the immature nervous system to disease. He offered a classification of developmental disorders based on two main variables, developmental stage of onset and disease agent. A classification, supported by experimental data, must precede comprehension of mental retardation, epilepsy, and other groups of diseases.

The conference was sponsored by the Jackson Laboratory. In lieu of published proceedings of the conference, a detailed checklist and bibliography of neurological mutants in the mouse will be published by the Harvard University Press, Cambridge, Massachusetts.

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Electronic and Atomic Collisions

When activity in the field of atomic collision physics (along with extranuclear atomic physics generally) went into its decline three decades ago, it was widely felt that the field was completely understood in principle and that a limited number of then impossible experiments and calculations would tie up the entire matter. The 4th international conference on the physics of electronic and atomic collisions, held at Laval University in Quebec, Canada, 2–6 August 1965, disclosed that assessment to be far from adequate.

The "impossible" experiments have disclosed an incredible richness of phenomena in atomic and electronic collision physics, of importance to space, atmospheric, and plasma physics and to gas-phase chemistry; the computer-aided theoretical work has brought to light at least as many new problems as it has solved.

Typical of the new areas is the matter of "resonances" in scattering. As presently used, the term "resonance" refers to observation of energy-dependent structure in electron collision cross sections. This structure appears to be well fitted by the Breit-Wigner resonance formula much used in nuclear physics; moreover, theoretical calculations, especially in e-H scattering, have predicted the observed structure and have shown that it is associated with the rapid energy variation of individual phase shifts.

Papers on resonances, given by P. G. Burke (England), A. Herzenberg (England), and E. Holøien (Norway), made it clear that the techniques of predicting resonances have steadily improved since 1963. In particular, a means of projecting out the coupling to the continuum, and thereby of associating the complex energy eigenvalue responsible for a resonance with a real eigenvalue computable by the Rayleigh-Ritz minimum principle, has been developed. Moreover, a variational (nonminimal) principle for the complex eigenvalues has been shown to have great promise. Thus accurate predictions of resonances in not-too-complicated electron-molecule reactions (for example, $e + H^2$ collisions) soon should be forthcoming.

The theoretical advances in resonances have been well matched by advances in experiments. Particularly striking were the new measurements on the H atom resonance reported by H. Kleinpoppen (Germany); these measurements verify and are an improvement on the earlier measurements of G. J. Schulz (U.S.A.). Also noteworthy were the studies by H. Ehrhardt and G. Meister (Germany) on the angular distribution of electrons scattered by helium in the vicinity of the resonance first predicted by Gerjuoy and Baranger (U.S.A.) and previously observed by G. J. Schulz, J. Arol Simpson, and C. E. Kuyatt (U.S.A.).

Among the other experiments which employed high-resolution electron techniques and which were particularly interesting for development of theory were those of Kuyatt, Simpson, and Mielczarek. Their electron scattering experiment displayed the vibrational level structure in H_2. In the experiments of McGowan and Fineman (U.S.A.) the ionization of H_2 curves displayed structure due to rotational excitation.

The question of resonances in electron scattering is closely related to the existence of states of atoms and molecules with excitation energies in excess of the first ionization potential (so that autoionization can occur) and to the existence of unstable, compound negative ions. Techniques to map out the energy levels of these super-excited states have been developed.

Related to the question of these super-excited states is the matter of characteristic energy losses in ionizing collisions between ions and atoms.

Such energy losses have been studied by coincidence methods in the laboratories of N. V. Fedorenko (U.S.S.R.) and E. Everhart (U.S.A.). It now appears that at small impact parameters any ionization process is correlated with the excitation of one of the characteristic energy losses and that these energy losses are evidently associated with ionization and excitation from the inner shells of the colliding heavy particles. The finding by M. E. Rudd and D. V. Lang (U.S.A.) that the energy spectrum of the electrons produced in ion-atom collisions show well-defined, sharp structure further supports the view that ionization in heavy particle collisions proceeds in part through excitation to super-excited states, followed by autoionization.

Classical (that is, nonquantum) methods for computing cross sections were discussed by a panel consisting of M. Gryzinski (Poland), A. Burgess (England), I. C. Percival (England) and L. Vriens (Netherlands) in perhaps the most spirited and controversial session of the conference. The use of classical theory to compute atomic cross sections dates back to J. J. Thomson in 1912. Recently, however, as a result of Gryzinski's demonstration that Thomson's formula for ionization of an atom by electron impact could be improved by taking into account the actual velocity distribution of the atomic electrons, the possibility of estimating atomic collision cross sections classically has attracted widespread interest. In general, the panelists thought that the remarkable successes of these classical calculations stem from the "accidents" that atomic interactions involve Coulomb forces and that scattering of a pair of otherwise isolated charged particles is independent of Planck's constant, that is, the scattering is the same whether calculated classically or quantum mechanically. Gryzinski appears to believe that atomic collision cross sections ultimately can be predicted accurately without reference to quantum concepts.

