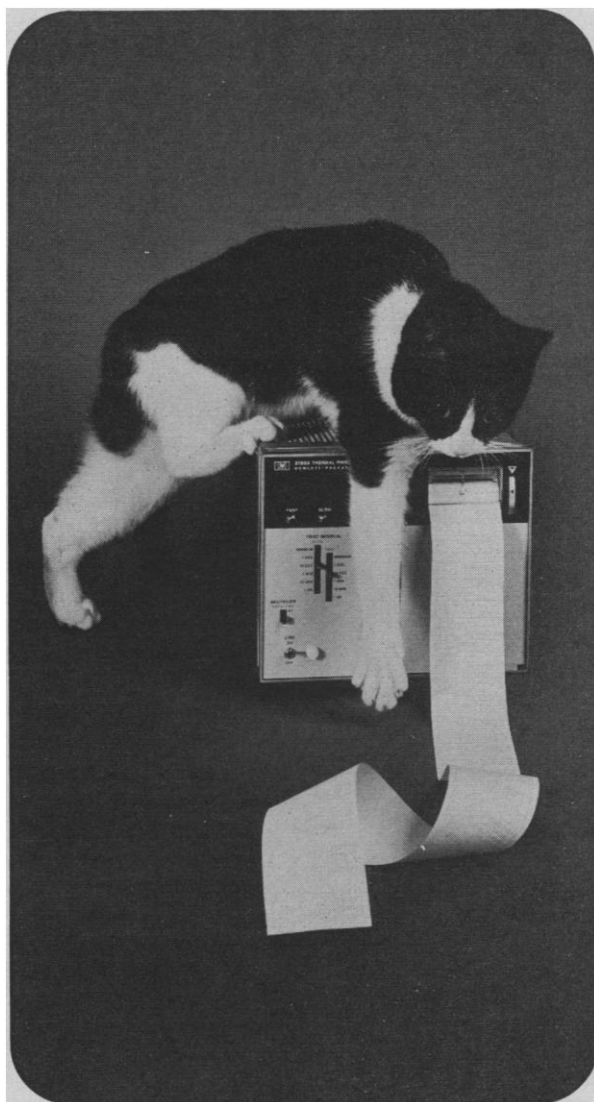
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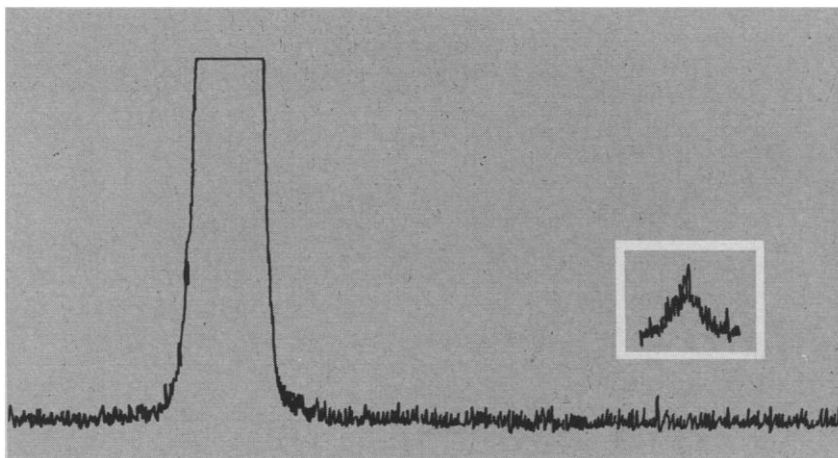
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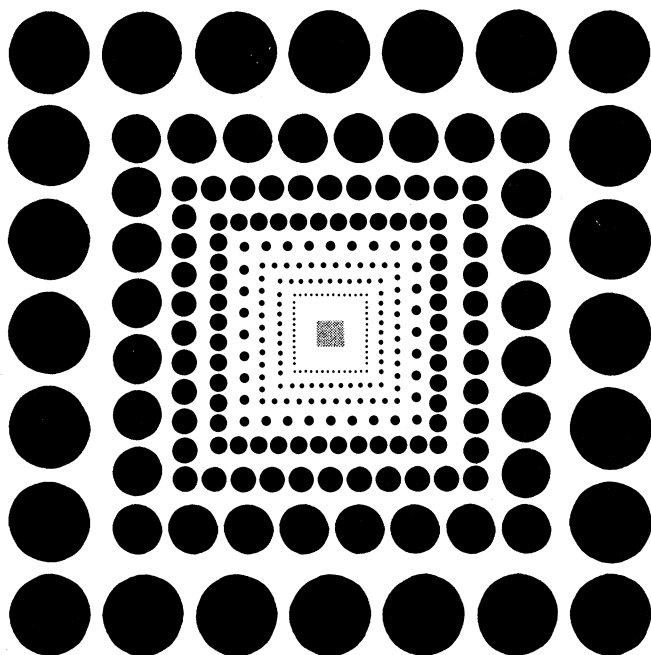
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DOTS

