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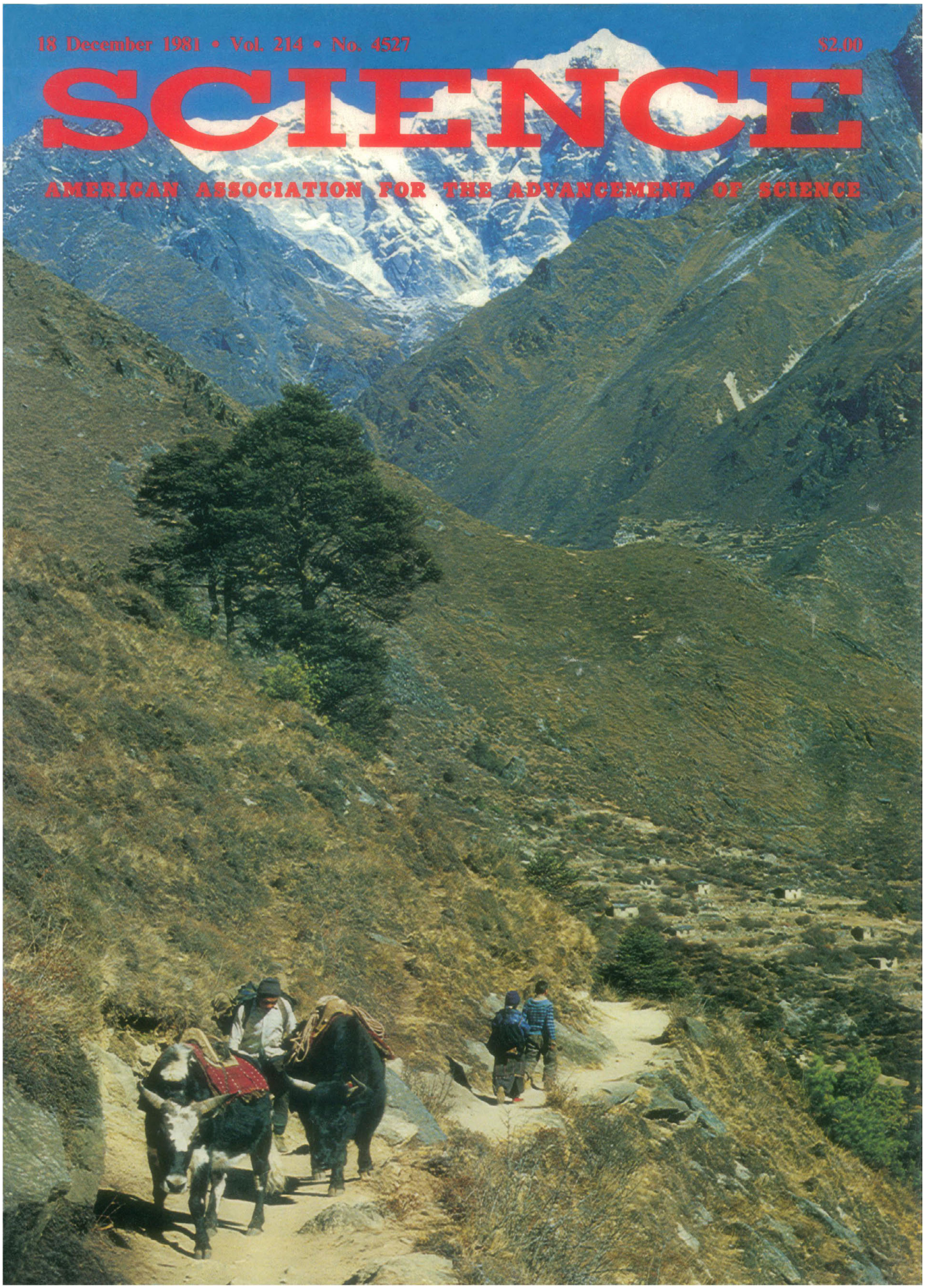

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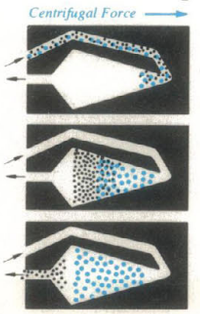

1. Sample suspended in a medium enters Chamber.
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3. Flow increased—slow-sedimenting particles elutriated out of chamber.

