

exclusion principle has the effect of partially suppressing the more obvious manifestations of strong interaction between the electrons. Similar effects may occur in nuclear structure although this is not certain. Further studies will be necessary, according to Weisskopf, to establish more reliably whether the evidence on shell structure in nuclei is the effect of a new fundamental property of nucleons or whether it can be understood in terms of the application of old ideas to a complicated many body problem.

Maria Mayer, the third speaker, described the $j-j$ coupling shell model and discussed in detail the excellent correlation with experimental spins and magnetic moments. The basic assumption added to the model of single particle orbits in a potential well is that spin-orbit coupling is very large, producing a large energetic separation of levels with parallel and antiparallel orientations of the intrinsic spin and the orbital angular momentum vectors. The model accounts for many facts of beta decay and nuclear isomerism, but fails to provide possibilities for isomeric transitions in odd nuclei with spin changes greater than two units and no change in parity. Although several suggestions have been made to account for the closed shells, it was remarked that the predictions resulting from different models are surprisingly similar.

L. W. Nordheim described the basic features of his model and of the central elevation model. The guiding principle in Nordheim's level scheme is the production of the magic numbers with a minimal departure from the level order in a rectangular potential well. The central elevation model is based on the effect of the Coulomb repulsion between protons on the variation of particle density within the nucleus. This repulsion causes the density to vary from a minimum value at the center of the nucleus to a maximum near the boundary.

Evidence indicating a close correlation between beta decay selection rules and the shell structure of odd nuclei was then reviewed by Nordheim. Allowed unfavored transitions are accounted for particularly well. Regularities are also apparent in the beta decay of even nuclei.

E. Feenberg contrasted the Schmidt single-particle model of nuclear magnetic moments with the Margenau-Wigner uniform model. The experimental evidence is consistent with a composite interpretation utilizing both models. The existence of well defined islands of isomerism points to a close connection of isomerism with shell structure. Possibilities of accounting for the islands occur in all three level schemes although the schemes differ in regard to the possible parity changes. In particular, level crossings in the central elevation model provide a number of pairs of closely spaced configurations with the same and with opposite parity and with spin changes of 3, 4, and 5 units in both islands of isomerism (twelve odd isomers with no change in parity and spin changes greater than 2 units are known).

The speaker next discussed an example to illustrate the connection between shell structure and the unique first forbidden energy distribution in the beta decay of Cl^{36} , K^{42} , Sr^{80} , Y^{90} , Y^{91} , and Cs^{137} . These transitions illustrate the alternations in parity of the orbits available to the odd particles as N and Z increase. The area of agreement of

the central elevation and $j-j$ coupling schemes includes all these examples.

E. Feenberg

PHOTOGRAPHIC SENSITIVITY

THE LATENT IMAGE OF BRISTOL

The third international conference on "Fundamental Mechanisms of Photographic Sensitivity" was held at the H. H. Wills Physical Laboratory of the University of Bristol from March 28th to April 1st, 1950. The general character of the meeting was determined by the participation of industrial and academic research workers in almost equal numbers. Thus the papers and discussions represented a fruitful mixture of pure and applied science.

The preponderant interest of the meeting centered on the latest developments in the theory of the latent image, and related topics. N. F. Mott opened the conference with a review of the theoretical work that had hitherto been done on the subject. Throughout the subsequent proceedings, J. W. Mitchell, The University, Bristol, correlated the mass of theoretical and technological detail given by the speakers.

Since 1938, when Gurney and Mott advanced their theory of the formation of the latent image in silver halides, much of the experimental work seems to be consistent with the proposed mechanism. Gurney and Mott assumed that absorption of light by the bromide ions produces conductance electrons which are eventually trapped by sensitivity centers at the surface of the crystal. These centers were believed to consist of silver sulfide formed during the manufacturing process. The negatively charged centers subsequently attract mobile interstitial silver ions (Frenkel-type defects), thus forming metallic silver. When large enough, a silver speck is thought to induce development. The theory failed, however, to explain the latent image formed inside the crystal rather than on its surface, the existence of which was demonstrated quantitatively a few years later by W. F. Berg and co-workers in England.

This led Mitchell in 1949 to propose a drastic modification of our conception of the nature of the sensitivity and latent image centers, and of the ionic conductivity in the crystal. On the basis of experimental work with large monocrystals by Stasiw and Teltow in Germany, Mitchell concluded that the sensitivity specks consist of aggregates of F-centers (bromide ion lattice sites occupied by electrons) instead of metallic silver or silver sulfide. According to his modification, the ionic conductivity is due to the motion of the bromide ion vacancies (positive Schottky defects) instead of silver ions. Such a mechanism will permit formation of the internal latent image as well as of the surface latent image.

The questions of the existence of Schottky defects, of the relative mobility of silver and bromide ions, and of their vacancies in silver halides, play important roles in the new theory. They were, therefore, the subjects of extensive discussions. Considerable disagreement exists concerning the interpretations of earlier work by C. Tubandt and A. Langer, and more recent work reported at the

meeting by E. E. Schneider, K. E. Zimen, and T. B. Grimley. Mitchell therefore invoked temporary associations and jumping of vacancies to account for the needed ionic motion.

