de la résonance magnétique nucléaire" ; and Prof. A. Lösche (Leipzig), "Quelques travaux sur la résonance paramagnétique nucléaire effectués à Leipzig". A lecture by Prof. C. H. Townes (Columbia) on the measurement of time by spectroscopic methods was an apt illustration of the application of many of the ideas and techniques discussed during the conference.

Some fifty papers were presented in six sessions, fairly evenly distributed over the subjects mentioned above and representing contributions from some thirty laboratories. Preprints of almost all the papers were available before the conference ; authors were allowed fifteen minutes for presentation of the gist of their papers, and the matter was then thrown open to discussion. As is usual at these conferences the discussions were unusually free and frank and therefore most valuable to all concerned. It is perhaps conducive to a free exchange of views at such a meeting that the discussion itself is not recorded or published.

It is evidently impossible to mention each paper in detail, and I am obliged to pick out the ones which seemed of more than usual interest. The first two sessions on dielectric constant and loss included several papers on measuring techniques. There were also two papers on mixtures, which still present many difficulties, by J. M. Hough and J. A. Reynolds (Hull) and by G. P. de Loor (The Hague). Study of the dielectric properties of hydrogen-bonded liquids (R. Arnoult *et al.* (Lille) and C. Brot (Paris)) continues to produce interesting results. G. Offergeld (Brussels) described dielectric measurements on a series of methacrylate polymers. R. Freymann and his group (Rennes) presented papers on dielectric effects in various solids and particularly in selenium and zinc sulphide, showing the effect on dielectric properties of illumination at 3650 A. They also showed that one of the dielectric absorption regions in solid camphor is in reality due to fenchone impurity.

The third session, on electron resonance of various types, included several papers on free radicals and particularly on DPPH. R. Gabillard (Geneva) and J. Berlande (Paris) described ingenious uses of electron resonance in the control and measurement of magnetic fields in particle accelerators. Measurements on ferrites still attract considerable interest in view of their great technical importance ; several papers in the fourth session were concerned with these and in particular with the Faraday effect (F. Mayer, of Grenoble), the behaviour in the resonance region (J. Pauleve, of Grenoble), and the effect of losses (J. Snieder, of The Hague). In the fifth session, J. Winter and J. Brossel (Paris) described electron resonance experiments on optically oriented sodium atoms in which they observed absorption bands at multiples of the usual Larmor frequency. D. Dautreppe and B. Dreyfus (Grenoble) discussed the effect of hydrostatic pressure on the pure quadrupole resonance frequency in *p*-dichlorobenzene ; the effect found is readily interpreted in terms of the effect of the pressure on the libration frequency of the molecule in the lattice.

In the last session G. E. G. Hardeman and N. J. Poulis (Leyden) presented new results on the relaxation time for proton magnetic resonance in the antiferromagnetic crystal, hydrated copper chloride, and showed that the relaxation is due to interaction with the copper ions. W. G. Proctor (Basle) described experiments in which the nuclear resonance signal of sodium in sodium chloride is modified by subjecting the sample to ultrasonic radiation at double the Larmor frequency. J. G. Powles (London) discussed the correlation between mechanical, dielectric and nuclear resonance absorption processes in polymers. G. J. Béné, R. Beeler and D. Roux (Geneva) showed that paramagnetic resonance can now be used to measure magnetic field strength down to about 0·05 oersted using metal–ammonia solutions, which have very narrow lines. H. H. Staub (Zurich) has measured the nuclear relaxation time for the rare gas xenon and found a satisfactory explanation in terms of nuclear quadrupole interactions during interatomic collisions.

The success of the conference was due in large measure to the excellent organization of Prof. Extermann, Dr. Béné, Dr. Denis and Miss P. Cottier. A report of the conference is being published in the May issue of the *Archives des Sciences*, and copies can be obtained from the Institut de Physique, Université de Genève, price 25 Swiss francs.

J. G. Powles

PELAGIC MOLLUSCA: SWIMMERS AND DRIFTERS

THE Malacological Society of London held an open discussion meeting in the rooms of the Linnean Society on the evening of March 14, with Prof. Alastair Graham (University of Reading) in the chair. Invitations had been issued to the staff and students of biological departments, and there was a large attendance, mainly from scientific institutions in or near London, and also from Reading, Oxford and Swansea.

