

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

Report of the Council for 1961-62

The Council have to report with regret the death of Col. Sir Edward T. Peel, K.B.E., D.S.O., M.C., who had been a Vice-President of the Association since 1936.

THE COUNCIL AND OFFICERS

Four ordinary meetings of the Council were held during the year, two in the rooms of the Royal Society, one in the rooms of the Royal Astronomical Society, and one at Plymouth. At these the average attendance was seventeen.

THE PLYMOUTH LABORATORY

During the year the old portion of the library has been completely redecorated and its general appearance improved. The remaining space between the north building and the Citadel wall has been concreted. The underground hot-water pipes connecting the south and north buildings which had corroded have been renewed.

The Plymouth Corporation has agreed to the transfer of the lease of a strip of land about 60 feet by 20 feet adjoining the eastern boundary of the land already occupied by the Association. The Land Department of the War Office has approved this transfer and the land has now been taken in. It will add greatly to the amenities of the laboratory in allowing room for a lawn as well as a car park in front of the eastern extension.

During January to March 1962 extensive repair work was done to the original south building, which was necessary on account of the increasing penetration of moisture through the porous limestone facade. The parapet walls at the east and west ends were taken down as far as the second floor window lintels and rebuilt with the insertion of lead damp courses. The chimney stacks which formed part of the parapet walls have not been replaced. At the west end large wooden beams over the windows on the south side were replaced by reinforced concrete lintels.

The roofs of both ends and the centre block were relaid with asphalt. The east, south and west walls were dressed with waterproofing solution, and the woodwork, gulleys and downpipes were repainted.

AQUARIUM

No further constructional work has been needed. The circulation system has worked very efficiently, the water remaining exceptionally clear always.

The fish and invertebrates have been in excellent condition and the death rate has been low. Many appreciative remarks have been made by visitors on leaving. During the summer months the public hall has often been crowded to capacity. Parties of school children have been brought by their teachers at all times of the year.

LABORATORY EXTENSION

The building of the laboratory extension and the alterations to the existing buildings are nearing completion. The extension to the east has a lecture room on the ground floor, and on the first floor there are botanical laboratories and a temperature-controlled culture room. The addition to the north building comprises a basement floor with constant-temperature room, electro-physiology laboratory, and photographic dark-room facilities; on the first floor there is a large physiology laboratory, while on the second floor there are oceanographic and inorganic chemistry laboratories. In the old north building the original photographic room on the ground floor has been converted into a physiological chemistry laboratory, with a constant-temperature room; and on the first floor there is now an organic chemistry laboratory.

The above accommodation and some new research rooms give greatly improved facilities for the staff and additional working accommodation for visiting research workers.

The extensions and alterations were designed by our architect, Mr F. L. Preston, F.R.I.B.A., of Messrs Easton & Robertson, Cusdin, Preston and Smith, London, and built by Messrs John Garrett and Son Ltd, Builders, of Plymouth.

Details of the plans were outlined by the Director and members of the scientific staff of the Plymouth laboratory, to whom the Council wish to record their appreciation, especially also to Mr F. J. Warren, who supervised all the electrical installations, and Mr F. G. C. Ryder, who gave invaluable supervisory help throughout the building operations.

RESEARCH SHIPS

The three research vessels R.V. 'Sarsia', R.V. 'Sula' and M.V. 'Gammarus' have been in operation during the year.

During November and December, 1961, R.V. 'Sarsia' underwent her tail-shaft survey and her eight year Lloyds hull special survey. At the same time she completed her continuous survey of engines.

R.V. 'Sula' was unfortunately put out of action for two and a half months during the summer owing to an explosion of the engine crank case. During this period the Association hired a 36 foot motor launch 'Sylvia' for collecting purposes. Although this vessel was unable to trawl on the outer grounds, there was little interruption in the supply of material normally brought in by R.V. 'Sula'.

The Council would like to express their appreciation of the prompt action of Capt. W. J. Creese and the crew of R.V. 'Sula' at the time of the accident in preventing loss of the vessel by fire.

GRANT FOR FLAGELLATE RESEARCH

The Council are pleased to report that H.M. Treasury have continued the grant to the Association for research on marine flagellates in Prof. Irene Manton's department at Leeds University in collaboration with Dr Mary Parke. Mr D. G. Rayns has been appointed as from 1 October 1961 in succession to Dr G. F. Leedale who has joined the staff of Leeds University.

