curricula of different physics departments should occur.

Faculty attitude. The attitude of physics faculties toward careers in applied physics, engineering physics, and public-interest physics should change toward a greater acceptance of these careers. They should be accepted as equal to the traditional careers in the heirarchy of values of the physics community. A change in the reward structure of physics to reinforce the change in attitude should be considered.

Applied physics. Physics departments should establish ties with applied research laboratories in industry, government and other institutions. These ties may influence the selection of research areas at the university departments, may lead to greater awareness by the faculty of emerging technologies, and bring about a greater involvement by faculty and students in cross-disciplinary contacts.

Nontraditional fields. It should be made clear to each student early in graduate schoo! that there is at least a 50% probability that he will have to build a permanent career in a nontraditional field of physics or in a field completely out of physics. The student should design his graduate program accordingly.

Teaching in non-PhD granting institutions. Although there is no total growth in the physics faculties of masters-granting or bachelors-granting institutions, there are some career opportunities in these institutions for physicists who know and can teach nontraditional fields such as oceanography or atmospheric physics. There are also teaching career opportunities in junior colleges and high schools. But a PhD will often be too expensive for the school district. Physicists heading for those careers might better stop at the bachelor, master or doctor of arts level.

Career mobility among older physicists. Career changes are highly desirable and could benefit everyone. For example, during his sabbatical a professor might be encouraged by his institution to work in an area outside his speciality. He might end up liking the new area, leave his old career, and make a job for a young physicist. Department policies might, through the offer of seed money or reduced course load, encourage faculty members to try nontraditional fields, thus producing openings for young physicists in a traditional field.

The entire conference was greatly indebted for much of its financial support to the Ford Motor Company Fund, Esso Research and Engineering Company, E. I. du Pont de Nemours and Company, and Corning Glass Works.

An account of the conference with short versions of many of the papers will be published in an issue of the *Newsletter* of the Forum on Physics and Society [Vol. 4, No. 1 (1975)]. The abstracts of the conference appeared in the July 1974 issue of the *Bulletin of the American Physical Society.*

References

1. L. Grodzins, Newsletter of Forum on Physics and Society **4,** No. 1 (1975). Bull. Amer. Phys. Soc. **16,** 737 (1971).
2. S. Ellis, AIP Publ. No. R-151.11, May 1974.
3. B. F. Porter, S. F. Barisch, R. W. Sears, PHYSICS TODAY, April 1974, page 23.
4. A. M. Cartter, Science **172,** 132 (1971). For a criticism of Cartter's and similar "pessimistic" projections (such as our own) see: T. R. Vaughan, G. Sjoberg, Science **177,** 142 (1972).
5. D. A. Bromley, PHYSICS TODAY, July 1972, page 23.
6. S. Kasden *et al.*, Report on the Education of Physicists Symposium, Batelle Memorial Institute, Seattle, 1971 (unpublished).
7. G. Hardin, Science **162,** 1243 (1968).

MARTIN L. PERL
Stanford University
R. H. GOOD, JR
The Pennsylvania State University

Ode to charm

The world of nuclear power
is full of sinister "charm."
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at a three-billion electron-volt arm.

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in the wake of an unheard of smack—
A gentler approach is producing
a mere bit of "strangeness"—alack.

Oh man, were you made of that matter!
Would you too exude charm on attack!!
But, alas, you react to the latter
with nothing but counter-attack.

TRUDE WEISSKOPF
Palo Alto, California

Extending the interferometer

In his excellent article "Michelson and his interferometer," Robert S. Shankland retraced the history, indeed most fascinating, of Michelson and his work (April, page 37). This account, however, omitted almost entirely a recent extension of the interferometer, namely the Fourier Interferometer Polarimeter (FIP).

In recounting the narrow-slit experiment, Shankland stresses Michelson's "remarkable observational ability as he describes precisely the . . . polarization . . ." He also suggests that the optical phenomena observed in this experiment were precursors to the invention of the interferometer. It does not appear, however, (and Shankland never hinted even at the possibility) that Michelson ever thought of using his interferometer for measuring the polarization of light within spectral lines.

continued on page 80

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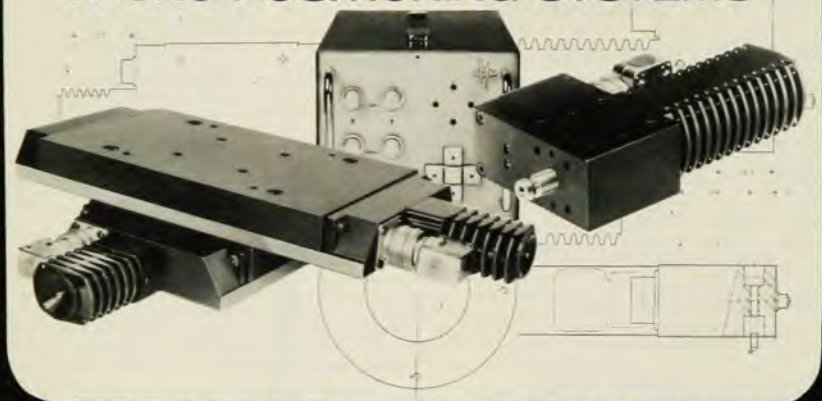

