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SCIENCE

Science in Japan

18 July 1986 $2.50
Vol. 233 ■ Pages 253–392

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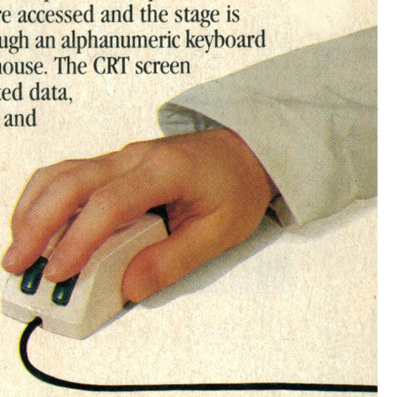

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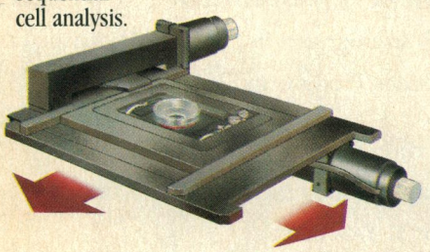

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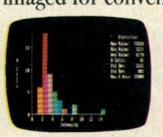

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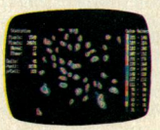

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COVER Traditional Japan, symbolized by this view of Nara's Muroji Temple, provides the cultural and social backdrop to the modern vigorous practice of science, technology, and economics that is emphasized in this special issue on Science in Japan. See page 291. [Photo courtesy of Japan Air Lines]

Reports

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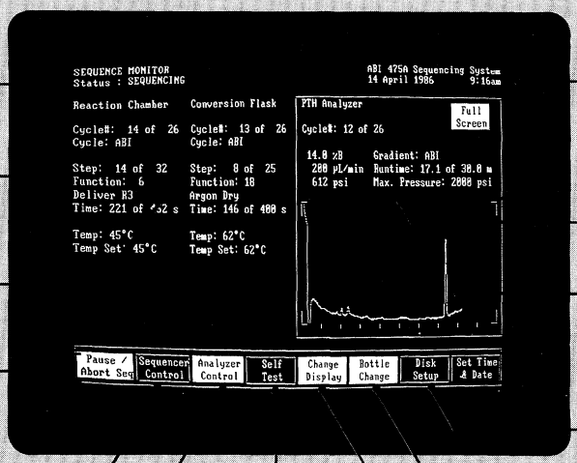

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Conversion Flask Status

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This Week in SCIENCE

Earthquake prediction in Japan

ONE of the most earthquake-prone countries in the world is Japan, which lies in the circum-Pacific seismic belt (page 324). It is thus no surprise that the country has a national earthquake prediction project aimed at forecasting where and when earthquakes will occur and how strong they will be. In one of the special articles in this issue on science in Japan, Mogi describes this program, the premonitory signs that are considered important in earthquake prediction, the seismic events that have preceded recent earthquakes, what precursors are associated with different types of earthquakes, and some of the complicating factors that have hampered attempts at forecasting. Because earthquakes tend to be periodic and some regions are "overdue," the ability of seismologists to predict when an earthquake will take place could be of major importance in reducing earthquake-related injuries and deaths.

Ordovician extinction

FIVE mass extinctions have punctuated and altered the earth's biological evolution; the second largest one that ended the Ordovician period (440 million years ago) reduced by 20% the diversity of families on the earth and included a major extinction of marine invertebrates (page 339). Wilde *et al.* assessed whether an asteroid or comet (bringing large amounts of iridium to the earth) could have been responsible for the Ordovician extinctions. No peak of iridium was found in the shale at Dob's Linn, Scotland, where the Ordovician-Silurian boundary is well demarcated. The amount of iridium in the shale decreases gradually across the boundary and was about two orders of magnitude lower than that at the Cretaceous-Tertiary boundary that marks the extinction event for which the impact theory was proposed. The iridium abundance at Dob's Linn was, nonetheless, high compared to iridium elsewhere; it correlated positively with chromium abundance, suggesting that the source of the two elements may have been rocks that originated deep in the crust or in the upper mantle of the earth. Thus, although the cause of the Ordovician extinction remains a mystery, one possibility—an impact—has been ruled out.