STAFF

Dr F. S. Russell, F.R.S., was awarded the Gold Medal of the Linnean Society of London for Zoology for 1961; he was also elected a Foreign Member of the Royal Danish Academy of Science and Letters.

Dr J. A. C. Nicol has been awarded the degree of Doctor of Science of the University of Oxford.

Mr F. A. J. Armstrong has been promoted to the grade of Principal Scientific Officer.

Dr D. B. Carlisle has been appointed Senior Principal Scientific Officer in the Department of Technical Co-operation to do research in the Anti-Locust Research Centre. He left the staff of the Plymouth laboratory on 1 February 1962.

Dr G. T. Boalch joined the staff of the Plymouth laboratory as Senior Scientific Officer on 1 October 1961. He has been seconded to the International Paints Research Fellowship for the year ending 30 September 1962.

Dr F. S. Russell attended the International Council for the Exploration of the Sea Symposium on Zooplankton Production in Copenhagen in October.

Dr J. A. C. Nicol spent two months at the Woods Hole Oceanographic Institute during July and August, and then attended the Symposium on Light in the Sea at the Pacific Science Congress in Honolulu.

Dr D. B. Carlisle attended the International Union for the studies of social arthropods in Pavia in September.

Mr F. A. J. Armstrong attended the Pacific Science Congress in Honolulu in September, after which he took part in a special meeting of Chemists concerned with the Indian Ocean Expedition.

Dr E. D. S. Corner attended the meeting of the International Council for the Exploration of the Sea in Copenhagen in October and took part in the Symposium on Zooplankton Production.

Dr A. J. Southward spent a month in April and May at the marine laboratory at Banyuls-sur-Mer studying the biology of Mediterranean barnacles. Together with his wife, Dr Eve C. Southward, he spent six weeks in June and July visiting the Zoological Institute and University Zoological Laboratories in

Leningrad, and the Institute of Oceanology and the University Laboratory of Invertebrate Zoology in Moscow. During their journey they visited laboratories in Denmark, Sweden and Finland.

Dr T. I. Shaw attended the International Biophysics Congress in Stockholm in August; he also visited the new fisheries research laboratory in Bergen.

OCCUPATION OF TABLES

The following one hundred and twenty-six workers have occupied tables at the Plymouth Laboratory during the year.

- Dr A. ACARA, Istanbul (Physical oceanography).
 E. ADAMS, Plymouth (Library).
 Dr M. N. E. ADAMS, Reading (Phytoplankton).
 Dr J. S. ALEXANDROWICZ, Plymouth (Nervous system of invertebrates).
 P. F. BAKER, Cambridge (Biochemistry of squid axons).
 M. W. BALDWIN, Plymouth (Library).
 D. BARKER, Leicester (Ostracoda).
 A. BECKINSALE, Bristol (Submarine geology).
 B. E. BELL, Zanzibar (Physical oceanography).
 Prof. F. BERNARD, Algiers (Culture of marine flagellates).
 Mme M. F. BERNARD, Algiers (Culture of marine copepods).
 Dr ANNA BIDDER, Cambridge (Buoyancy of Pearly Nautilus).
 Dr E. J. BINYON, London (Ionic composition of *Asterias rubens*).
 B. M. BIRD, Bristol (Submarine geology).
 Miss E. BLACKMAN, Keele (Epiphytes on algae).
 Dr G. T. BOALCH, International Paints Research Fellow (Effects of toxic substances on algae).
 Dr A. D. BONEY, Plymouth (Ecology of red algae and effects of carcinogens on sporeling development).
 Miss J. K. BOWMAN, Plymouth (Library).
 R. R. BUTLER, Cambridge (Submarine geology).
 Dr P. C. CALDWELL, Bristol (Muscle and nerve physiology).
 N. L. CHADWICK, Salisbury (Library).
 D. M. CHAPMAN, Cambridge (Scyphozoan hydratuba).
 A. D. CHEESMAN, London (Physiology of squid axons).
 Miss E. CLAY, Brixham (Library).
 A. J. COLLINGS, Birmingham (Volatile organic matter in sea water).
 J. S. COLMAN, Port Erin (Deep-sea plankton).
 R. H. COOK, Cambridge (Library).
 C. A. COSWAY, Torquay (Library).
 Miss A. C. COUPLAND, Birmingham (Library).
 E. CROWTHER, Southampton (Library).
 D. CURRY, Bristol (Submarine geology).
 Dr R. P. DALES, London (Pigments of sabellids and *Arenicola*).
 P. J. DARE, Plymouth (Library).
 P. S. B. DIGBY, London (Pressure sensitivity in marine animals).
 M. EDMUNDS, Oxford (Defence mechanisms in nudibranchs).
 Dr D. ETHERINGTON, London (Library).
 Mrs J. ETHERINGTON, London (Marine algae).
 Dr MARIA M. FELINSKA, Ashby de la Zouche (Ciliates).