Of further interest in this connection was the work on the ionic properties of alkali halides reported by R. W. Pohl and H. Pick. As working models these are preferred to silver halides because of greater ease in observing the complicated absorption bands. The successive appearance of six different bands after irradiation in the F-band and in each subsequent band, was described in detail, as was also the appearance of two closely associated bands under x-ray excitation and their simultaneous disappearance under irradiation in one band only. The Göttingen workers hesitated to go beyond the statement that only ionic diffusion processes can explain these phenomena.

Several descriptions of new methods of sensitization were presented by members of industrial research laboratories. A paper by W. G. Lowe, J. E. Jones, and H. E. Roberts, of the Eastman Kodak Laboratories in Rochester, N. Y., disclosed reduction sensitization which consists in the addition of very small quantities of stannous chloride to a photographic emulsion. H. Hoerlin and F. W. H. Mueller of the Ansco Laboratories in Binghamton, N. Y. presented a new application of gold sensitization, originally discovered by Koslowsky in the Agfa Laboratories in Germany, to x-ray emulsions. Gold sensitization is particularly effective for high energy x-ray and gamma ray exposures. Quantitative data on the efficiency of optical sensitization by cyanine dyes and correlations between photoconductance and photographic sensitivity were presented by J. A. Leermakers, Rochester, N. Y., on the basis of work by West and Carroll. The mechanism of the energy transfer from the adsorbed sensitizing dye to the silver halide crystal is still the outstanding unsolved problem in the theory of optical sensitization.

According to Mitchell, "chemical" sensitization, which produces increased sensitivity in the inherent sensitivity band of the halide, consists in the creation of F-center aggregates slightly less than critical size needed to induce development. The need of building the F-centers into the lattice was stressed; Mitchell postulates that any effective sensitizing method must result in intragranular changes, in contrast to the belief of E. E. Loening that latent image formation is due to extragranular conditions. Thus, the well known sulfur sensitization consists in the formation of F-centers in association with singly charged sulfide ions. Reduction sensitization is due to formation of double F-centers by adsorbed stannous ions which lose two electrons forming a quadrivalent ion. In the case of gold sensitization, electrons, from a pre-existing small F-center aggregate, are released to adsorbed gold ions, thus forming metallic gold which is more efficient in inducing development.

Outstanding was J. Eggert's "Contribution to the Photochemistry of Endothermic Compounds"; it was the only paper not directly related to the ordinary silver halide process. Investigating the quantum efficiencies of several photochemical reactions, he found that nitrogen

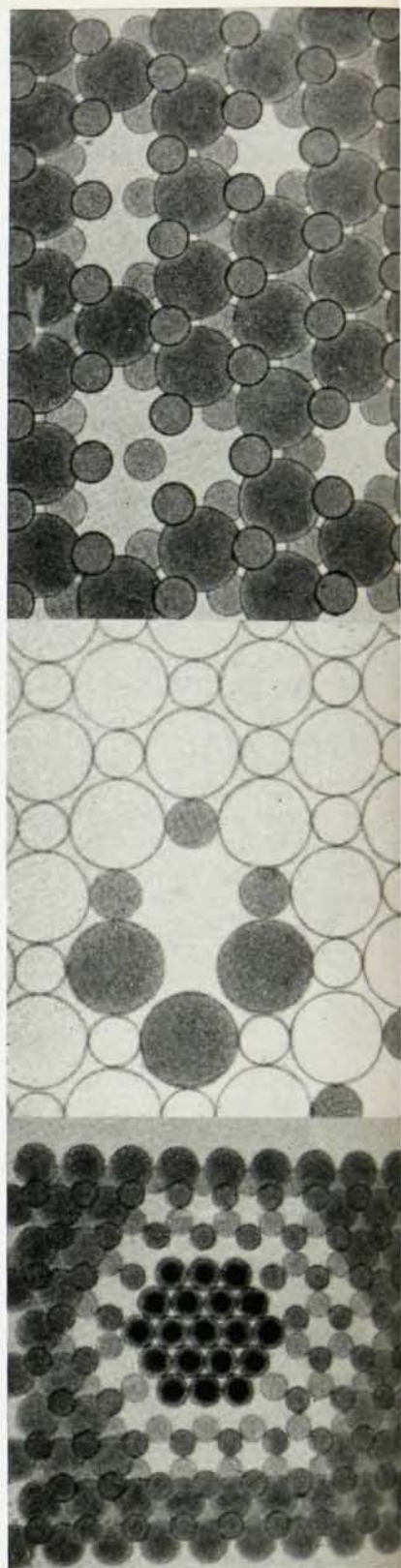
*Aggregation of
F-centers in
silver bromide.*