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About 30 years prior to that time, G. G. Stokes derived his parameters $\{S_i\} = \{I, q, U, V\}$, $i = 1$ to 4, which give respectively the light intensity, the degree of polarization, the orientation of the plane of polarization and the ellipticity of the polarization ellipse, for representing the state of arbitrary polarization of light, of which Rayleigh gave an account from a different point of view. In 1871 (approximately ten years before the invention of the interferometer) Rayleigh also investigated the illumination and polarization of the sunlit sky. He further pointed out in 1892 that the missing phase information in the visibility-curve technique could be recovered if, additionally, one measured the position of the fringes, thus opening the way to modern Fourier spectroscopy. And yet, despite his work on both polarization and interference spectroscopy, Rayleigh did not conceive the possibility of using an interferometer as a spectral polarimeter. That possibility had to wait until the mid-1960's and early 1970's for its conception, implementation and development.

In 1965–66, when I was at the University of California, Los Angeles, I was computing synthetic spectra of both light intensity and polarization formed in the atmosphere in the presence of scattering. Some of these results were published only several years later along with the detailed analytical theory for the study of the spectral multiple scattering of arbitrarily polarized light,[1] including the formation and behavior of absorption, emission and resonance-fluorescence spectra when observed in the diffuse light coming from either a localized region of a remote planetary disk (e.g. Venus) or from the entire disk. While these computations showed that polarization exhibits a marked variation across spectral lines and across the composite bands, it soon became evident that the conventional methods of measuring polarization (photopolarimeters) would give neither the necessary spectral resolution for this purpose (even if a high-resolution spectrometer were used as a filter) nor a significant signal-to-noise ratio (unless one were restricted to single spectral lines and to extremely bright sources). On the other hand, the Fourier spectroscopic technique was known to possess both multiplex and luminosity advantages—hence the concept of the FIP. In 1969, with the important collaboration of K. D. Abhyankar, then a visiting scientist from Osmania University, India, the concept was fully developed at the Jet Propulsion Laboratory and published the following year.[2] This novel application of the interferometer as a spectral polarimeter was also presented by

me at the 1970 International Conference on Fourier Spectroscopy[2] in Aspen, Colorado. While Shankland refers to the Proceedings of this Conference (his reference 9) as a witness to the "large activity in Fourier spectroscopy," it is regrettable that he overlooked the article describing the FIP, which is a new development in both interferometry and Fourier spectroscopy.

The concept was subsequently further refined, both theoretically and experimentally, and four alternative interferometric methods were proposed for recording spectral polarization[3] (including spectral ellipsometry). All four methods can be applied to either one of the two beams emerging from the interferometer or to both. In one method (this is the original method developed with Abhyankar), two linear polarizers with transmission axis azimuths s_1 and s_2 are inserted, one in each arm of the interferometer, and one linear polarizer-analyzer with azimuth s_3 placed in front of the detector. Three interferograms denoted (s_1, s_2, s_3), namely (0°, 0°, 45°), (90°, 90°, 45°) and (0°, 90°, 45°), were shown to provide the four spectra $S_1(\sigma)$, $\sigma = \upsilon^{-1}$, υ = light frequency. On adding the first two interferograms, the spectrum usually provided by Michelson's interferometer results. In a second method, which is to be preferred to all other methods if one is interested in the complete set of Stokes parameters, only s_3 is used and the three interferograms now denoted (s_3), namely (0°), (45°) and (90°) can also yield $S_1(\sigma)$. The third method is similar to the former one except that s_3 is now placed in the incident beam. The last method is a hybrid of the latter two methods. However, the third and fourth methods, although requiring also three interferograms, cannot yield V. In some applications, only I and Q may be of interest. In this case, two interferograms obtained from any one of the four methods just described are sufficient. On the other hand, with a single interferogram, the first method can provide U and V.