- H. FORD, Salcombe (Library).
I. H. FORD, Bristol (Submarine geology).
R. FOWLER, Plymouth (Library).
C. J. FOXWELL, Plymouth (Library).
B. M. FUNNELL, Cambridge (Submarine geology).
J. D. GAGE, Southampton (Benthic communities of rocky bottoms).
Dr D. R. GLASSON, Plymouth (Library).
Dr A. V. GRIMSTONE, Cambridge (Structure of fish gills).
Dr D. N. HARCOURT, Plymouth (Library).
M. G. HARDY, Reading (Stretch receptors of *Astacus*).
Dr A. DE HARO, Barcelona (Anatomy of brachiopods).
Dr C. DEN HARTOG, Yerseke, Holland (Algal communities).
Dr H. W. HARVEY, F.R.S., Plymouth (Library).
D. HEDDLE, Oxford (Functional histology of asteroids).
Dr J. H. HICKMAN, Plymouth (Library).
Dr M. N. HILL, F.R.S., Cambridge (Submarine geology).
Dr R. B. HILL, Glasgow (Innervation of gastropod hearts).
Dr D. HINES, Plymouth (Library).
Prof. A. L. HODGKIN, F.R.S., Foulerton Research Professor of the Royal Society
(Physiology of squid axons).
Dr E. P. HODGKIN, Nedlands, W. Australia (Littoral biology).
Dr G. M. HUGHES, Cambridge (Structure of fish gills).
D. J. HUME, Teignmouth (Library).
O. D. HUNT, Newton Ferrers (Library).
Miss A. HURST, Reading (Buccal mass of opisthobranchs).
F. J. JEFFREY, Plymouth (Heart action in lamellibranchs).
Miss J. E. KANE, N.I.O. Wormley (Library).
G. C. KEARN, Birmingham (Monogenean parasites of fish).
Dr G. Y. KENNEDY, Sheffield (Chlorophyll pigments).
F. J. L. KETT, Ashford (Library).
Mrs M. J. A. KETT, Ashford (Library).
Dr R. D. KEYNES, F.R.S., Cambridge (Physiology of squid axons).
Prof. E. W. KNIGHT-JONES, Swansea (Library).
H. D. KUMAR, London (Algal physiology).
Dr MARIE V. LEBOUR, Plymouth (Library).
Dr H. LEMCHE, Copenhagen (Opisthobranchs).
Dr J. G. E. LEWIS, Bradford (Littoral centipedes).
Dr J. LLEWELLYN, Birmingham (Trematode parasites of fishes).
L. C. LLEWELLYN, Swansea (Parasitology).
C. T. MACER, Lowestoft (*Ammodytes*).
G. I. MANN, Plymouth (Library).
Prof. Irene MANTON, F.R.S., Leeds (Flagellates).
Dr SHEINA M. MARSHALL, Millport (Organic matter and carbohydrates in sea water).
Dr A. L. MARTIN, London (Library).
R. W. MARTIN, Norwich (*Patella*).
C. S. MASON, Cambridge (Submarine geology).
D. H. MATTHEWS, Cambridge (Submarine geology).
Mrs A. K. MILLER, Kampala (Marine algae).
C. J. MILLER, Plymouth (Library).
Dr P. L. MILLER, Kampala (Respiratory structures of marine dipterous larvae).
J. W. MURRAY, London (Ecology of Foraminifera).
Dr R. W. MURRAY, Birmingham (Skin sense organs of elasmobranchs).

