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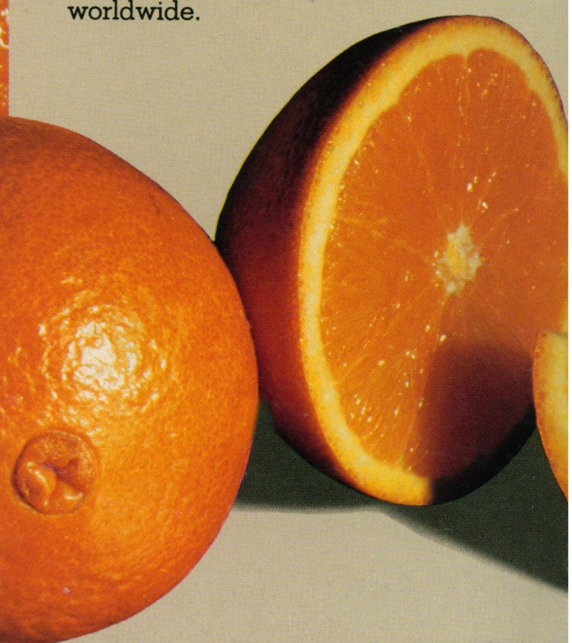

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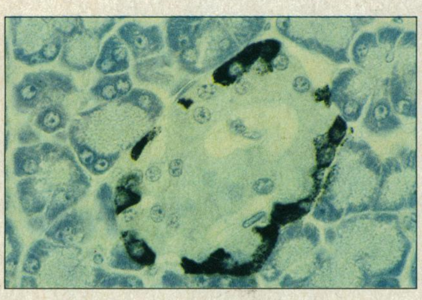

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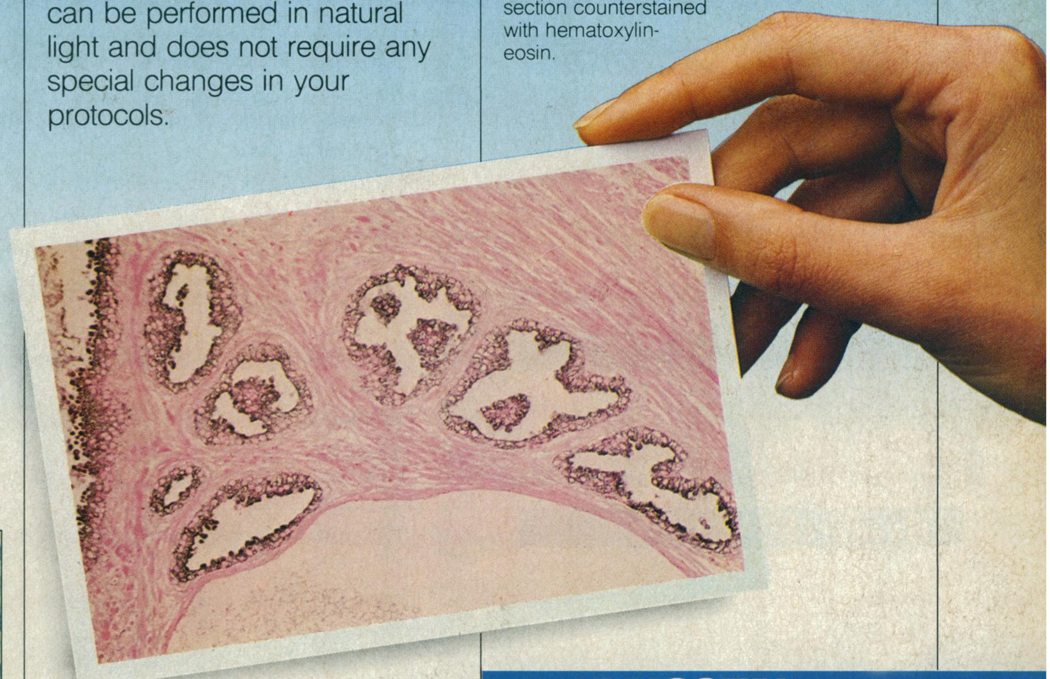

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SCIENCE

ISSN 0036-8075
26 June 1987
Volume 236
Number 4809

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COVER Caribbean sponges, similar to the large barrel-shaped *Xestospongia muta*, are almost exclusively heterotrophic, whereas many of those on the Great Barrier Reef rely heavily on symbiotic cyanobacteria for much of their nutrition. The incidence of symbioses in the two regions is comparable, but those in the Caribbean, like *X. muta*, typically have only a thin layer of red-brown symbiont–containing tissue. See page 1654. [Clive R. Wilkinson, Australian Institute of Marine Science, Townsville MC, Queensland 48101, Australia]

Reports

Technical Comments

Book Reviews

Products & Materials

Author Index to Volume 236 found on pages I–X.
Information for Contributors is found on pages XI–XII.