Among the outstanding of the 72 theoretical contributions was the work of F. T. Smith and R. P. Marchi (U.S.A.). They showed that the oscillations in the He^+ + He charge-transfer cross sections could be accounted for in detail; indeed it should be possible to infer the He^+ - He interaction potential from the oscillations observed. Also, G. F. Drukarev and Yu. M. Demkov (U.S.S.R.) contributed a very interesting and novel paper on the distribution of poles and zeros of the scattering matrix on the imaginary axis in the complex wave number plane. The positions of these poles and zeros largely determine the energy dependence of the cross section. It was extremely regrettable that neither Drukarev nor Demkov was able to be present for the discussion of their interesting work.

Turning to but a few of the "nonresonant" experimental highlights of the conference, one can point first to recent experimentation on the free hydrogen atom. S. J. Smith (U.S.A.) reported a new measurement for electron-impact excitation of Lyman alpha which confirms the earlier results of Fite (U.S.A.) that the "best" quantum theory as of present (the close coupling approximation) is indeed in error at lower energies. H. B. Gilbody (England) has extended the energy range for charge transfer between protons and hydrogen atoms by a factor of three over previous measurements.

H. Kleinpoppen (Germany) reported some beautiful results concerning the effect of nuclear spin on polarization of optical radiation. His work goes far toward testing the predictions of Percival and Seaton made in 1958. In the experiment, atoms of Li^6, Li^7, and Na^{23} were excited by electron impact; the polarization of the first resonance line was measured as a function of electron energy. These three isotopes represent cases where the hyperfine separation compared to the level width of the excited state is small, comparable, and large, respectively. It was found that although the transitions are the same electronically, the polarization fractions near threshold were 40, 21, and 15 percent in good agreement with theoretical prediction.

The first experiment on two-photon absorption by negative ions, combining laser and crossed beam techniques, was reported by Hall, Robinson, and Branscomb (U.S.A.). Extremely elegant experiments on the interaction of electrons and ions, particularly enlightening for theory development and for plasma physics, were reported both by Dance, Harrison, and Smith (England) and by Dunn, van Zyl, and Zare (U.S.A.).

The question of the effect of internal excitation on measured cross sections in ion-neutral collisions has begun to be evaluated. Perhaps the most definitive experiments reported were those of Turner, Stebbings, and Fineman (U.S.A.). Initial ions were produced in various states of excitation, and variations of cross sections were studied. From such studies it seems clear that much of the disagreement between different laboratories in earlier measurements originated from differences in state population of beams from different ion sources.

In the thermal energy range, the methods involving flowing pulsed, afterglow, which were devised by E. E. Ferguson and his associates (U.S.A.), were particularly impressive. Also impressive was their tabulation of a large number of measured rates for processes occurring in the upper atmosphere.

Numerous experiments delved into less well-defined problem areas relating to excitation, ionization, and heavy particle collisions. The supply of entirely unexpected observations reported is ample to keep the theoreticians hard at work for a number of years.

The conference was invited by N. V. Fedorenko to meet next in Leningrad in 1967, a proposal which was accepted with great enthusiasm.

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Forthcoming Events

October

30–2. American **Speech and Hearing** Assoc., Chicago, Ill. (K. O. Johnson, 1001 Connecticut Ave., NW, Washington, D.C.)

31–4. American Soc. of **Agronomy**, 57th annual, Columbus, Ohio. (ASA, 677 South Segoe Rd., Madison, Wis. 53711)

31–5. Society of **Motion Picture and Television Engineers**, 98th technical conf., Montreal, P.Q., Canada. (SMPTE, 9 E. 41 St., New York 10017)

31–5. American Soc. for **Testing and Materials**, 5th Pacific area natl., Seattle, Wash. (H. H. Hamilton, ASTM, 1916 Race St., Philadelphia, Pa. 19103)

November

1–3. Development of the **Lung**, Ciba Foundation symp., London, England. (Ciba, 41 Portland Pl., London, W.1)

1–3. American **Physical** Soc., southeastern section, Charlottesville, Va. (H. Carr, Auburn Univ., Auburn, Ala.)

1–3. **Industrial Static Power Conversion**, conf., Philadelphia, Pa. (L. W. Morton, General Electric Co., Bldg. #2, Schenectady 5, N.Y.)

1–3. Information Processing in **Sight Sensory Systems**, California Inst. of Technology, Pasadena. (E. D. Johnson, 208 Booth Computing Center, California Inst. of Technology, Pasadena 91109)

1–3. **Systems**, intern. meeting, Chicago,