Based on the second spectropolarimetric method described earlier, an instrument was subsequently built[4] and recordings made of the Stokes polarization parameters of Venus in the wavelength range 0.8 to 2.7 microns with a resolution of 0.5 cm^{-1}. These observations were carried out using the 154-cm Cassegrain telescope of the National Mexican Observatory, Baja California, Mexico, on 12 and 13 July 1972. A preliminary limited analysis of four spectral features and of the CO_2 rotational band structures at 6080 and 6200 cm^{-1} has already demonstrated the existence of spectral polarization. These experimental results, confirmed by two series of observations, have provided experimental substantiation for this novel,

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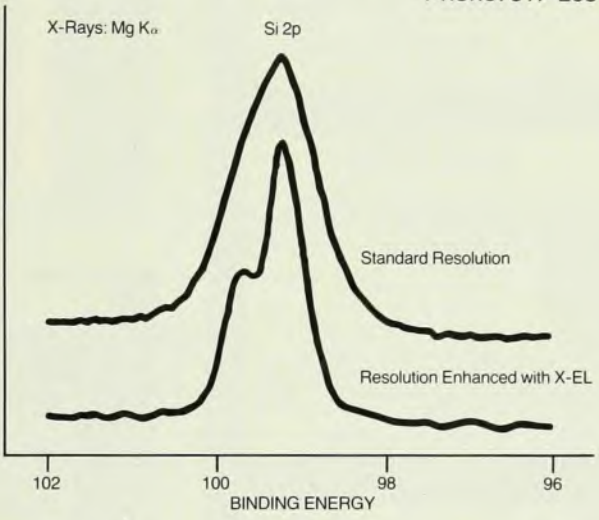

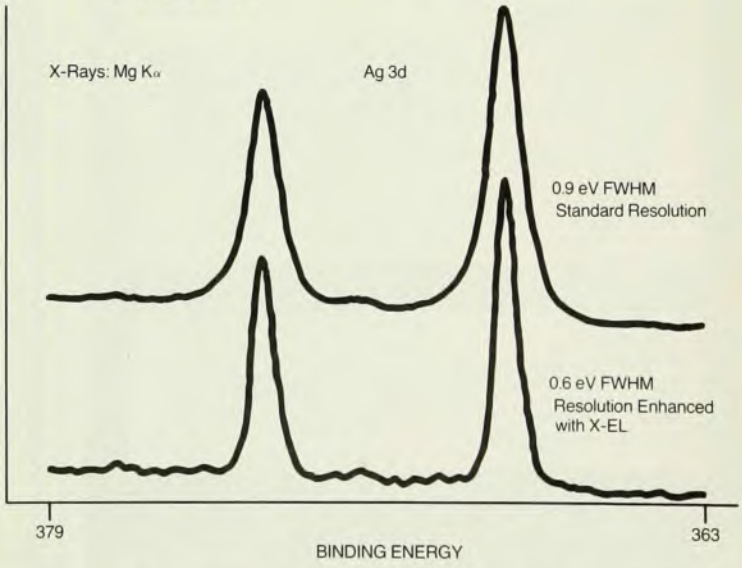

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theoretically predicted phenomenon, thus establishing the capability of a suitably modified Michelson interferometer to measure polarization within spectral lines in addition to providing the usual spectrum.[4]

References

1. A. L. Fymat, in *Planets, Stars and Nebulae Studied with Photopolarimetry*, (T. Gehrels, ed.) University of Arizona Press, Tucson (1974); page 617.
2. A. L. Fymat, K. D. Abhyankar, Applied Optics **9**, 1075 (1970); NASA Tech Brief 70-10405 (1970); US Patent No. 3 700 334; in *Proc. 1970 Intern. Conf. on Fourier Spectroscopy*, Aspen, Colorado, (G. A. Vanasse, A. T. Stair, D. J. Baker, eds.) AFCRL Report 71-0019 (Special Report 114), 377 (1971).
3. A. L. Fymat, Applied Optics **11**, 2255 (1972).
4. F. F. Forbes, A. L. Fymat, in *Planets, Stars and Nebulae Studied With Photopolarimetry*, (T. Gehrels, ed.) University of Arizona Press, Tucson, (1974); page 637.

ALAIN L. FYMAT
California Institute of Technology
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Which Cavendish?

Three years ago you published a letter (March 1972, page 57) I had sent to Samuel Devons on the Cavendish laboratory. In it I had quoted the current official Cambridge University publications that attributed the name of the laboratory to the donor Lord William Cavendish rather than to the famous scientist Henry Cavendish. My recent correspondence with Brian Pippard revealed, however, that this source was in error on at least two counts: (1) the laboratory was originally named for Henry, and (2) the official opening date was 16 June 1874 rather than 18 July 1874.

E. L. OFFENBACHER
Temple University
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Corrections

March, page 55: The price for *Phase Transitions and Critical Phenomena, Vol. 3: Series Expansions for Lattice Models*, edited by C. Domb and M. S. Green, should read £ 18.00, not $18.00.
May, page 35: For "15-kA beam" on line 18, read "150-kA beam."
—page 36: The parameters of the Aurora facility given at the end of the first full paragraph of the second column should read "12 megavolt, 1.6 megamp and 160 nsec." □

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