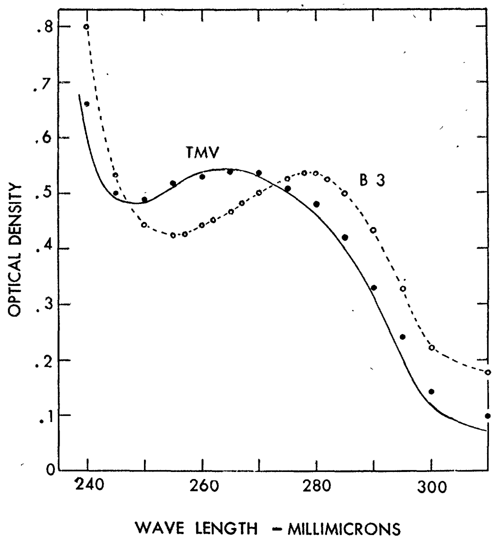

FIG. 6. The ultraviolet absorption spectra of protein B3 (open circles, dotted line), TMV (solid line), and a complex of protein B3 with nucleic acid prepared from TMV (closed circles).

ing experimental approach to the problem of TMV synthesis: an attempt to induce infectivity in the nucleic acid free presumed precursor by the addition, *in vitro,* of nucleic acid obtained from TMV. Proteins frequently form nonspecific *in vitro* complexes with nucleic acid. The absorption spectrum of such a complex between B3 and TMV nucleic acid is illustrated in Fig. 6. This product was not infectious. It is, of course, presumptuous to suppose that the mere mixing of the two components in simple solution would accomplish what must be in the living cell a highly specific, structurally oriented process. Nevertheless, such studies may shed light on the intracellular behavior of the nonvirus proteins.

Alternative 2. Nonvirus protein is an alternative rather than sequential product of the mechanism that produces TMV and appears during the course of virus synthesis as a result of a sudden loss in specificity of the synthesizing processes.

If this were the case, a rather close resemblance of the new products (i.e., A4, B6, B3) to the old one (TMV), such as that revealed by immunochemical cross reaction, is to be anticipated. Such an event might be usefully thought of as a mutation, and the nonvirus protein as a noninfectious "mutant" of TMV, or perhaps a low molecular weight breakdown product of such a "mutant."

Alternative 3. Nonvirus protein is part rather than product of the TMV-synthesizing apparatus of the cell. If this were the case, our observations would show that: (a) the parts of the apparatus represented by nonvirus protein are synthesized *de novo* subsequent to inoculation and do not antedate the entry of the inoculum; (b) these parts of the virus-synthesizing mechanism bear a close structural similarity to TMV; (c) the soluble nonvirus protein detected in tissue extracts is probably sloughed off from an insoluble cell component; and (d) this degeneration of the TMV-synthesizing apparatus begins at about 200 hr after inoculation, and is possibly associated with depletion of a source of pentose nucleic acid.

Experiments bearing on these alternative propositions are in progress.

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Birmingham Conference on Nuclear Physics

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An international conference on nuclear physics, arranged by the departments of physics, electron physics, and mathematical physics, was held at the University of Birmingham, July 13th to 18th, 1953. It was attended by about two hundred fifty visitors, thirty of them from America. The chief topic of the conference was the complex nucleus; cosmic rays and meson physics proper were not discussed, nucleon-nucleon collisions only briefly. This wise concentration allowed a reasonably detailed treatment of the different items on the program. Each session was opened by a summarizing talk on the present status of the subject which was followed by short contributions and ample discussion.

Rather than reviewing the whole conference chronologically, some of the results of the discussions will be presented. References will be given sparingly, and will pertain only to the speaker.

Nuclear Radii. The $2p$-$1s$ transition of μ^--mesons, the diffraction pattern for high-energy particles, and the isotope shift seem to indicate nuclear radii somewhat smaller than the usual value of 1.45 to 1.50×10^{-13} $A^{1/3}$ cm. An irregular variation is found between Be^9 and O^{16}, both from neutron cross sections and the stripping interaction distance, Be^9 being high, C^{12} low (Bonner, Holt).

The diffraction pattern of 125- to 150-Mev electrons from heavy nuclei does not show the maxima and minima expected for a uniform charge distribution, but agrees with an exponentially decreasing density whose rms radius has about the normal value (Hofstadter). This result, however, is expected to be modified by further theoretical treatment.