Chernobyl accident

AN American physicist who visited Chernobyl in February cites design flaws in RBMK-type reactors, which cause dangerous instability at low power, as the principal factor among several that led to the accident (page 1636). After the reactor began to malfunction, operators unfamiliar with elementary reactor physics took actions that then exacerbated the situation. Wilson describes impressive cleanup and containment operations at the plant and quick resumption of activity in the undamaged reactors (in contrast with a 6-year start-up time at Three Mile Island). Although a new and safer reactor has been designed and some are under construction, 15 RBMK reactors remain in operation in the Soviet Union and others are being built; despite the addition of safety features to these reactors, their inherent instability remains. Resettlement of communities near the plant is proceeding as environmental contamination drops and the cleanup operation continues.

Brain metabolism in three dimensions

IMAGES of brain metabolic activity in three dimensions have been generated by computer methods (page 1641). Hibbard *et al.* describe new computer programs that facilitate the conversion of two-dimensional autoradiographic data from serial sections of the brain to three-dimensional constructs and that convert digitized images to rates of glucose utilization. The methodology was illustrated in studies of glucose metabolism in rat brains in the presence of various anesthetics. Each anesthetic had a different effect on brain glucose metabolism: one depressed glucose metabolism throughout the brain, another caused elevated glucose metabolism in some regions but no change in most, and the third caused depression of glucose metabolism in one region but little change in another. This imaging method will be valuable for studying normal and abnormal brain metabolism, blood flow in the brain, brain receptors, and transport across the blood-brain barrier.

Water on Mars

THERE were times during the early history of Mars when there was water on the planet; today, the atmospheric pressure is so low that liquid water cannot remain on the surface (page 1653). The surface of Mars is cratered, includes a network of river, stream, and tributary beds of different ages (suggestive of several periods 3 to 4 billion years ago when the planet was wet), and has volcanic rock strewn over more than half its surface. The extensive volcanism is thought to have begun around 4 billion years ago and to have continued for most of the planet's history. Greeley estimated how much water could have been released from rocks brought to the surface during volcanic eruptions: geologic data collected during the Mariner 9 and Viking Orbiter missions, which included long-term observations and mapping of the planet's surface, were used for estimating rock volumes, and the water content of extruded magmatic rock was taken to be similar to that of mafic rocks on the earth. A layer of water 46 meters deep over the planet could have been contributed by volcanism. Other water could have come from different sources (for example, comet impacts). The forces that have been responsible for changing Mars from a wet to a desiccated planet are not known.

Coral reef sponges

SPONGES that live on coral reefs in the Caribbean Sea differ markedly from those that live on the Great Barrier Reef and on reefs off Fiji in the Pacific Ocean (page 1654). In earlier studies, Wilkinson found that most sponges on the Great Barrier Reef depend on photosynthetic symbionts (usually blue-green algae) for much of their energy supply; on outer reefs distant from shore, up to 90% of sponges were the flattened phototrophs with large numbers of symbionts throughout their tissues. In contrast, almost no phototrophic sponges were found on Caribbean reefs; sponges were tall and erect filter-feeders with only a thin layer of associated photosynthetic symbionts (cover). The Caribbean sponges consume an order of magnitude more particulate and dissolved organic matter than do their counterparts living in the clear waters of the Great Barrier Reef, and they were, on average, bigger. Species of sponges in the two oceans were different, and the biomass of Caribbean sponges was many times as great as the biomass at the Great Barrier Reef. It is likely that the evolution and success of distinctive sponge populations on these distant reefs reflect different levels of organic productivity in the ocean as well as other differences in the environmental conditions to which they were exposed.