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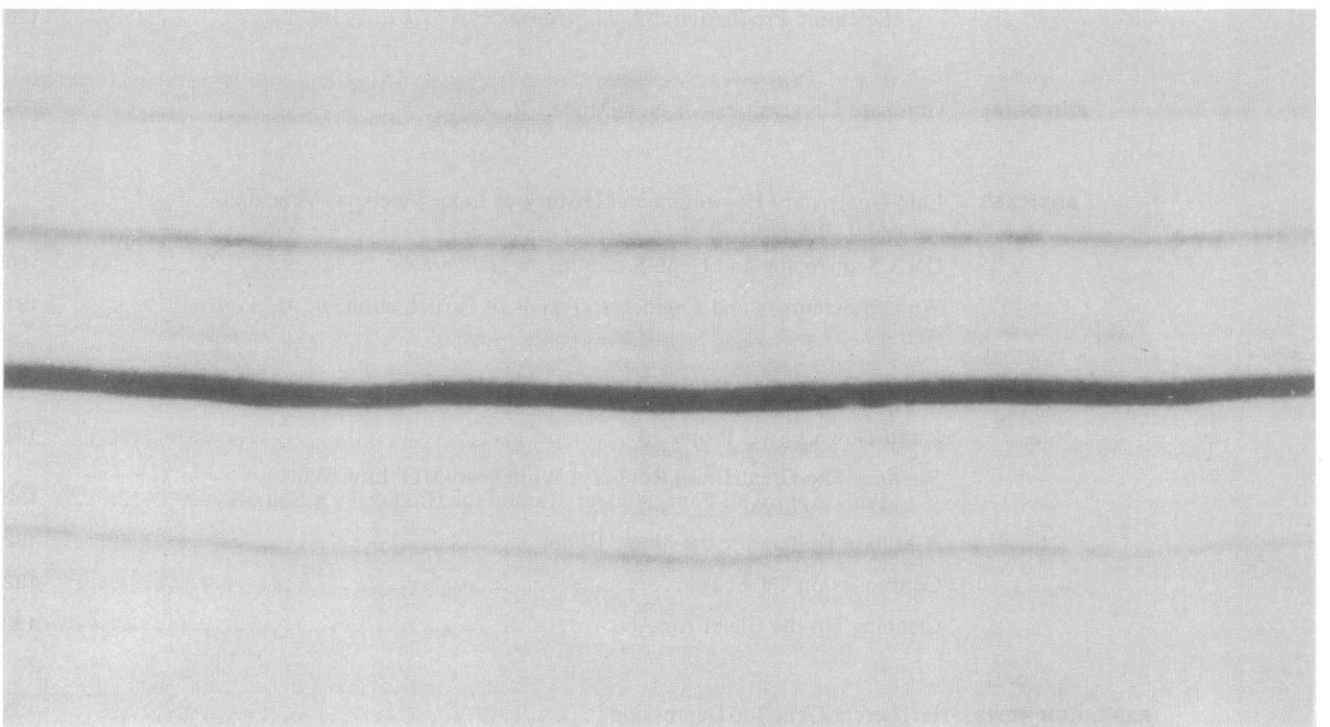

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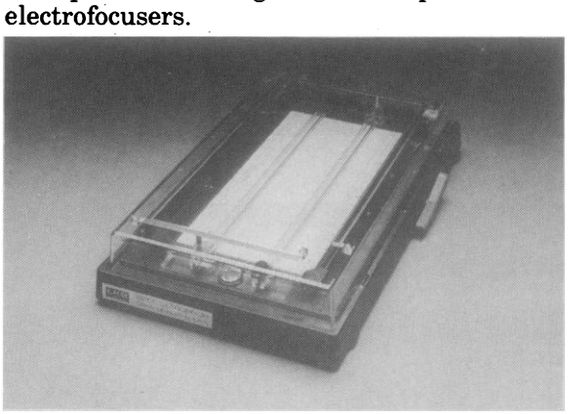

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COVER

Taboche Peak (elevation, 6400 meters), Khumbu region, Nepal, as seen from trail near Kumjung. The trail traverses roughly 200 kilometers from Katmandu to Mount Everest Base Camp and is the main artery connecting Himalayan villages in this area. Far from industrial sources, air pollution in the Khumbu valleys can be attributed to local wood and dung fires used for heating and cooking. See page 1344. [Cliff I. Davidson, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213]