Strategy used by sole survivors

THE toxins secreted by *Pardachirus* soles protect them from predatory fish and sharks (page 341). Thompson *et al.* characterized dorsal and anal fin gland secretions from five *Pardachirus pavoninus* soles. Toxic substances called paradaxins containing 33 amino acids were able to kill killifish and had many properties and effects in common with the well-known toxic peptide of bee venom, melittin. Both are able to lyse red blood cells, both have hydrophilic, hydrophobic, and helical regions arranged in similar molecular organizations (although their primary sequences differ), both aggregate into tetramers under the same conditions, both are strong surfactants, and both lose activity when their amino-terminal regions are removed. Thus, although these toxins are secreted by phylogenetically distant organisms, they may act through similar mechanisms. The isolated preparations of the sole toxin caused sharks to attempt to escape. In addition to pardaxins, *Pardachirus* soles have several steroidal saponins that are secreted from the glands and that act as shark repellents. These fish are thus well protected from shark attacks.

Cold comfort for fish and bacteria

IN the cool springtime waters off the coast of Newfoundland, fish may thrive because bacteria do not (page 359). Such a scenario is proposed by Pomeroy and Deibel as a result of experimental observations of the metabolic events that take place during the spring bloom of phytoplankton. In April and May, when the water temperature is near 0°C, the phytoplankton engage in photosynthesis and generate organic compounds in the water. Because of the cold, bacteria have a low metabolic rate and do not consume much of the organic material; they do not grow and proliferate and are not, in turn, consumed by protozoa. The organic matter remains in the water and sinks to lower depths where it is available for use by other organisms (metazoan consumers, including both benthic and planktonic invertebrates), and these organisms are subsequently consumed by larger invertebrate and vertebrate grazers. Later in the year when the waters are warmer, bacteria may consume more organic material, and their food web may flourish; by that time, the food web leading to fish is thriving.

Human prion

SMALL hypothetically infectious prions have been associated with a number of degenerative neurologic diseases—scrapie, Creutzfeldt-Jakob disease, kuru, and Gerstmann-Straussler syndrome (page 364). In diseased brains, the protein molecules of the prions, called PrP 27–30, assemble into rod-shaped aggregates resembling amyloid plaques. Liao *et al.* isolated and characterized the human prion gene from which the protein comes (rodent genes had been isolated previously) and mapped it to a single location on human chromosome 20. The deduced human PrP has an amino acid sequence that is 89% homologous with the rodent sequence, indicating considerable conservation in evolution; both proteins have conformational features characteristic of amyloid. Since the prion has been retained through evolution (similar structures are found also in amphibians, insects, and plants), it probably has an important normal biologic function. Its association with specific diseases may occur when the molecule is altered or produced in some unusual way.