New malaria parasites

NOVEL forms of malaria parasites have been generated through cross-fertilization of gametes in mosquito vectors (page 1661). In studies described by Walliker *et al.*, genetic recombination—reassortment of genes and exchange of genetic markers between chromosomes—between distinct *Plasmodium falciparum* parasites took place within mosquitoes. *Anopheles freeborni* mosquitoes were permitted to feed on mixtures of gametocytes of two cloned lines of *P. falciparum*, the most pathogenic human malaria strain. Sporozoites soon appeared in the mosquitoes' salivary glands, chimpanzees were infected with the sporozoites, and parasites were later isolated from the chimpanzees' blood. Genes from the two original clones were present in new combinations in the progeny: this was apparent in patterns of drug sensitivities, forms of several proteins (an enzyme, two antigens, and certain other proteins), hybridization patterns with DNA probes, and altered chromosome sizes. Control measures (vaccines and therapies) for malaria must take into account and overcome the ability of malaria genes to recombine and produce new pathogenic strains.

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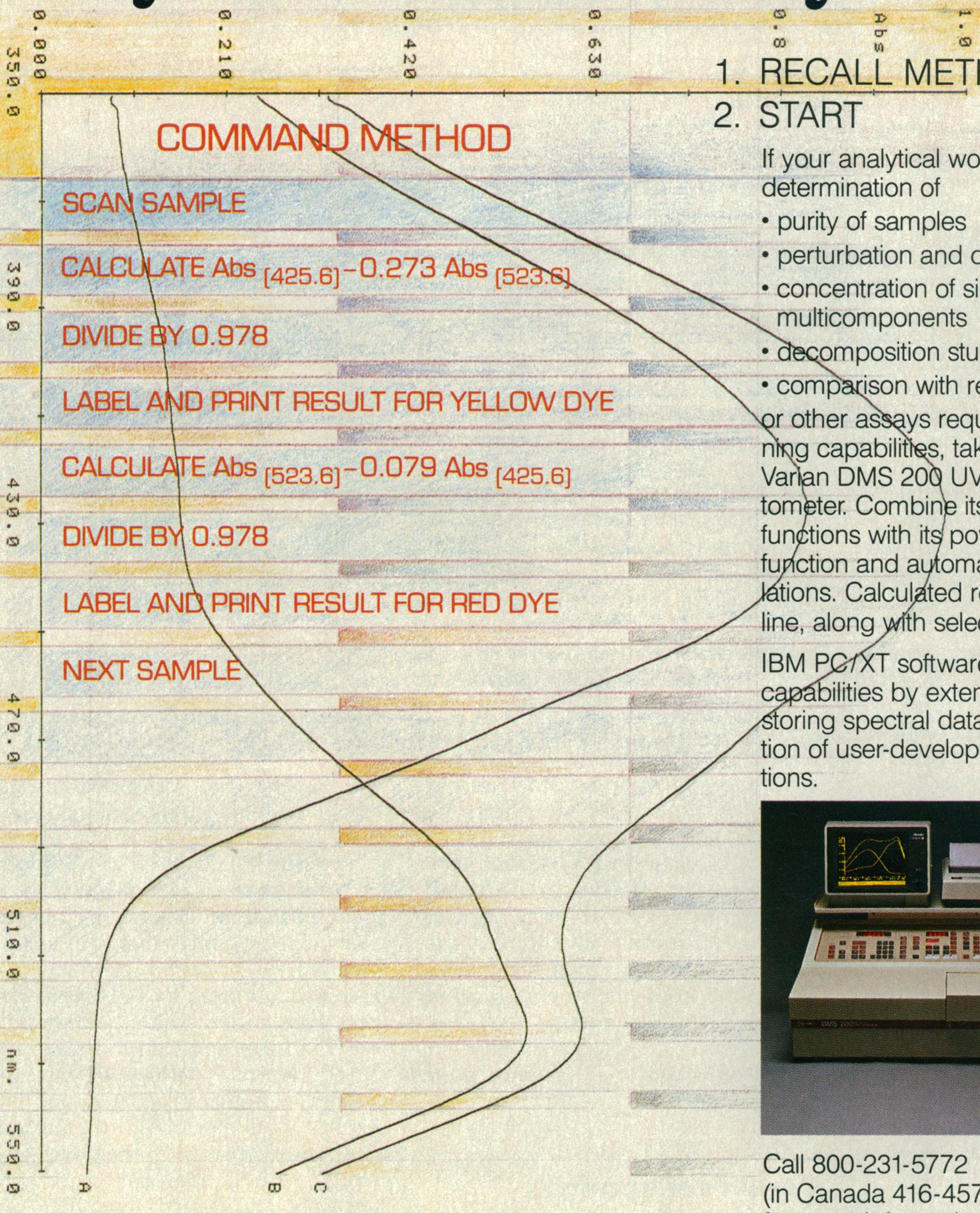