Dr. J. E. Morton (Queen Mary College, London) introduced the subject of pelagic Mollusca with an account of pelagic prosobranchs. Prosobranchs became pelagic in two instances, both of them in the order Mesogastropoda. The three families, together known as the Heteropoda (Atlantidae, Carinariidae and Pterotracheidae), are actively swimming carnivores, and the family Ianthinidae are passive drifters. These two groups illustrate strongly contrasting modes of attaining the pelagic life. In the Heteropoda, the emphasis was upon the lightening and eventual loss of the now unnecessary shell, and the development of lightness and buoyancy, with the tissues becoming jelly-like and the heavy viscera restricted to an insignificant mass. The mantle cavity was fully retained in *Atlanta* and eventually lost in *Pterotrachea*. The foot was transformed into a gracefully undulating fin, and there was considerable speed of movement. Large eyes were developed, with great visual acuity. The shape of the body became fusiform, the higher families losing the planorboid spiral form of *Atlanta*. They are reminiscent of small translucent serpents, moving rapidly, and with the sharp teeth of the buccal mass taking a strong hold of smaller planktonic prey.

The Ianthinidae adopted a pelagic life in a very different way from the Heteropoda. The shell—though lightened—remains of normal size, and forms a globular body whorl with a short apex, vivid violet in colour, floating mouth uppermost. The animal has no special locomotor organs and drifts at the surface, buoyancy being conferred not by jelly-like tissues but by a raft secreted by the foot. In *Ianthina ianthina* this consists of a bubbled mass of air-filled

vesicles ; in *I. prolongata* and *I. exigua* it is flatter and is used also for the attachment of egg capsules to its under-surface. The teeth of the radula are long and sharp. *Ianthina* feeds on the floating siphonophore *Velella*, attaching itself to the under-surface of the siphonophore and grazing upon its living tissues, until the chitinous float is stripped bare. When feeding on *Velella*, *Ianthina* appears to lose the raft and to make use of the siphonophore not only as food but also to obtain buoyancy and transport. This specialized mode of feeding suggests an origin for the Ianthinidae among those benthic mesogastropods which are sluggish carnivores, grazing on sessile animals, including cœlenterates. *Ianthina* illustrates such a mode of feeding transferred to the pelagic level.

Dr. J. E. Forrest (Queen Mary College, London) directed attention to the interest and importance of the order Opisthobranchiata in considering the development of the free-swimming habit in the Mollusca. The order includes benthic as well as truly pelagic species, while some, essentially creepers, are yet able to adopt a swimming habit at times. It is, therefore, perhaps possible to see something of the steps by which the pelagic habit was acquired. A tendency towards a reduction of the shell characterizes this group and culminates, eventually, in its absence in the gymnosomatous pteropods and throughout the nudibranchs. The foot also has a certain plasticity and is frequently modified by the development of parapodia or wings which, arching upwards on each side, form a cloak enclosing the shell and visceral mass as, for example, in *Aplysia* and *Akera*. In the latter, parapodia are particularly well developed, and by their means the animal can periodically, and notably in the breeding season, perform vigorous and effective swimming movements the significance of which, however, is not clear.

In the Tectibranchiata, both the Bullomorpha and the Aplysiomorpha have, apparently independently, evolved pelagic representatives, the thecosomatous and gymnosomatous pteropods respectively, and of all the gastropods which have taken to this mode of life they are, perhaps, the most specialized. *Limacina*, a primitive thecosome, is in many respects intermediate, sharing benthic and pelagic features although the animal is planktonic. It has a fully coiled shell and visceral mass, swims by means of wings, and is microphagous, but still possesses a pallial ciliary feeding mechanism. The more specialized thecosomes, such as *Cavolinia*, *Creseis* and *Cymbulia*, have a greatly reduced, paper-thin shell which is no longer coiled, and swim by movements of the extensive wings spread out laterally beyond the opening of the shell. A pallial feeding mechanism no longer occurs, and the feeding tracts are limited to the now greatly reduced central part of the foot and, in some genera, the wings as well. These are minute animals, the larger species measuring perhaps 2 cm. in length, and in all their features show a complete adaptation to a pelagic habit.