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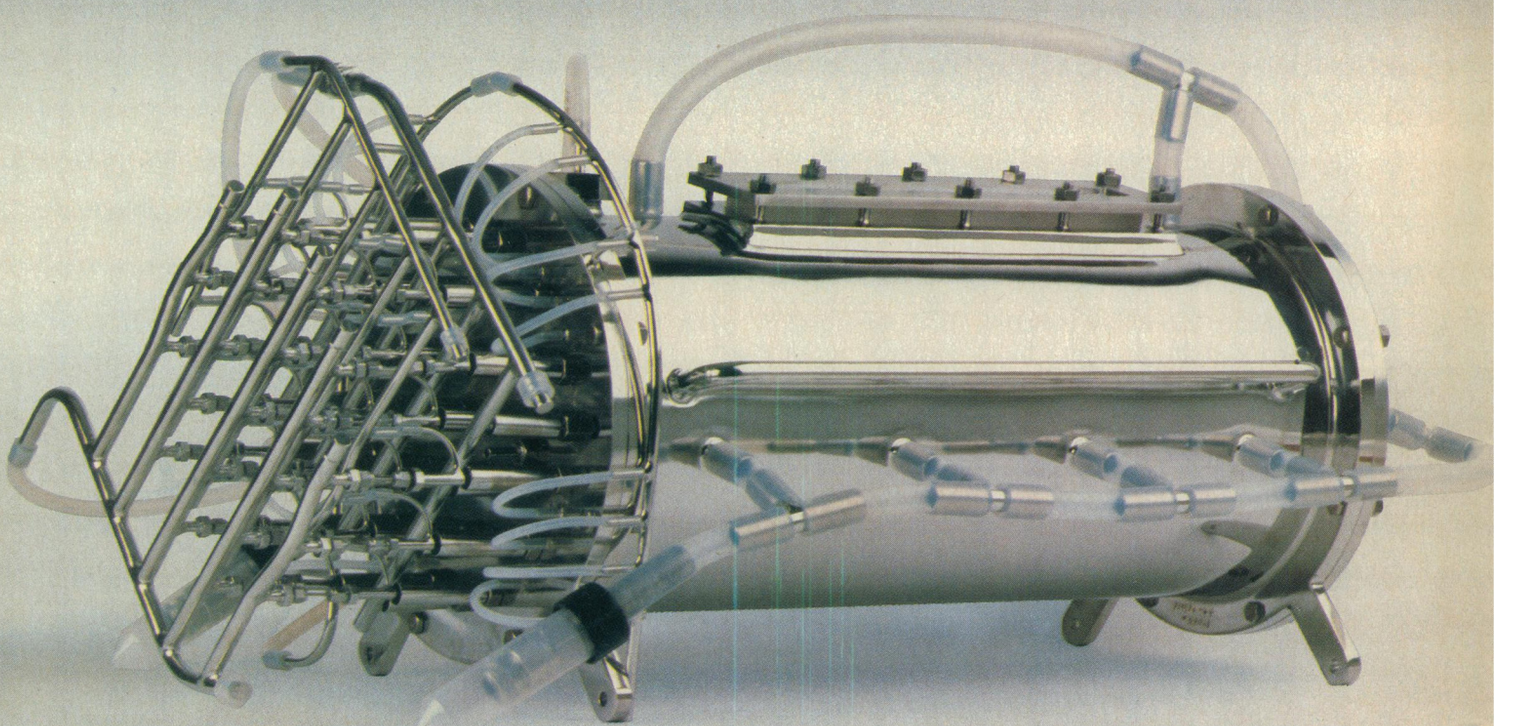

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SCIENCE

18 JULY 1986
VOLUME 233
NUMBER 4761

Science in Japan: A Status Report

The nations of the world are saying, "We have seen the future, and it is Japan." A combination of awe, fear, and respect has been earned by a country whose history is as amazing as its present achievements. A nation with half the population of the United States occupies an area about the size of the state of Montana, but more than 80 percent is inhospitably mountainous. Japan imports most of its raw materials, almost all of its iron ore and petroleum, and all of its rubber, wool, and cotton. Yet it has one of the highest literacy rates and school attendance rates and one of the lowest crime rates among the developed countries.

