on current LWR technology!

While the LWR does not have optimal fuel utilization, one must remember that it was developed for submarine use and had a substantial head start. Other reactor concepts may indeed be viable, or even superior to the LWR, but they will not be developed unless the reactor vendors can see a large enough potential market.

If the government were to offer Westinghouse or General Electric or any other repository of nuclear expertise a share in the development and manufacture of a molten salt breeder, or a heavy-water thorium-cycle reactor or any other alternative type, I am willing to bet they would accept the research monies, quite readily, and produce an acceptable and marketable design rapidly.

JACK PENKROT
5/19/77 *Pittsburgh, Pa.*

Nathiagali summer college

Nathiagali—the name takes one from the scorching summer heat of the Punjab plains to the heavenly scenic hill resort (altitude 8000 feet) 50 miles northeast of Rawalpindi in northern Pakistan with snowclad views of Nanga Parbat and other Karakaram peaks. A small village, only known to those seeking escape from the heat, has become the home of the international summer college on Physics and Contemporary Needs. The first two colleges have been held in August 1976 and June 1977 and more are planned. The college is attended by participants from thirty countries and is perhaps the first of its kind to be organized in a developing country with its emphasis on physics and its applications to technologies useful for developing countries and the role it can play in solving the problems of a developing nation.

The major aim is to offer to the large number of physicists of developing countries, most of whom have had the training in fundamental research in an environment of a European-American University, a broad spectrum of topics ranging from solar energy, oceans, geophysics and lasers to elementary particles and black-hole physics. Some fundamental topics are included to share the excitement of the recent front-line discoveries in elementary particles, astrophysics and cosmology, with physicists isolated from the main stream of today's research. However, the college's main role is to encourage physicists to contribute to the development of fields relevant to the needs of developing countries. Participants have discussed examples where physicists have successfully helped in solving problems not only in technology and energy but also in transport, communications and planning. One result from these discussions has been awareness of the need to establish an international center for experimental physics along lines similar to that of the International Centre for Theoretical Physics at Trieste, primarily aimed at offering reasonable research facilities to physicists from developing countries. High costs and technological restraints make the establishment of such centers on a local basis very difficult.

Need was also felt to encourage the physicists from developing countries to devote at least some of their time doing physics that would relate to local developing technologies. Perhaps the most noticeable feature of the college was the intellectual hunger, so evident from the high-level participants who have so long been isolated from the mainstream of ideas and developments in physics, both in theory and experiment. One must record the participants' appreciation to the Chairman of the Pakistan Atomic Energy Commission, Munir Ahmed Khan, for his personal interest in the working of the seminar, to the local director of the college, Professor Riazuddin, and to their devoted staff.

In view of its success, the Pakistan Atomic Energy Commission plans to continue the college as an annual event. If these plans are realized, the Nathiagali Summer Science Centre would revive an academic tradition that existed some fifteen hundred years ago in Julian University near Taxila (forty miles away from Nathiagali) where scholars from all over the then known world gathered to contemplate problems of society, civilization and the world.

KHALID RASHID
Pakistan Institute of Nuclear Technology
8/24/77 *Rawalpindi, Pakistan*

Laser Raman spectroscopy

In his recent article on coherent Raman spectroscopy (May, page 44) Marc Levenson wrote . . . "fifteen years ago, the development of gas lasers completely revolutionized the practice of Raman spectroscopy." Later on after making remarks on tandem monochromators, cooled photomultiplier tubes and so on he continues with: "What had been a difficult and exotic technique became a routine analytical procedure for studying vibrational and other elementary excitations of materials."[1] Reference 1 lists two books that do indeed give a survey concerning the progress made. Unfortunately one does not find too much in these books about the early history of laser Raman spectroscopy—that is the period 1962–66 when lasers were used to demonstrate that Raman spectra of strongly scattering molecules could indeed be excited as well as stimulated—and other fundamental Raman processes. Already

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in 1962, S. P. S. Porto and D. L. Wood,[1] using a pulsed ruby laser, photographed a vibrational Raman spectrum. Boris Stoicheff[2] obtained similar results in 1963, and E. R. Lippincott[3] of the University of Maryland photographed a spectrum of a colored compound. Then in 1963, Porto and H. Kogelnik[4] photoelectrically recorded spectra with the sample inside the laser cavity of a He–Ne laser, and finally photo-electrically recorded vibrational spectra taken with the sample outside the cavity are shown in a letter by J. A. Koningstein and R. G. Smith.[6] This letter appeared in the same August issue of *JOSA* as Porto and R. C. C. Leite's paper[5] in which they claimed to have also observed spectra with the cell outside the cavity. These initial results were obtained while Porto, Kogelnik, Leite, Wood, Koningstein and Smith were at Bell Labs and Stoicheff at the National Research Council. Developments in laser Raman spectroscopy also took place in England. G. W. Chantry[7] *et al.* (1964) —like Lippincott—obtained spectra of colored compounds and J. P. Russell,[8] while at the Radar Research Establishment, of single crystals (1965).

The deluge of photoelectrically recorded spectra, initially of solids (phonons) was to come after 1964, but it should be remembered that the stimulated Raman effect was already observed in 1962 by E. J. Woodbury[9] *et al.*, the inverse Raman effect by Stoicheff and W. J. Jones[10] (1963), the hyper Raman effect by R. W. Terhune, R. D. Maker and C. M. Savage[11] (1965) and electronic excitations by Koningstein[12] (1966) and C. H. Henry, J. J. Hopfield and L. C. Luther.[13] As a result of the renaissance of Raman spectroscopy there are now two series of conferences—Light Scattering Spectra of Solids, and The International Conference on Raman Spectroscopy—and moves are underway to celebrate the 50th anniversary of the discovery of the Raman effect during the coming year. The proceedings of these conferences reflect the interest in the field and contain experimental and theoretical information that is related to one or more of the fundamental excitations mentioned above.

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J. A. KONINGSTEIN
Chairman
Raman Section Technical Group
Optical Society of America

6/22/77

THE AUTHOR COMMENTS: J. A. Koningstein's chronology of the first laser revolution in Raman scattering aptly parallels my account of the more recent developments in nonlinear mixing spectroscopy. Then, as now, there were a variety of competing techniques with various claimed advantages. Then, as now, the newfangled instruments were more difficult to use than the standard apparatus. Ultimately, however, a new standard technique could concentrate on the systems being studied rather than upon the methods needed to study them. The revolution was a great success, and the contributions of those who led it should not be forgotten. A more extensive memoir of the period from 1962 to 1966 might well be in order. My own article was not an attempt to recount those successes, but rather a report on the present status of Raman techniques employing nonlinear mixing, which at present are at the level of development that the more established techniques had achieved in 1965.

MARC LEVENSON
University of Southern California
Los Angeles, California

7/5/77

CBO is not OMB

A relatively minor but amusing and instructive error crept into the text of the article "Four Years of Congressional Science Fellows" (August, page 36). On page 37, the article lists several organizations "that support Congress," and the list includes the Office of Management and Budget (OMB). The institution originally cited in a revised manuscript submitted to PHYSICS TODAY was not OMB, but the new Congressional Budget Office (CBO).

Among people knowledgeable about the operation of the federal government, the notion that the OMB supports Congress produces either gales of laughter or snorts of disbelief. While individual re-