In contrast, the gymnosomes, also minute, are carnivores preying, it is thought, on the smaller thecosomes. In common with them, they possess wings which serve for locomotion and also help to keep the animal afloat, but in almost all other features they stand apart. The shell is absent, the body cylindrical and the complex buccal apparatus includes series of suckers for grasping the food and paired-hook sacs in relation to the buccal cavity. They have never developed a ciliary feeding mechanism. Although conveniently considered together, the thecosomes and gymnosomes probably represent two independent lines of evolution which parallel each other in certain respects. To place them together in one order, the Pteropoda, is probably an unnatural grouping.

The nudibranchs are more conservative and have given rise to only a few pelagic forms—the rare, transparent, brilliantly luminous phyllirhoids the modifications of which follow less spectacular lines.

Dr. Anna Bidder (Cambridge) spoke of the Cephalopoda, with particular reference to the method of swimming. Jet-propulsion, the basic swimming mechanism of the Cephalopoda, is effected in two ways. In the Nautiloidea, the non-muscular mantle of which lines the living chamber of the external shell, water enters between the overlapping folds of the funnel. Proximal 'circular' muscles provide the necessary expulsive force, and distal longitudinal muscles can be used in steering and are firmly anchored to the shell through the shell muscles. In the Belemnoidea and in all living cephalopods except *Nautilus* the shell is internal or absent. The circular fibres of locomotion constitute the mass of the muscular mantle, the major muscles of the tubular funnel are longitudinal, and both systems are anchored to the guard, phragmacone and pro-ostracum or to their derivatives when present.

Fins, first known as small posterior rounded lobes, may be regarded as stabilizers during forward movement and as assisting in gentle to-and-fro or hovering movements. Fins show a wide variety in shape, size and position ; they are missing in incirrate octopods only. The deep web, characteristic of the cirromorph octopods, the Vampyromorpha, and the squid *Histioteuthis* may, Dr. Bidder suggested, serve for medusa-like swimming, especially in the Cirromorpha, the small funnel and reduced mantle aperture of which seem inadequate for locomotion. Chun's figure of "*Opisthoteuthis medusoides*" was suggested by Dr. Bidder as evidence of this type of swimming.

Dr. W. J. Rees (British Museum (Natural History)) discussed the characteristics of deep-sea cephalopods and indicated that very few species have been studied alive and that the available depth records with open nets are too few to permit precise conclusions. Likewise, records from the neighbourhood of oceanic islands are unreliable because of upwelling from deep water. Despite this, the broad picture for squids is comparable with what is known for other groups, especially fish.

Dr. Rees demonstrated that the web and arm membranes (the functions of which were discussed by Dr. Bidder) increase in size in benthic octopods and hinted that bathypelagic octopods like *Amphitretus pelagicus* may have arisen from deep-water benthic forms. *Amphitretus*, with its thick gelatinous outer covering, is the only species of cephalopod known to have 'telescopic' eyes. The most remarkable deep-sea forms, however, are the Vampyromorpha and the Cirromorpha, with their paddle-shaped fins, enormous webs and the tactile cirri on the arms. *Cirrothauma murrayi* in the latter group is very fragile and is the only blind species of cephalopod known.

Epipelagic squids of the upper 500 m. are chiefly transparent larvæ of the Cranchiidae, but deeper-living species at about the threshold of light have large eyes (sometimes accompanied by light organs) and often retain powerful toothed or hooked suckers as in *Taonius pavo*. Species living at still deeper

levels have a very varied range of light organs and are deep red to bluish-black in colour. The tentacles may become long and whip-like with minute suckers, as in *Mastigoteuthis* and *Bathyteuthis*. Accompanying these external features there are often reduction of radula and loss of ink sac, with a general degeneration of musculature which is largely replaced by a gelatinous layer. *Heteroteuthis dispar*, with its luminous secretion, often regarded as a deep-water species, is usually captured in the upper 300 m. Dr. Rees's contribution was illustrated with colour transparencies of the various species under consideration.