How has this success story been achieved? The envious hypothesize that it is a combination of low-wage rates, willingness to emphasize application at the expense of innovation, and centuries of tradition that have taught docility and loyalty to the population. Admirers say that it is a combination of realistic appraisals, exemplary discipline, and imaginative policies. The readers of this issue of *Science* will find that Japan today has mixed these qualities in a way that is perhaps even more amazing than the simplistic paradigm of either extreme. Those who would like to believe the low-wage–docile-worker explanation had better read the story by Constance Holden on the Toyota–General Motors automobile plant. There, American workers on American soil are responding to Japanese management techniques in ways that are bound to revolutionize that industry. Those who would like to believe the all-they-do-is-imitate myth should read the lead articles by the world-renowned Japanese investigators Fumio Kodama, Ryogo Kubo, Shigeo Minabe, Kiyoo Mogi, Teruaki Mukaiyama, Yasutomi Nishizuka, Takashi Sugimura, and Toshimitsu Yamazaki. They represent the many Japanese scholars now doing pioneering work and making fundamental contributions to basic research across the spectrum of science from mathematics to the social sciences.

Perhaps even more impressive than the successes already achieved is that this nation, which learned early in its history that it would have to live by its wits, is even now reexamining the operation of its most venerable institutions, as Eliot Marshall reports. The school system, which on the basis of statistics might be assumed to be sacrosanct, is being reappraised by Japanese authorities because some believe more freedom and creativity are needed if it is to serve as the base for the increased innovation in the future. While recognizing the important historical value of imitation and applied science, Japan's current leaders are examining the need for a heavier emphasis on basic research. Articles by Mark Crawford and Leonard Lynn describe the economic and industrial changes that will be required to adjust to a global economy and a saturated Japanese market.

As a modern phenomenon this story is astonishing. As an extension of history it is perhaps less so, for Japan has had a legacy of adaptability. Its closed society in the 1800's responded to its clash with Western aggression by determining to learn from it. The Meiji emperor, with the help of a far-sighted group of native leaders, sent emissaries to the United States and to Europe to follow the principles of *Wakon-yosai*, the adaptation of Western concepts to fit into a Japanese cultural framework. Even earlier in its history this same nation had profited by the philosophy of *Wakon-Kansai*, the conversion of Chinese learning into Japanese values. In more recent years Japan embarked on a militaristic phase but recovered from that ill-fated period to develop a society with no significant armed forces at all. Its present leaders are already planning to modify possibly the world's most successful industrial society to prepare for the changes predicted for the 21st century.

It is a noteworthy and rare human being who is highly disciplined and yet readily adaptable to change. It is astonishing when a nation is capable of being introspective, rational, and decisive. If Japan were perfect for this instant in time, we would admire it as a rare, artistic creation of beautiful glass sculpture whose fragility would be vulnerable to future shock. That it is less than perfect, yet constantly willing to examine its imperfections and act on them, means that it is made of a metal that will last for ages. No one magazine issue—in fact, no book—can analyze comprehensively the phenomenon of modern Japan, but readers of this issue will be able to infer on reasons for its past accomplishments and will be able to recognize some of the seeds of future greatness.—DANIEL E. KOSHLAND, JR.

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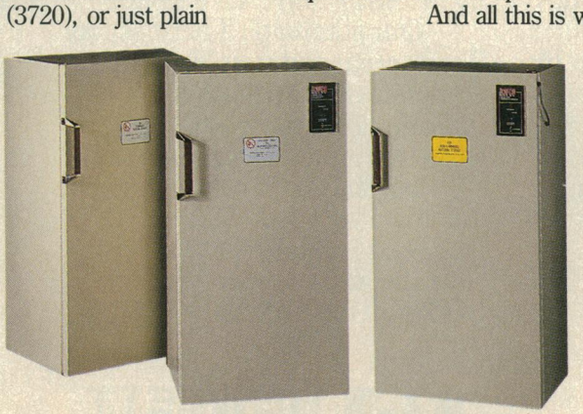

