latter influencing the disturbance by Brownian movement, shape, the interaction forces, and the degree of reversibility of the changes. If the interaction forces are strong, there is a greater tendency to a disordered separation of the second phase, whereas weak forces suffice to make the necessary links only when a degree of order is attained. These considerations were illustrated by the structures obtainable with *poly-γ-benzyl-L-glutamate* in chloroform solution, and with insulin. Birefringent structures show orientation to be occurring when phase separation occurs.

Primary interest is on the behaviour of the cell nucleus and its component nucleoproteins. Whereas nucleic acid alone fails to give phase separation, nucleoprotein forms fibrous structures, showing birefringence and dichroism. The existence of different structures at different concentrations for nucleoproteins is shown by a discontinuity in the relation between concentration and diffusion constants. No discontinuity is observed for the nucleic acid alone. The techniques and theories have been applied to the structure of chromosomes and also to the formation of the tail of the sperm during meiotic division.

In the second paper, Dr. A. Wassermann (University College, London) described his work on a viscosimetric investigation into the influence of pH and ionic strength on molecular shape of a structural muscle protein. Two views have been put forward concerning the actomyosin molecule, the first regarding it as a stiff rod or elongated ellipsoid of revolution and the second treating it as a flexible random coil. Use of the mixed-bed ion-exchange resin column enables actomyosin solution of very low salt content to be prepared. Alkali additions give solutions, the 'intrinsic viscosities' of which extrapolated to zero rate of shear, and to zero concentration, are a maximum in the region of pH 8-9. At higher pH, lower values are obtained. No peak is observed on the acid side. The absence of change below pH 4 is assumed to arise from anion binding neutralizing the charges developed. The peak is considered to arise from the stretching out of the molecule by the repulsion of negative charges present at the pH's concerned. Beyond a certain pH the concentration of counter ions becomes sufficient to reduce the forces between the charges, so that a reduction in 'intrinsic viscosity' occurs; similarly, the addition of neutral salt in sufficient amount reduces the changes in intrinsic viscosity to zero. All these observations are fully compatible with the random coil hypothesis but are inconsistent with the stiff rod theory.

In the third paper at the symposium, on some rubber-like and relaxation properties of gelatin, Mr. D. W. Jopling (Kodak, Ltd.) demonstrated that gelatin films maintained at a water content of 25-30 per cent by immersion in 85/15 alcohol/water or by exposure to high humidity show rubber-like extensibilities of up to several hundred per cent. This is best shown when the ordered arrangement, brought about by drying, has been destroyed by immersion in boiling methanol.

By cross-linking gelatin molecules with formaldehyde, measurements on the resultant film can be carried out at temperatures at which normal gelling forces are absent, for example, 60° C. Stress relaxation then follows the Maxwell relation $\log(\text{stress}) = A - B(\text{time})$, whereas at room temperature stress is proportional to $\log(\text{time})$. It is assumed that at 25° C. the mechanism is primarily the release of secondary bonds, with a wide spectrum of relaxation times.

whereas at 60° C. only primary bonds are broken. At 40° C. both processes can be observed to occur in succession. The form of the extension-tensile stress relation for gelatin cross-linked with formaldehyde at 60° C. follows the theoretical curve for an ideal rubber-like system up to extension ratios of 4:1. The values for the chain molecular weight between cross-links deduced from the theory appear high; the reasons for this are not clear.

The final paper, by Dr. J. Brooks and Mr. H. P. Hale (Low Temperature Research Station), on the mechanical properties of the ovomucin gel of the egg, was given by Dr. Brooks. The thick white fraction of the hen's egg consists of a gel in which a transparent phase is separated by a series of parallel bands of microscopic fibres. After the egg is laid, the volume of thick white decreases at a rate depending on the temperature. The mechanical properties of the gel have been investigated by a method originally devised by Freundlich, in which the displacement of a minute nickel particle inserted in the gel is measured microscopically. The force is applied by means of a magnetic field. For stresses of short duration, the displacements are elastic in character in both the transparent phase and the bands. The bands are anisotropic. The relative values of the rigidities are converted into absolute units by means of a series of measurements on gelatin gels. Measurements have been made on fresh eggs and on eggs stored at 25° and 0° C., and it has been found that there is a close relation between the rigidity of the thick white fraction and its volume, irrespective of the reason for the volume difference.

A. G. WARD

SOME RECENT DEVELOPMENTS IN MAGNETISM

THE Electronics Group of the Institute of Physics held an informal symposium in London during September 23-24 on "Some Recent Developments in Magnetism", at which seven papers were read and discussed. The first speaker, Dr. E. W. Gorter (Philips Laboratories, Eindhoven), outlined the theory of the magnetic properties of the ferrite group of materials. They have the spinel type of structure, in which the metal ions occupy two different types of site, and the interactions between the ions are such that the total magnetic moment is roughly equal to the difference between those for the ions in the two types of site. Dr. Gorter showed why this relation might not be exact, and how various anomalous shapes of saturation/temperature curve can occur; he demonstrated a striking example, namely, a material the spontaneous magnetization of which is reversed as the temperature rises. The properties of ferrites can be used to infer the relative strengths of the interactions between ions in various configurations, and the evidence so obtained supports the theory of super-exchange.