A short discussion followed, in the course of which Mr. B. B. Boycott (University College, London) suggested that analysis of the variety of fin sizes and shapes shown in the animals described by Dr. Bidder and Dr. Rees can be made in terms of the stability requirements of their differently shaped bodies and arms. He reported observations on *Sepia officinalis* and *Loligo vulgaris*. *Sepia* is slightly lighter than water, and relatively broad and short: the two fins are long, movable, muscular flaps, one on either side of the visceral mass. *Loligo* is slightly heavier than water, and relatively narrow and long: the two fins are triangular flaps confined towards the apex of the visceral mass. In both animals when swimming fast ('giant fibre response'), the fins are shut down against the body. When moving gently, waves pass down the fins corresponding to whether the animal is moving forward, backwards or turning. The major propulsive force in both cases is produced by jets of water from the funnel. If the fins are removed in *Sepia*, manœuvring is not much impaired, though the animal does not maintain its position in the water as well as usual but tends to drift towards the surface. The main defect is that it rolls when moving. The fins therefore give the animal lateral stability during gentle swimming. This is probably true also for *Loligo*; but since the funnel is at one end, the fins probably also serve to keep the apex of the visceral mass up when the animal is going forwards and down when it is going backwards. That this is so is indicated by the fact that the head is higher than the visceral mass when moving forwards and lower during backwards motion.

RECENT FLORISTIC STUDIES: BRAZIL, GUATEMALA AND TANGANYIKA

THE following floristic studies have recently been published.

In the Smithsonian Miscellaneous Collections (126, 1, pp. 1–290, with 128 illustrations; 1955), L. B. Smith has given a comprehensive account of the Bromeliaceae of Brazil, based on long and intensive observations. In preparing this work, the author has taken into account the particular interest of this group from the point of view of vegetative propagation, economic and horticultural uses—the pine-apple belongs here—and, in some areas, the need for eliminating bromeliads in effecting the control of malaria. A classification of Brazilian Bromeliaceae made some twenty years ago comprised some five hundred native species; but since then 135 additional species have been discovered, and others are coming to hand. An account is given of the sources of information (herbaria and earlier published work), geographical distribution and origin, and keys to the three sub-families and their genera and species, with line drawings of representative species.

A further contribution to the "Flora of Guatemala", Part II, "Grasses", by J. R. Swallen (with the section on "Bamboos" by F. A. McClure), is published as volume 24, Part II, pp. 1–390, of *Fieldiana*, 1955 (Chicago Natural History Museum). In this treatise, the author includes 120 genera and 455 species, native and introduced. This very considerable number of species is attributed in part to the diverse habitats, from tropical lowlands to sub-alpine meadows, which the territory of Guatemala provides. The largest genera are *Panicum*, *Paspalum* and *Andropogon*, these comprising about one-third of the total grass species. In conformity with the general arrangement of this Flora, the genera and species are set out in alphabetical order. An evident disadvantage of this is that certain closely related genera and species may be widely separated in the text. More than a hundred clear line drawings add to the value of this work.

The extensive hydrobiological survey of Lake Tanganyika, undertaken during 1946–47 under Belgian auspices, has yielded a further report, in which accounts are given, by different authors, of the Characeae, Hepaticae, Pteridophyta and certain families of flowering plants of the Lake region. ("Exploration Hydrobiologique du Lac Tanganika (1946–1947): Résultats Scientifiques." *Inst. Royal des Sci. Nat. de Belgique*, 4, Fasc. 2, pp. 1–82; Brussels, 1955.)

NATIONAL OCEANOGRAPHIC COUNCIL

REPORT FOR 1954–55

THE chief instrument of the National Oceanographic Council is the National Institute of Oceanography at Wormley, near Godalming, and the two main fields of study pursued at the Institute are marine biology (centred about problems concerning the Antarctic whale fisheries) and marine physics (involving mostly studies of surface waves, wind stress, and more recently, storm surges). The annual report for 1954–55, recently issued*, shows that relatively little work is done in marine chemistry and submarine geology. A comparative analysis of publications of the two leading oceanographic institutions in the United States suggests that the scientific programme of the National Institute of Oceanography most nearly resembles that of the Woods Hole (Mass.) Oceanographic Institution. The Scripps Institution, at La Jolla, Calif., places additional emphasis on biology, geology and chemistry, in descending order, and in this sense the Scripps Institution appears to present the most balanced programme. That the National Institute of Oceanography compares so favourably with the American institutions is all the more impressive when one considers that it is about one-third the size of either of them (inasmuch as budget and total number of persons employed are an index of size).

* Annual Report of the National Oceanographic Council, 1 April 1954–31 March, 1955. Pp. v+38. (Cambridge: At the University Press, 1956.) 5*s*. net.