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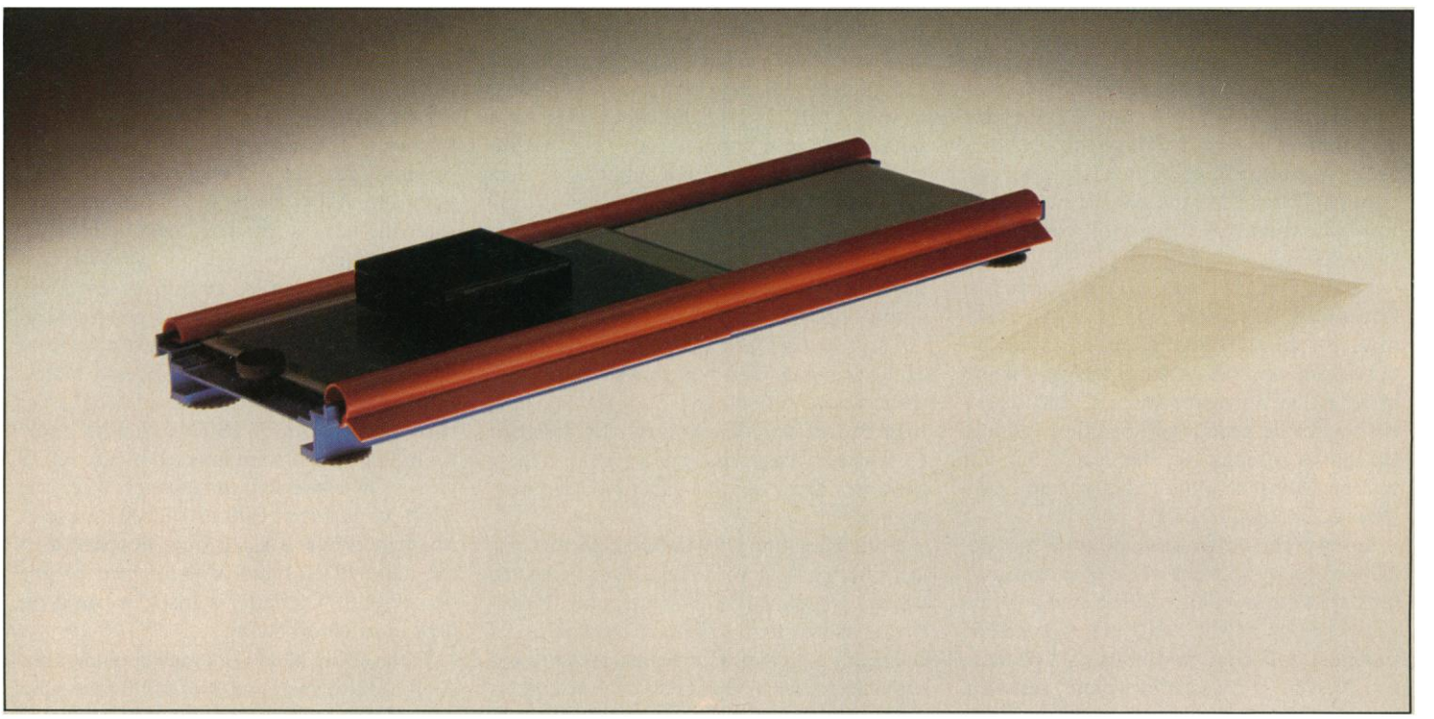

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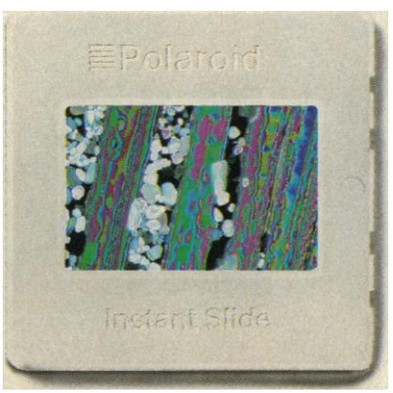

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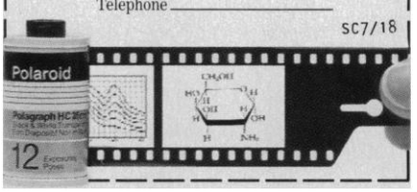