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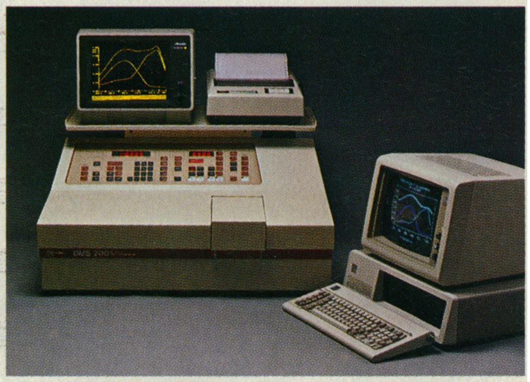

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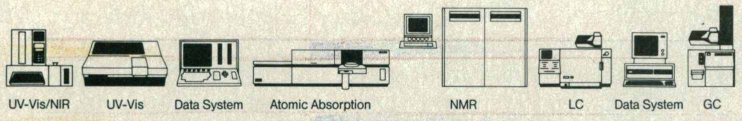

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SCIENCE

26 JUNE 1987
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Technology and Global Industry

Scientists are highly aware of a climate of rapid change in many technologies, including, for instance, those of computers and materials. But most of us have not been as conscious of a rapid globalization of industry and roles of international companies in promoting it. An interesting discussion of factors that have led to intense global competition in manufacturing is provided in a publication* that stemmed from a symposium conducted in 1986 by the National Academy of Engineering.

Globalization was rooted in a homogenization of markets, decreasing costs of transport and communication, and decreasing trade barriers. In the developed countries, national markets have become increasingly similar in taste as income distributions have equalized. In this changing environment companies noted that they could achieve growing economies of scale in their R&D and production through tapping global markets. Changes in product and process technology have increased the minimum efficient size for production in a variety of industries.

The multinational companies originally established factories abroad to avoid tariff and other barriers in various countries. But with time they perceived that they might attain cost advantages in the new locations. As the multinational corporations have gained experience at such locations, their subsequent responses to opportunities have been quicker and more assured. Earlier, their practice was to develop a new product or technology in the home country and to manufacture and market the products at home before introducing them abroad. With time, the pace has quickened, and technology may be transferred abroad almost as quickly as it is developed at home.

Technological changes in communications and transportation have greatly reduced costs to late-industrializing countries for assimilating technological information and for moving goods and people across great distances. They can be highly competitive in supplying finished goods. They can also manufacture many components at low costs. The multinational companies have been quick to locate plants in those countries or to buy components from them. The practice of out-sourcing is important and growing. With U.S. multinational enterprises accounting for two-thirds or more of U.S. industrial output, most U.S. producers will be ceaselessly looking abroad for cost reductions.

Many of us have hoped that competence in science and innovation would enable this country to be competitive in global trade. However, experience is showing that firms and nations can lose ground in the commercialization of advanced technologies at a time when they are the major sources for technological innovations of industrial significance. Rarely do patents confer perfect protection. Trade secrets are useful but only if the product can be distributed while the underlying technology is kept secret. Today, with widespread scientific and engineering competence and powerful analytical and computing capabilities, technological secrets are hard to keep. When a new product achieves widespread consumer acceptance, many companies are likely to produce it. The winners among them will be those who achieve low costs of manufacture and high quality and have marketing skill. The United States has been comparatively weak in achieving low-cost manufacturing with high quality. In the past, U.S. engineers have tended to shun the factory floor. In contrast, Japanese engineers are active there, and through a series of small incremental improvements they usually succeed in achieving substantial economies.

Another source of U.S. failure to compete is in the quality of the labor force, particularly in its lack of vocational training. Both West Germany and Japan are superior in these aspects. More important is the impact of military R&D on U.S. engineering talent. Roughly half of total U.S. R&D expenditures are devoted to military research. In Japan about 2 percent is allocated to that effort. Earlier, there were important spin-offs for the United States, but military hardware is becoming increasingly remote from civilian applications. Another source of U.S. failure is an archaic set of antitrust policies. There is also need to revise national policies to influence managements to respond to foreign competition by creating new facilities and achieving higher productivity here rather than sourcing aboard. —PHILIP H. ABELSON

***Technology and Global Industry: Companies and Nations in the World Economy* (National Academy Press, Washington, DC, 1987), $19.95.

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