active patch and be activated when there ; there must be a highly specific relation between the structure of the active patch and the substrate adsorbed from solution for both these processes to occur. These surface patches do not appear to constitute any great part of the mass of the colloidal particle, for many pure enzymes activating very different reactions are so similar in general composition that ordinary chemical analysis cannot distinguish between them. The enzyme may thus be regarded as a colloidal carrier having a specific local surface structure. The nature of the carrier is of importance, though it is secondary to the nature of the surface grouping ; if the carrier is changed the catalytic efficiency of the enzyme may, or may not, be changed. The complex phenomena of activation of enzymes are often due to the combination of two types of particle ; and among the most important activators are the sulphydryl grouping and the iron-containing part of hæmoglobin.

The discussion gave a good idea of the progress made by the new science of the molecular anatomy of surfaces ; it is well started and cannot fail to develop rapidly and increase in interest and in usefulness to the biologist, and perhaps ultimately also to the practising physician.

N. K. ADAM.

Migrations of Animals

A COMPREHENSIVE discussion which covered the movements of most of the migratory groups of animals occupied the morning of September 10 at Section D (Zoology) of the British Association at Norwich and brought together much recent information about migration and theories concerning it.

The discussion was opened by Prof. James Ritchie, of the University of Aberdeen, who dealt with the migrations of mammals and directed attention to two problems—the cause or causes of migration and the way in which migratory routes were determined. He described briefly the well-known large-scale movements of such as the lemmings in Scandinavia, the brown rats which invaded Europe from the Caspian region in 1727, the grey squirrels and martens in North America before 1866. These, due to lack of food following undue multiplication, were casual, rather sporadic, one-way movements—overflow movements and not migration proper, and they aimed at no definite goal. True migrations, regular seasonal goings and comings or two-way movements, are of two types, differing in degree rather than essence. The local migration, shown by the red deer of Scottish hills or the Wapiti deer of the Yellowstone Park in the United States, was a movement from summer feeding grounds at high altitudes to a winter range in the shelter of the valleys. Its primary urge was food.

The great seasonal migrations, impressive in extent as well as in the mass of animals taking part in them, were formerly represented by the movements of the wild horses of the steppes of Asia, of the countless antelopes of Africa, the bison, reindeer and musk-oxen of America. They were determined mainly by scarcity of food, though other 'hungers' for water or for salt, also induced regular migrations ; and their route often followed regular tracks or roads surveyed and made by far distant ancestors after trial and error towards a definite goal. Road-making is characteristic of the daily activities of mammals, and migratory tracks formed a heritable property handed down from generation to generation. Such an explanation of migration avoids the need of invoking any special migratory instinct or special sense of direction.

Dr. N. A. Mackintosh described the migrations of whales from the antarctic region where they are most abundant during the summer, gorging upon the crustacean *Euphausia superba*. In winter they move northwards to temperate waters for the breeding season, and although actual migrations have not been often traced, the circumstantial evidence is strong. For example, in the antarctic, whales fatten enormously as the summer advances, and then off South Africa whales very fat in body and yet with empty stomachs are found, clearly immigrants from the antarctic feeding grounds. Again in winter off the African coast whales bearing fresh scars were found, but when whales were caught in the antarctic the scars were healed —they had been contracted in warmer waters during the northern migration. How the migrating whales are guided on their movements is not clear : except in coastal waters landmarks seem to be out of the question, but perhaps the temperature of the water controls the movements, since the regular presence of whales seen from the *Discovery* in the antarctic shows that they frequent tongues of warm water and are obviously sensitive to temperature.

Recent discoveries regarding the migrations of birds were described by Dr. A. Landsborough Thomson, who pointed out that the old idea of narrow migration routes along coast-lines and river-valleys had been abandoned in favour of the

idea of migratory movements upon a broad front. The extraordinary complexity and variety of migration in different species, sometimes closely related, were illustrated by a series of well-chosen examples, some selected from the recently investigated movements of birds confined to tropical areas; but it was pointed out that overriding all the complexities a regularity of time and place and route characterises migratory movements as a whole. The outstanding problem still to be solved is that of route-finding, and although there are many indications that vision plays an important part (for example, fog is one of the serious disturbances of a migration) yet the orientation of a migration journey must still be looked upon as something of a mystery.

Some interesting results of marking experiments were described by Dr. E. S. Russell in discussing the migrations of fishes, where knowledge of migration is of great economic importance since the movements of concentrated shoals of food fishes regulate the fisheries. In fish-marking experiments, hundreds of thousands of individuals have been marked and a high return of 30–40 per cent gave a clear indication of the major movements, which was supplemented by the analysis of fishery statistics. Generally speaking, the migrations of fishes consist of three movements—of mature fish to the spawning grounds, generally upstream, a dispersion after spawning, generally downstream, and local seasonal migrations such as that of the tunny into the North Sea in autumn. Dr. Russell illustrated these facts by describing in detail recent observations upon the movements of cod, plaice and salmon.

The series of general papers on migration was concluded by an account of the migrations of insects by Dr. C. B. Williams. In this case, migration does not necessarily include a return flight, though in the last five years evidence has accumulated that some Lepidoptera do make a return journey. Migration is widespread in the insect world, many instances being known from the groups of Lepidoptera, locusts, dragon-flies and beetles. One of the most remarkable cases is that of the American monarch butterfly which spends the summer so far north as Alaska and winters in the southern States and Mexico, returning to a state of semi-hibernation in the same groups of trees year after year, although one or two generations have passed since the former occupants had traversed the migration route. The extraordinary movements of the world-wide painted lady butterfly were described, and it was shown that insect migration takes place in definite directions, and is independent of the direction of the wind. The understanding of insect migration is complicated by the short life of insects which makes impossible any learning of the route from direct ancestral experience.

The migration symposium was a popular feature of the Section's discussions, and was attended by a very large audience.

Character and Causes of New Stars

AT the British Association meeting in Norwich, a discussion on new stars was opened in Section A (Physics) on September 10 by the Astronomer Royal (Dr. H. Spencer Jones), and other papers were contributed by Mr. J. P. M. Prentice, Prof. F. J. M. Stratton, Prof. W. H. McCrea, Mr. E. G. Williams, and Dr. A. B. Wyse and Mr. R. H. Stoy. The following is a summary of some of the chief points which emerged.

A new star may be defined for practical purposes as a star the apparent brightness of which increases within a few days by some five magnitudes or more. The first well-authenticated historical record of a nova is of that observed in 1572 by Tycho Brahe, and since then novæ have been looked for and observed with increasing zeal. This may be illustrated by the fact that, since 1901, forty-two galactic novæ have been recorded, and of these seven have been near enough and discovered soon enough for detailed spectroscopic study. These seven include Nova Herculis 1934, discovered by Prentice, through whose promptitude in communicating the fact a spectrum was obtained by Martin at Greenwich within one hour after discovery.

The 'light-curve' of a nova in general shows a steep rise to its principal maximum, followed at first by a steep fall, and then by a more gradual fading, with small fluctuations, to something very near the pre-outburst magnitude. The case of Nova Herculis, however, showed novel features in the way of many comparable maxima, extending over some months, before the steep drop occurred. The intrinsic surface brightness, as judged by the effective temperature, does not in general change much before the principal maximum, and hence the increase in total brightness must be attributed to an increase in the radiating surface. In a typical case, the radius of the star, as defined by its photosphere, must increase about a hundredfold. In the later stages, however, the effective temperature does increase very considerably, so