or

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It began to happen quite recently. Engineers, realizing that the mythical mind of the well-programmed and capacious digital computer does not boggle, put it to work translating mind-boggling complexities of logic into physical form. The ancient philosophers who invented logic as a game that is all in the mind had perhaps never actually encountered minds that do not boggle. To put logical constructs into a physical form that is readily multiplied, one turns to a craft generally credited to Gutenberg. The particular physical form, whether a metal-oxide-semiconductor (MOS) chip, a bipolar integrated circuit, or a charge-coupled device (CCD), rests also on subsequent contributions by the artists who invented photography, by the inorganic chemists who vied to discover new elements in rocks, by the physicists who invented quanta and electrons to explain their experiments, by the organic polymer chemists, even by us in one small way or another.

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Mineral Research in Turkey

Attending a meeting in Ankara during February was no holiday. Going and returning, about half of a group of 16 had some kind of mishap—lost luggage, canceled flights, or missed connections. Ankara was cold, electric power was intermittent, and there was a heavy acrid smog.

Despite these handicaps, visitors came away with a favorable view of Turkish vitality and enterprise. They were especially impressed with the Mineral Research and Exploration Institute of Turkey. The institute, known locally as MTA, is an important factor in the development of the country.

In 1935 when MTA was formed, there were practically no indigenous geologists in Turkey. Today MTA has a staff of about 3000, of whom about 1000 are Turkish professional people including geologists, geophysicists, geochemists, mining engineers, and other experts, many of whom had received grants from MTA for training abroad. The organization carries through projects ranging from the discovery of resources to the preparation of final comprehensive feasibility reports. These reports include careful evaluations of reserves based on extensive drilling, descriptions of pilot plant work demonstrating methods of ore concentration, and planning for production plants.

Most of the area of Turkey has been subjected to a series of tectonic events which have left very complex structures but also substantial mineral resources. Turkish geologists have produced good maps of their country and in the process have identified many exploitable occurrences. In recent years, geophysical methods have been particularly helpful. Airborne surveys have led to discovery of an iron ore deposit sufficient to meet the nation's needs for a generation. Laboratory and pilot plant studies have shown that the ore can be readily concentrated by magnetic separation. Airborne radiation measurements have also led to discovery of a large phosphate deposit, which will soon be providing all of Turkey's requirements.

The laboratories of MTA have made a significant contribution to solving local energy problems through development of a process that upgrades the quality of lignite, which is the country's largest fossil fuel resource. This dusty fuel has a relatively low energy content of about 3100 kcal/kg and a rather high sulfur content. When burned, the fuel produces fumes and smoke. However, MTA has obtained international patents on a process that produces a smokeless fuel yielding over 5000 kcal/kg and at the same time lowers its sulfur content. To obtain this result, the lignite is briefly heated to 400°C and compressed. Considerable water and most of the organically bound sulfur is thus driven off and the end product is a solid briquette.

A tour of the laboratories at MTA created a mixed impression. Some of the equipment was vintage 1940. Some of the techniques would be regarded in the United States as antiquated. However, there was also a considerable amount of modern equipment. The scientists were busy, absorbed in their work, oblivious to visitors.