Nuclear Spectroscopy. Advances in the different techniques were discussed. A more refined deuteron stripping theory takes into account the reaction of the outgoing proton (Messiah). It yields smaller cross sections than the original Butler theory; larger reduced widths are thus deduced from the experiment. The *n-p* interaction in the deuteron is still neglected. In view of a rapid variation of the angular distribution pattern with deuteron energy observed by Parkinson, the question of interference between the stripping process and compound nucleus formation with possible resonance features was discussed, without conclusion. The analysis of the patterns into contributions from different angular momenta seems rather unreliable.

The interpretation of angular correlations of successive radiations is subject to the uncertainties due to the influence of extranuclear fields. In the classical case of In^{111} (Cd^{111}) the electric quadrupole interaction was shown to be responsible for the diminished anisotropy observed with most solid sources. From measurements with a variable magnetic field parallel to the electric field gradient in a single crystal, both the magnetic and the electric coupling constants can be deduced. Most liquid sources show the full anisotropy and are thus suitable for analysis. This seems to be due to the rapid change of the external fields. In liquids with long relaxation times, e.g., glycerin at normal temperatures, the anisotropy is decreased (Heer, Novey).

The powerful tool of conversion measurements has been further improved by more accurate determination of the dependence of α_K/α_L on gamma-ray energy and atomic number. The analysis of the angular distribution of the two partners of internal pair conversion has been applied successfully (Devons).

Radiative widths can be determined by coincidence methods down to decay times of a few 10^{-10} second. In addition to the old methods of comparison with particle widths and neutron resonance widths (Kinsey), two new procedures were applied for levels that decay to the ground state. In resonance scattering the energy gap due to the recoil of the emitting and the absorbing nucleus is bridged either by mechanical motion (Moon, Davey) or by temperature motion (Malmfors). The scattering intensity is then proportional to the level width and measurable for decay times less than a few 10^{-11} second. On the other hand, the level width can be determined by measuring the cross section for the excitation by the Coulomb field of bombarding particles (Huus). Still, a general method for the measurement of decay times between 10^{-9} and 10^{-12} second is lacking.

Nuclear Models. The basis of most of the discussions was the shell model, in the Mayer-Jensen variation. For the levels of the light nuclei the isotopic spin is nearly a good quantum number, the intensity of admixtures being of the order of 10^{-3} to 10^{-2}, as expected from the Coulomb interaction alone (Wilkinson). For the ground state and first excited state of N^{13} and C^{13}, the reduced and radiative widths and the magnetic moments can be explained by intermediate coupling (between *ls* and *jj*) with the same parameter that also gives the best overall agreement with the empirical level schemes (Lane). Low-lying many-particle levels in the $f_{7/2}$ shell were reported for N or $Z = 23, 25$, i.e., for 3 particles or holes; they are absent, as expected, for N or $Z = 21, 27$ (Nussbaum). A beautiful scheme of ten levels in Pb^{206} was reported, which is in very good agreement with the expectation for two neutron holes and *jj* coupling (Alburger, Pryce).

The treatment of heavy nuclei with partly filled large subshells is controversial. In the individual-particle approach (Flowers), all properties are calculated with the aid of the unfilled shell only. It gives, therefore, the characteristic strong variations near the ends of each shell; the mathematical difficulties in the middle of the large shells, however, are considerable. They are avoided in the collective model (A. Bohr) which treats the whole nucleus (again) as a "liquid drop" whose surface oscillations are coupled to the motion of the individual particles. The lowest excited states, thought to be surface waves of an irrotational liquid, can be described like rotational levels. Experimental support for this picture is claimed to be furnished by regularities in the level energies and the spin assignments obtained from alpha fine structure and conversion data, by the agreement of the electric quadrupole moments of the excited states (which are deduced from the Coulomb-field excitation) with that of the ground state and, quite generally, by the large quadrupole moments and $E2$ transition probabilities. The model, in its simplest form, does not give good agreement with the experiments near the shell ends. The discussion between the exponents of the two models continued throughout the conference week, with an apparent gradual rapproachement of the viewpoints.