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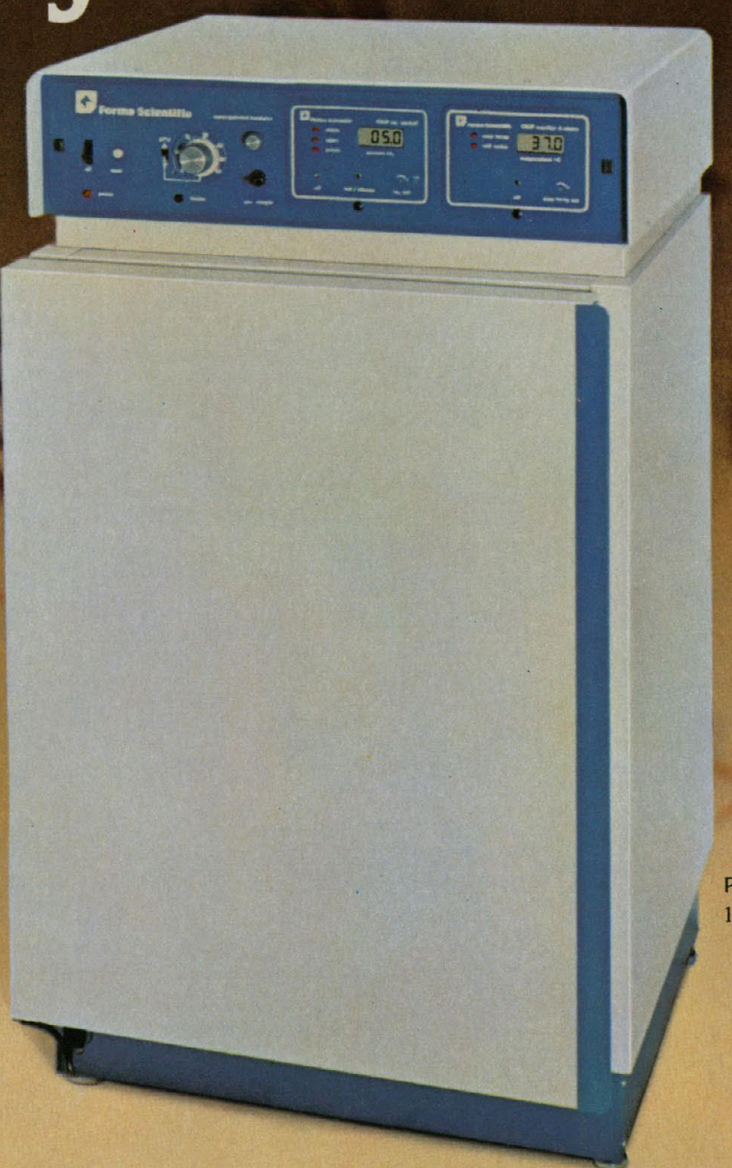

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18 December 1981, Volume 214, Number 4527 SCIENCE

Graduate Universities—A New Model

The serious troubles facing graduate education in the applied sciences and engineering are well known: while undergraduate enrollment is skyrocketing, graduate enrollment is down and consists of between 50 and 75 percent foreign students in some fields. Teaching loads of faculty are up, but university presidents are loath to increase tenured faculty slots, and in some fields young American faculty are virtually unobtainable anyway. Equipment for state-of-the-art research is extremely expensive and difficult to acquire and maintain. It appears certain that there will be no return to the universities' golden age of the 1960's.

What is needed now is thinking about new models for educational structures. I confine my remarks to graduate education in applied science and engineering in proposing the formal creation of new interinstitutional structures (interversities?) based simultaneously in the major industrial and government research laboratories and in the universities.

The obsolescence of the research capability in the universities is not only a matter of money or instrumentation. It is chiefly one of organizational capability. Given the present social and financial climate, most universities are simply unable to innovate on any front. I cite as one specific area the state of interdisciplinarity on the campus. Industry and government laboratories routinely bring scientists with different disciplinary backgrounds together to work on a problem, but universities have not been able to devise stable structures to do the same, even with federal financial incentives. In most of the applied sciences the sacrosanct departmental unit is now well below critical mass, with respect not only to personnel and equipment but to the sheer intellectual breadth necessary to define important problems. Many of our best young minds are unnecessarily shielded from society's needs partly expressed in industry's needs.

It is my thesis that there is one obvious solution, at least in the applied sciences—wherever modern engineering and science are put into the service of national purposes. This solution requires the creation of a new cooperative institution of higher education which marries the best the university has to offer with the enormous educational potential of the industrial (and government) research laboratories. In the laboratories of Bell Telephone, IBM, Xerox, General Electric, Hewlett-Packard, Brookhaven, Oak Ridge, and the like there are concentrations of Ph.D.'s greater in number and comparable in quality to those in approximately 90 percent of individual universities in most applied science fields. The same laboratories maintain and continuously update the array of equipment needed for modern scientific research. Education of great numbers of American scientists is already going on in these laboratories. Can it not be made more effective and extended by formal combination with nearby universities?