Because it has good leadership and because it contributes importantly to meeting national needs, MTA enjoys good support from the government. Funds are provided with a minimum of haggling and Sadrettin Alpan, the director general of MTA, has complete freedom to reallocate funds once a budget is approved. Moreover, in contrast to the situation in the United States, appropriations are approved before the start of a fiscal year.

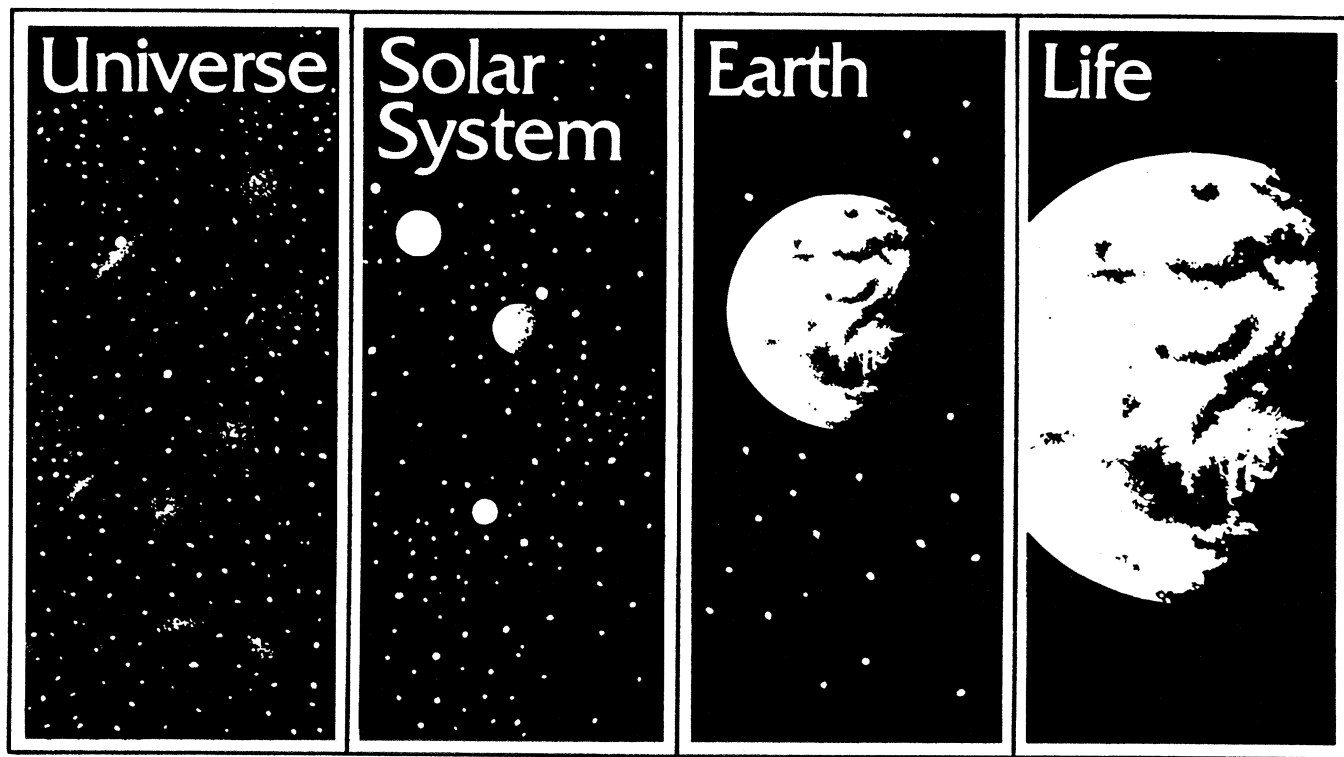
In its management and integration of research and development activities leading to exploitation of natural resources, MTA has been outstandingly successful. The organization could well serve as a model for other developing countries; even the United States might learn a lesson or two from it.—PHILIP H. ABELSON

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