Ferrites are insulators, some of them having resistivities of the order of 10^5 ohms, and can therefore be studied in fields alternating even at microwave frequencies, whereas any similar experiments with metals are largely prevented by the effects of eddy currents. J. Watkins (G.E.C. Research Laboratories, Wembley) described the Faraday rotation and the transverse phase-shift, two effects observed in such experiments. The latter effect is a variation

in phase and attenuation for the two directions of propagation, observed when a magnetic material in a waveguide is subjected to a transverse magnetic field. The Faraday effect, observed when there is a static magnetic field along the direction of propagation, is non-reciprocal—that is, waves travelling either with or against the direction of the static field have their planes of polarization rotated in the same direction in space.

B. G. Parkin (Post Office Research Station, Dollis Hill) discussed the properties required in the magnetic cores used for the 'memory' circuits of computers and similar apparatus. These cores should have nearly rectangular hysteresis loops and must be capable of reversing their magnetization in a few microseconds in a field of about 1 oersted. The time required for reversal is governed not only by the decay of eddy currents but also by the damping of changes of alignment of electron spins. The operating conditions can be met both with ferrites and with metal tapes a few microns thick. A rectangular loop in metals may be produced by grain orientation as the result of severe cold-rolling, or by annealing in a magnetic field. In the discussion, Dr. Gorter explained the rectangular loops of ferrites as the result of one source of anisotropy outweighing all others.

Dr. R. Street described the experimental methods developed at the University of Sheffield for the measurement of spontaneous magnetization. In the interesting range near the Curie point, the magnetization is markedly dependent on field, and the problem is to find methods which allow extrapolation to zero field. There are two main techniques available: the measurement of mechanical force in a non-uniform field, and the measurement of temperature rise on the removal of an applied field. The use of photo-electric amplifiers with galvanometers has so increased the sensitivity attainable by the second method that results obtained by the two methods can now be compared. The approximations made in deducing Curie temperatures are such that the methods lead to values differing by, for example, 4 deg. C., but the existence of anomalous shapes of saturation/temperature curves has been established beyond question.

Particles of iron, if small enough, are known to be magnetized as single domains and therefore to have very high values of coercivity. This coercivity depends on the shape of the particles, being high if they are acicular, and is also high if the anisotropy of the material is large, as in manganese bismuthide or in cobalt. Dr. E. P. Wohlfarth (Imperial College of Science and Technology, London) indicated the types of formula that have been calculated for the effect of interactions between particles in an aggregate, and for several possible distributions of particle shapes. This work has applications not only to the manufacture of permanent magnets and magnetic recording tapes, but also to the study of rock magnetism. He is now extending the theory to the properties of particles which are large enough to contain a single domain-wall.

Dr. N. C. Tombs (G.E.C. Research Laboratories, Wembley) described experiments to produce iron powders showing the properties of a permanent magnet. For practical purposes, a coercivity of about 200 oersteds is needed, which cannot be obtained with spherical particles. Particles of hydrated alpha-ferric oxide are known to have acicular shapes, and with the help of a series of electron micrographs Dr. Tombs was able to demonstrate this property on a number of these

powders prepared under laboratory conditions. X-ray analysis confirmed that the particles seen in the electron micrographs were in fact single crystals. If such powders could be reduced in a stream of dry hydrogen under carefully controlled conditions, without their shape and size being altered, then the resulting iron powder should exhibit useful magnetic properties. A further series of electron micrographs showed that during the reduction much of the acicularity of the particles was lost. Sufficient remained, however, to give a useful coercivity even after compacting. Although the $(BH)_{\max}$ product was much lower than the corresponding figure for barium ferrite, the ratio of B to H is so different in the two materials that each may be useful in particular applications.

Dr. G. E. Bacon (Atomic Energy Research Establishment) reviewed the rapidly expanding field of neutron-diffraction studies of magnetism. Elastic scattering of neutrons from either ferromagnetic or antiferromagnetic substances gives regular diffracted beams which are superposed on the ordinary scattering, and from which the order of the atomic magnetic moments can be inferred (though not without ambiguity unless the specimen is a single crystal). The evidence so obtained supports Néel's theory of ferrimagnetism in ferrites, and neutron diffraction is the main source of evidence for antiferromagnetism. Ordered forms of alloys such as Ni_3Fe have been detected. Inelastic scattering also occurs; in magnetic materials it disturbs the atomic magnetic moments and causes further inelastic scattering by which the disturbance can be detected. The most serious experimental difficulty is the weakness of the available 'monochromatic' beams of neutrons, the intensity of the beams used for X-ray diffraction being about 10^5 times as great. There is great scope for further experimental work, but much of it must necessarily wait until powerful sources of neutrons are more widely available in research establishments.

Each of these seven papers was followed by questions and discussion, and Dr. Gorter's contributions should be mentioned as being particularly helpful.

A. C. LYNCH
J. WATKINS

DAILY MAPS OF THE SUN

IN the study of solar-terrestrial relationships, obtaining solar data of a homogeneous nature over a period of years or of decades is one of the principal difficulties. Where daily observations of the Sun are required, co-operation between a number of observatories is essential if there are to be only a small number of unrepresented days. The difficulty then arises of obtaining uniform quality of original material from the different contributing observatories. Although suitable means of doing this have been available for many years in the case of solar photographs in integrated light, similar co-operation with instruments showing the features only visible in monochromatic light has in the past been hindered by difficulties in reaching agreement on the precise instrumental requirements, in maintaining the observing routine and standard of quality, and in providing suitable means for reduction and publication of material. A fresh attempt at co-operation between a number of observatories has now been