*Large circles:
bromide ions.
Small circles:
silver ions.*

*Shottky defects in
silver bromide.*

*Nucleations of metallic
silver (dark, small
circles) through
breakdown of
F-centers in
silver halide
"over-exposed"
latent image.*

Illustrations after Mitchell . . .



iodide explodes under high intensity flash-exposure, heat effects being carefully excluded. When nitrogen iodide was finely dispersed in a paper support it yielded photo-prints. At high flash-intensities the speed of this experimental material is about 1,000 times higher than that of print-out paper. It seems too early to say whether or not these experiments will lead to a commercial process; their significance lies rather in the fact that a new photo-chemical reaction has been found with such high primary quantum efficiency. Eggert, formerly director of Afga-Research and since 1946 head of the Photographic Institute of the Eidgenössischen Technischen Hochschule in Zurich, was presented with the Progress Medal of the Royal Photographic Society for the years 1949 and 1950 in recognition of his most valuable contributions to photographic science.

Space is too limited to review a large number of pertinent papers presented by a group of workers of the University of Liège, and by several additional English, French, Swiss, German, and Scandinavian speakers, notably Sauvenier, Hautot, Barton, Stevens, Morand, M. and Mme. Vassy, Ammann, Boissonnas, and Lorenz. One session was devoted to the properties of nuclear track emulsions and their application to the investigation of problems in nuclear physics and cosmic rays.

In Europe, photographic science enjoys considerable stimulation from contact with academic institutions. Each one of about six different European universities is devoting more attention to photographic research than any one similar institution in this country. The meeting was characterized by lively discussions, and the keen interest shown by all those attending. Great strides were made toward better understanding of the photographic process, part of which is still shrouded in industrial secrecy. Strange as it may sound there was almost a total absence of practising photography. Not even the customary group picture of the assembled photographic experts was taken.

Bristol in the English spring formed a most pleasant background for the meeting. It is cheering to note that the 12 years of British austerity have by no means retarded the progress of British photographic science.

Herman Hoerlin

OPTICAL SOCIETY

WINTER MEETING REPORTED

By scheduling six pairs of simultaneous sessions, and by opening the sessions with unfeeling promptness at nine each morning, the arrangers of the program for the winter meeting of the Optical Society managed to give each speaker his full meed of time. Indeed, the sessions were notable for the amount of discussion. The meeting was held at the Hotel Statler in New York from Thursday, March 9 through Saturday, March 11. Four hundred and twenty members and guests registered and a new record was set when the total number of invited and contributed papers reached seventy-nine.

G. B. M. Sutherland of the University of Michigan reviewed progress in the infrared work on crystalline forms of diamond in an invited paper Thursday morn-

ing. Then, while the first of two sessions devoted to infrared and Raman spectroscopy got under way, those interested in geometrical optics moved to the other meeting room and began one of the liveliest sessions on lens design to be held in recent meetings. There was strong emphasis on practical problems and on systematization of design procedures. L. I. Epstein described a first attempt at calculating lens aberrations on punched card equipment. In the afternoon the same audience heard a series of papers on testing methods, and a description of the problems encountered at the Boston University Optical Research Laboratory in procuring blanks for, figuring, and testing lens elements up to 38 inches in diameter caused much comment.

Eighty visitors spent a part of Thursday evening at the Selective Sequence Electronic Calculator in IBM headquarters. The big machine, the only one of the great electronic computers currently in full operation, blinked its thousands of neon indicators engagingly but was otherwise noncommittal.

Friday morning a group of four papers by John Strong, W. G. Langton, David Richardson, and G. R. Harrison on the problems associated with the new crop of ruling engines produced a large if somewhat heavy-eyed audience. A series of papers on general optics in the opposing camp featured a report by Brian O'Brien on improvements in his super-high-speed image-dissector motion picture camera. In the afternoon the Society heard a lively invited paper by R. P. Feynman of Cornell on quantum electrodynamics and ordinary optical phenomena. Sessions on interference-type filters and on emission spectroscopy followed. The latter began with a paper on the spectrum of promethium by W. F. Meggers, president of the Society, and his associates at the Bureau of Standards.

An informal dinner with 240 in attendance featured a talk on some problems of color television by the chief of the Central Radio Propagation Laboratory, Newbern Smith. Then, on Saturday morning, an invited paper by Peter Goldmark gave a discussion of the visual problems of the CBS color television system. In accordance with usual practice in describing color phenomena, these talks were illustrated with black-and-white slides!

The last sessions included reports of work in far-ultraviolet spectroscopy and in colorimetry. S. D. Stookey described the two types of photosensitive glass recently developed at Corning.

H. R. J. Grosch

SUMMER OFFERINGS

SYMPOSIA AT ANN ARBOR

An eight-week electronics symposium, presenting visiting lecturers from other universities and from various industrial and government laboratories, including representatives from England, will feature the University of Michigan's 1950 Summer Session. Coinciding with the electronics symposium, the departments of physics and of engineering mechanics will offer respectively a symposium on theoretical physics and a symposium on fluid mechanics.