The proposal is simple. A formal consortial unit is established between a university department (or interdisciplinary degree program) and six to ten of the major industrial (or government) research laboratories with outstanding capabilities in the field. New requirements are agreed upon for the M.S., Ph.D., and possibly a new intermediate degree. Such degrees would require less continuous time on the campus—one term (or two) for the M.S., perhaps two for the Ph.D. Most of the research would be done in the industrial research laboratory under the supervision of the specifically appointed adjunct faculty members within that laboratory. This scheme makes especially good sense for institutions just below the first rank, which could become regional leaders in combination with nearby industries.

The financial and organizational plight of the universities is such that a marriage between large industrial (and government) laboratories and the universities will require a new private sector initiative at the very highest levels, aided eventually with federal incentives. I am sure that under such circumstances some of what Clark Kerr classified as "multiversities" will formalize what many already permit, and become eager partners in the "interversities" of the future.—RUSTUM ROY, *Director, Materials Research Laboratory, Pennsylvania State University, University Park 16802*

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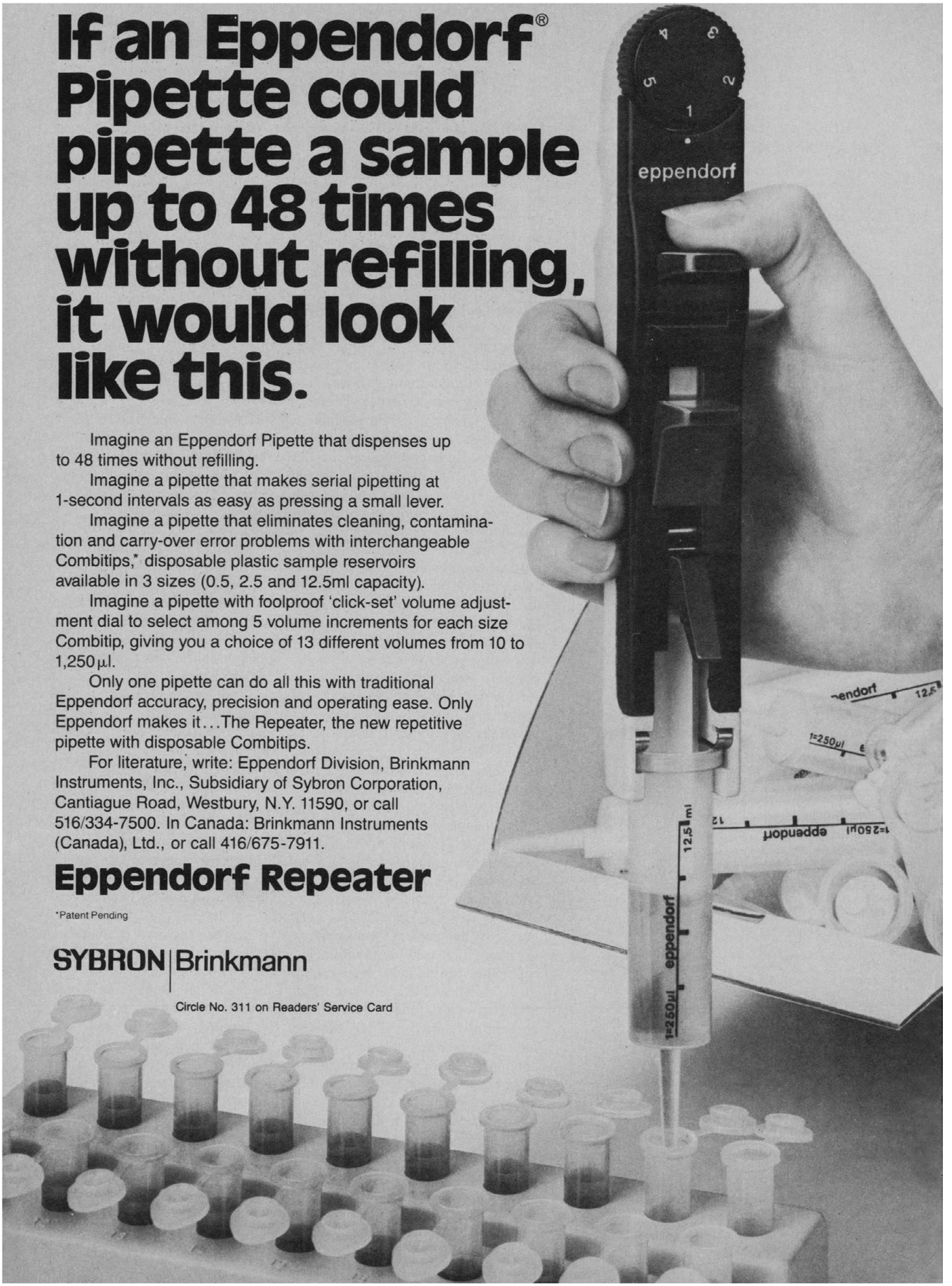

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