- Dr D. NICHOLS, Oxford (Ecology of *Acrocnida*).
 Dr A. P. ORR, Millport (Organic matter and carbohydrates in sea water).
 J. E. PALING, Birmingham (Monogenean parasites of fishes).
 J. F. PAREDES, Lisbon (Phytoplankton).
 Dr G. D. PARRY, London (Bromine fluxes in *Palaemonetes varians*).
 Dr W. T. W. POTTS, Birmingham (Body fluids in elasmobranchs).
 Cdr. C. F. B. POWELL, R.N. (Rtd.), Plymouth (Library).
 Miss S. B. PUTT, Plymouth (Library).
 Dr D. G. RAYNS, Development Commission Research Fellow (Algal cytology).
 Miss E. A. RITCHIE, Reading (*Patella* species).
 Miss M. SARGEANT, London (Origin of coelomic amoebocytes).
 P. D. V. SAVAGE, Plymouth (Heart action in lamellibranchs).
 Dr A. J. SMITH, Bristol (Submarine geology).
 Dr Eve C. SOUTHWARD, Plymouth (Pogonophora: polychaetes).
 B. W. P. SPARROW, Newton Ferrers (Library).
 Miss F. A. STANBURY, Plymouth (*Cladophora*).
 S. D. G. STEPHENS, London (Physiology of squid axons).
 D. M. STEVEN, Yelverton (Library).
 Dr MURIEL F. SUTTON, Chelsea (Embryology of *Salpa fusiformis*).
 Dr K. TAKAHASHI, London (Muscular contraction in *Mytilus*).
 Dr D. W. TAYLOR, Aberdeen (Composition of gas in cuttlefish bone).
 C. TEIXEIRA, Sao Paulo (Phytoplankton).
 C. H. THORP, Newton Ferrers (Library).
 Dr B. L. TONGE, Plymouth (Library).
 I. D. TUNKS, Guildford (Library).
 Dr BETTY TWAROG, Cambridge, U.S.A. (Anatomy of *Mytilus*).
 R. C. VERNON, London (Library).
 Dr H. G. VEVERS, London (Library).
 G. E. WALSTER, Plymouth (Glycolysis in *Maia*).
 J. M. WATSON, Plymouth (Library).
 J. B. J. WELLS, Exeter (Library).
 Dr D. A. WEST, Liverpool (Genetics in *Sphaeroma rugicauda*).
 Prof. W. F. WHITTARD, F.R.S., Bristol (Submarine geology).
 J. H. WICKSTEAD, Colonial Office (East African plankton).
 Dr W. WIESER, Vienna (Respiration of intertidal animals).
 Dr H. V. WYATT, Leeds (Library).
 R. Y. ZACHARUK, Saskatoon (Nervous systems in arthropods).

Among the many scientists who have visited Plymouth during the year to see the general work of the laboratory and to discuss problems with members of the scientific staff, the following have come from overseas: R. M. Cassie (New Zealand), Dr Vivienne Cassie (New Zealand), Prof. D. Davenport (U.S.A.), Prof. J. H. Day (South Africa), Dr Elda Fagetti (Chile), Prof. J. Q. Helpar (U.S.A.), Dr Y. Hiromoto (Japan), E. Hochberg (U.S.A.), Dr A. A. Kirpichnikov (U.S.S.R.), Prof. J. M. Moulton (U.S.A.), Prof. E. R. Noble (U.S.A.), S. Oscarson (Sweden), J. A. Patrick (Australia), Prof. M. Tamashige (Japan), Dr F. H. Tarp (U.S.A.), T. B. Widdowson (Canada), Dr I. R. Hagadorn (U.S.A.), Dr E. Boltovskoy (Argentine), Miss P. Figg-Holbyn (U.S.A.), J. Figg-Holbyn (U.S.A.), M. Garner (U.S.A.), F. Roberts (U.S.A.),

V. J. Hinds (Aden), Dr C. F. Baxter (U.S.A.), D. N. F. Hall (Zanzibar), E. J. Ferguson Wood (Australia), Dr M. Bernhard (Italy), Prof. M. Gordon (U.S.A.), Dr H. E. Winn (U.S.A.), Dr B. P. Fabricand (U.S.A.), Dr R. Sawyer (U.S.A.), Dr R. J. Conover (U.S.A.), C. S. Yentch (U.S.A.), Dr G. Pulitzer (Italy), Prof. C. S. Bachofer (U.S.A.), Dr G. Ueda (Japan), M. E. Stansby (U.S.A.), Dr U. Melchiorre-Santarelli (Italy), Prof. H. Koch (Belgium), Prof. E. Dodt (Germany), Dr P. Halldal (Sweden), E. S. Kordyl (Poland), Dr T. R. Rice (U.S.A.), K. R. H. Read (U.S.A.), E. Paasche (Norway).