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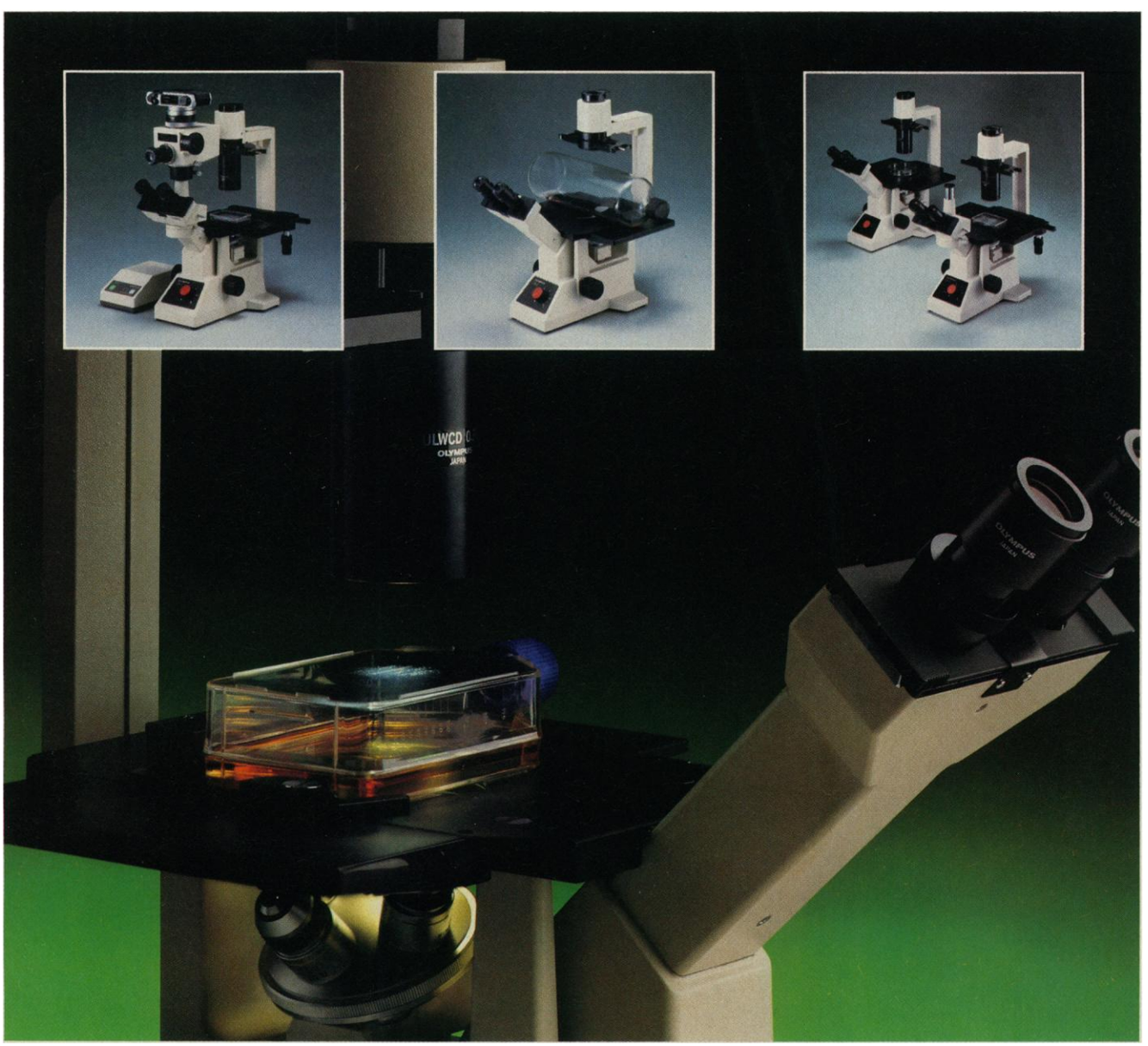