Nuclear Reactions. The discussion dealt chiefly with the validity of the N. Bohr assumption about the formation of a compound nucleus. The total averaged neutron cross sections from 0 to 3.5 Mev and the angular distributions of elastically scattered 1-Mev neutrons may be explained by a single-particle theory using a potential well of conventional radius and depth $-V = V_0(1 + i\xi)$, with $V_0 = 19$ Mev, $\xi = 0.05$ (Barshall). Despite the small value of the imaginary part of the potential which corresponds to a mean free path of the order of 10^{-12} cm, compound nucleus formation is not unimportant because of the many internal reflections of the neutron wave. This is evidenced by the cross sections for inelastic neutron scattering at 3, 4.5, and 14.5 Mev which show nearly "black" nuclei (Bonner), and by the isotropic distribution of inelastically scattered neutrons ($E < 4$ Mev) for a primary energy of 14 Mev (Rosen) and inelastically scattered protons ($E < 10$ Mev) for a primary energy of 18 Mev (Gugelot). Unfortunately, the above potential cannot be used to explain the angular distribution of elastically scattered protons. For Al, at 18 Mev, one would need $V_0 = 45$ Mev, $\xi \approx 0.5$; for Cu and heavier elements, no choice of parameters is satisfactory.

Attempts to determine level densities from the energy distribution of reaction products uncovered some queer facts. The high-energy part of the spectrum of inelastically scattered protons is more intense than expected from any expression for the level density. Furthermore, the shape of the spectrum is essentially independent of the primary energy while it is supposed to reflect the level density of the residual nucleus whose excitation energy varies with the primary energy. It is not clear, at the moment, if these deviations from the compound nucleus, evaporation picture can entirely be attributed to other processes, such as surface reactions or electric energy transfer (Gugelot).

Measurements on some reactions involving the lightest nuclei were reported. There still does not seem to be clear evidence for an excited state of He^4; the He^5 doublet could not be observed in the He^3 (T, p) He^5 reaction (Good).

Polarized Beams and Nuclei. The polarization of beams is a direct consequence of spin-dependent forces. The polarization of *d, d*-neutrons was detected by scattering on carbon and found to be about 20 per cent at 700 kev deuteron energy (Huber, Ricamo). The polarization of 240-Mev protons, produced by scattering on different elements, and detected by a second scattering process, is about 20 per cent for H, Al, Si, 30 per cent for Ag, and 50 per cent for Li, Be, B, C, Cu (Kaplon).

As an example of the information to be gained from the measurement of the anisotropy of the gamma radiation emitted by aligned nuclei, the case of Co^{58} was discussed (Grace). The distribution gives a spin $I = 2$ for the excited state of Fe^{58}, is compatible with Gamow-Teller selection rules only, and the temperature dependence indicates a magnetic moment of about 3.5 nuclear magnetons for Co^{58}.

Instruments and Accelerators. The discussion of instruments was limited to cloud chambers and scintillation techniques. The bubble cloud chamber, diffusion chambers, and a conventional chamber with an internal trigger system, essentially a proportional counter, were presented. With the latter it was possible to show that the previously reported ternary fission events, with all three particles heavier than alphas, are spurious, the third heavy track being due to a knock-on nucleus (Berthelot).

Applications of the scintillation technique that were discussed included a total absorption spectrometer for electrons or gamma rays of more than 50 Mev (Hofstadter) and an efficient counting system for slow and medium fast neutrons employing the counting of the gamma rays emitted after neutron capture in B^{10} (Gray).

Topics treated in the session on accelerators were the acceleration of sixfold charged N and O ions in the Birmingham 60-inch cyclotron, with beams of the order of 10^{-9} ampere (Walker); a method for obtaining the shape of a cyclotron beam pulse without recourse to widest-band amplifiers; and the design of several high-voltage machines, including the cosmotron injector.

Nuclear Forces. The discussion of the meson theory of nuclear forces was essentially a review of the present situation. It dealt with the $T = 3/2$, $I = 3/2$ resonance in $\pi - p$ scattering and photoproduction of π mesons, the Lévy theory—which gives potentials in agreement with the experiment, but contains errors and does not seem to converge—the effective range potentials for the low-energy *np* and *pp* data, and the phase analysis for the high-energy data. For the latter, it was shown experimentally that the distribution of *np* scattering at 135 Mev is not symmetrical with respect to 90°, but shows a predominant backscattering (Snowden). No great theoretical progress seems to have been made for some time.

It was a happy coincidence that during the meeting the Birmingham proton synchrotron attained its maximum energy, around 1000 Mev. All visitors felt that there could scarcely have been a better compensation for the magnificent work done by Professors Burcham, Moon, and Peierls, the conference secretaries Professors Field and Riddiford, and the entire staff of the physics departments in preparing this conference.