Infrared Spectroscopy

SPECTROSCOPY in the infrared has come of age since the recent war period which witnessed the development of such detecting devices as the lead sulfide cell, the lead selenide cell, and the lead telluride cell. These detectors are photoconducting in character and have demonstrated a sensitivity increase of at least two orders of magnitude in certain regions of the spectrum over the traditional types, such as the vacuum thermocouple and the bolometer. Only for wavelengths greater than about 6 μ are the thermocouple and the bolometer superior to the photoconducting devices. The thermocouple and the bolometer are further being challenged by the pneumatic detectors, of which the Golay cell is the best-known example. These are in principle gas thermometers, rivaling in sensitivity the best vacuum thermopiles but having a much higher speed. Although no monumental advance in detecting sensitivity has been achieved for the spectral region beyond 6 μ, it is not unreasonable to look for improvements in one form or another here, also, in the near future. Considering further the improvements that are currently being made in the sources of infrared radiation, it does not appear overoptimistic to envisage a tenfold increase in resolving power throughout most of the infrared region from 1 to 30 μ.

It is an interesting observation that, in many of the spectrometers in use when the improved detectors were installed, no significant improvement in performance was observed. This may be interpreted to mean that infrared spectrometers had been constructed to be optically as good as, but no better than, their detectors merited. Experience is teaching that many of the infrared spectrometers already in operation should be redesigned and equipped with optical components of higher quality, in particular with much improved dispersing components—i.e., better prisms and gratings. Experience is also teaching that, when this is done, the quality of the infrared spectra produced is very considerably improved. The best infrared spectrographs now in operation are recording spectra definitely comparable, and in some instances superior, to spectra recorded in other portions of the spectrum.

The great improvements in the techniques of infrared spectroscopy have given new impetus to the investigation of atomic spectra in this region. It is, moreover, now possible to study many more of the intimate details of molecular spectra than was previously feasible. The energies of a molecule in its normal electronic state are essentially energies of vibration and rotation. These motions are independent of each other to a first approximation, but it is well known that in higher orders of approximation they interact and give rise to interesting anomalies in the band structure. Some of these phenomena have been observed and studied carefully by the microwave spectroscopists, but the limited frequency range at their disposal makes it desirable to be able to study these effects in other regions of the spectrum. With spectrographs available now that are capable of resolving spectral lines separated by as little as one tenth of a wave number (0.1 cm^{-1}), it appears we are about to "see face to face" what heretofore we have seen only "as through a glass darkly."

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SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

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Annual subscriptions, $7.50; single copies, $.25; foreign postage, outside the Pan-American Union, $1.00; Canadian postage, $.50. Special rates to members of the AAAS.

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