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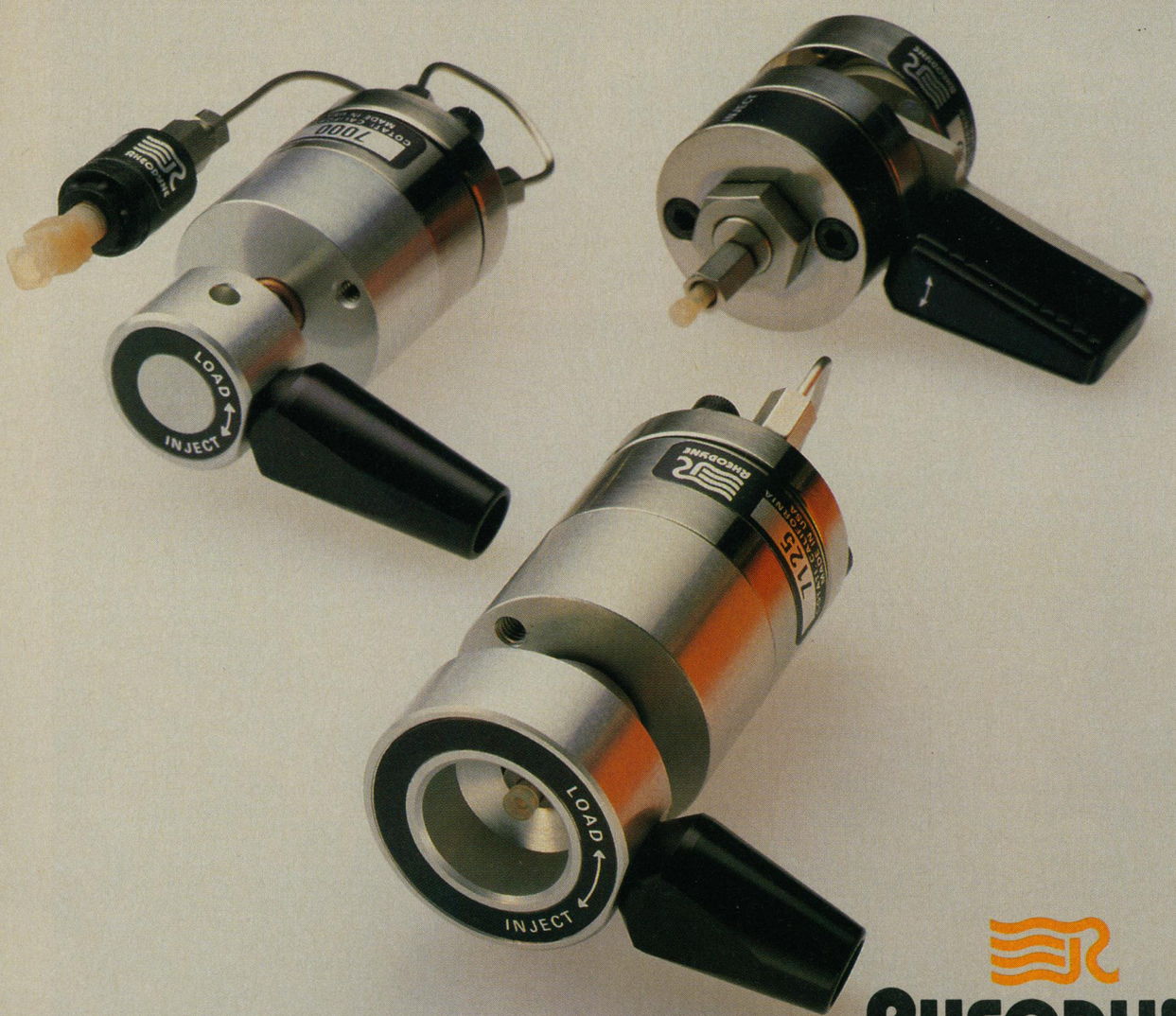

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