The Danish Research Vessel 'Dana' called at Plymouth on 29 June and among those entertained at the Laboratory were Mr F. Hermann and Mr V. Kr. Hansen.

On 1 June the laboratory was open to sixth-form students during the Commonwealth Technical Training Week. On 19 June a number of delegates to the Museums' Association Conference being held in Plymouth were entertained at the Laboratory.

A Symposium on Speciation in the Sea was held at the Plymouth laboratory from 27 to 29 September under the joint auspices of the Systematics Association and the Challenger Society. Apart from the staff and visiting workers, 129 scientists attended the meetings of whom 26 came from overseas. Delegates were entertained at the laboratory and a Reception was kindly given in the Guildhall by the Lord Mayor of Plymouth.

Visitors attending this Symposium from overseas, whose names have not already appeared above were: M. Anraku, Prof. B. Battaglia, Dr K. Banse, Dr W. W. H. Bé, Dr F. Beyer, Dr B. P. Boden, Prof. H. Brattström, Prof. H. Caspers, Dr and Mrs F. Creutzberg, Miss J. Indrehus, Dr M. W. Johnson, Prof. G. A. Knox, Dr J. A. McGowan, Prof. E. C. Raney, Dr R. H. Rosenblatt, Prof. J. T. Ruud, Dr Mary Sears, Dr J. W. Shield, Dr and Mrs P. Tardent, and Dr B. Werner.

The Easter Vacation Courses were conducted by Mr G. M. Spooner and Mr N. A. Holme and were attended by thirty-eight students from the following Universities: Oxford, Cambridge, Reading, Exeter, Aberdeen, Aberystwyth, Southampton, London, Sheffield, Glasgow, Leicester, Edinburgh and Hull.

Also during the Easter Vacation a party of eight boys from Hurstpierpoint College was brought by Mr D. E. Hardy.

Two fortnightly courses in Marine Physiology were conducted by Dr E. J. Denton and Dr T. I. Shaw in September. These were attended by twenty-two students from Queen Mary College, University College London, Cambridge, Southampton and Bristol Universities, and Charing Cross Hospital Medical School.

SCIENTIFIC WORK OF THE PLYMOUTH LABORATORY STAFF

Sea Water and Plankton

Dr L. H. N. Cooper has completed and published in Volumes 39 and 41 of the *Journal* a series of six papers on the physical and chemical oceanography of the Celtic Sea. In some restricted areas some reasonably persistent systems have been recognized, but over the Sea as a whole the 'currents' were wind driven and as variable as the winds. Though to have established an axiom as true seems small reward for so much work, nevertheless there is now a more assured foundation for further work in the area.

In May 1961 Dr Cooper and Mr J. S. Colman, Director of the Port Erin Marine Laboratory, undertook a joint investigation of the deep waters of the Bay of Biscay. Horizontal closing plankton nets were used to sample strata of water 50 m. thick. Four nets were used at a time from one warp, while replicated chemical observations at intervals of 10 m. were made to cover the strata sampled by the nets. Adjacent nets showed large variations in plankton abundance and the discontinuities in density, oxygen content and abundance of plankton were concordant. At one of the most striking discontinuities, apparent potential density decreased downwards by about 0.008 sigma-*t* unit and the difference seems to be significant. Since such a decrease is unlikely, we have to consider whether our density calculations are at fault due to small variations in the deep sea of ionic ratios such as Cl⁻/SO₄²⁻, Na⁺/Ca⁺⁺ or of isotopic ratios such as D/H. These in turn may be associated with variations in the abundance of plankton. Assurance comes but slowly when differences so slightly exceed experimental error.

Results are now being obtained of an order of magnitude more precise than when the work on the deep ocean was started ten years ago; but still they are barely sufficient to sustain a firm interpretation. In consequence many thousands of analyses at two stations only are being submitted to a very rigorous statistical scrutiny to establish a sound basis for stratification in the deep ocean.

For many years Dr Cooper, using the present as the key to the past, has been attempting a picture of oceanic circulation during the Cainozoic and Pleistocene eras. In these speculations, the geological history and present-day oceanography of the Greenland-Scotland and Mid-Atlantic Ridges and the meteorology of polar fronts play essential parts. Recent rapid advances in our knowledge of these has justified a renewed attack on the 'historical oceanography' of the North Atlantic Ocean. This research can advance only slowly.

Dr Altan Acara of the Hydrobiology Research Institute at Istanbul has been working with Dr Cooper on the comparative oceanography of the North Atlantic and North Pacific Oceans. The vertical circulation and nutrient distributions in these two oceans differ greatly and for this there are several

causes but one seems to be dominant. Each ocean at the north is separated from a cold adjacent sea by a long subterranean ridge or island arc. There is, however, a wide deep water channel between Kamchatka and the Aleutian Islands which has no counterpart in the ridge stretching from Greenland to Scotland. Through this channel deep cold nutrient rich water of relatively low salinity enters the Bering Sea where it is upwardly displaced or upwelled. In very strong contrast recruitment of new water into the Norwegian-Greenland Sea consists of relatively warm but very saline shallow water of the North Atlantic drift which has suffered an adverse partition of nutrients. Many of the salient differences in the two large oceans follow from this.

Mr F. A. J. Armstrong and Mr E. I. Butler have continued the monthly cruises to the International Hydrographic Station E1 and have arranged at intervals to include this position in a network of other stations, as was done in 1959 and 1960. The area of about 1400 square miles surveyed in those years was increased in 1961 to about 3400 square miles, with four lines across the western end of the English Channel giving thirty-nine stations between the 4° W. and 5° W. meridians. This network was worked in February, April, June and October. The results so far confirm, but in greater detail, earlier findings by Matthews and others showing that the entry of Atlantic water into the English Channel somewhat resembles that of sea water into a river estuary. There are signs that in this part of the Channel there is a clockwise circulation in winter which reverses in the early summer, as suggested by Dietrich. Another attempt to measure currents with a direct-reading current meter with the help and co-operation of the Lowestoft laboratory of the Ministry of Agriculture, Fisheries and Food had to be abandoned in rough weather.

Mr Armstrong has prepared some samples for checking phosphate analyses, using aged, heat-treated sea water sterilized with sulphite. They appear to be stable for a few months at least and are under test in some other laboratories.

Mr Armstrong and Dr G. T. Boalch have written an account for the *Journal* of their measurements of the ultra-violet absorption of sea water. Their work on the properties of the volatile constituents of sea water has continued. Attempts have been made to estimate trace amounts of some simple organic compounds in distillates from sea water, so far with little success, although it appears likely that a part of the volatile material is acidic.

Dr Mary Parke has during the year, either alone, or in co-operation with other workers, prepared several papers for the press. Her presidential address on the class Chrysophyceae to the British Phycological Society in January 1961, is published in the *British Phycological Bulletin*, Vol. 2, No. 2, and the joint paper with Miss Irene Adams on a problematic green flagellate, which was found to be one motile phase in the life-history of *Halosphaera viridis*, has just been published in the *Bulletin of the Research Council of Israel*, Section D, Botany, Vol. 10D. Dr Parke and Miss Adams have continued their study of

Halosphaera and a second type of motile phase has been isolated in culture and the non-motile phase grown from it. The complete life-history has not been elucidated, however, although a quite considerable part of the year has been spent in this study which has included the daily examination of townet samples for recording the occurrence of *Halosphaera* stages in the sea off Plymouth. At the same time forms which would probably be placed in the problematic series, the Pterospermataceae, have been isolated in culture from the routine daily townet samples for future study.

Dr Parke has continued her work on the genus *Chrysochromulina* and two interesting species in the Plymouth collection have been studied and their descriptions, based on light microscope observations, prepared for publication; this will be in conjunction with Prof. Irene Manton's observations with the electron microscope.

In co-operation with Prof. Irene Manton, F.R.S., of Leeds University and Dr J. W. G. Lund of the Freshwater Biological Association, a study of the type species of *Chrysochromulina* from Lake Windermere has been completed and this has been published in *Archiv für Mikrobiologie*, Vol. 42. Dr Parke is also continuing her study of the non-motile phases of inshore coccolithophorids.

Over 200 cultures have been sent to other laboratories for research purposes. In addition 46 cultures were sent to the American collection of Type Cultures of algae at Indiana University. Prof. R. C. Starr reports that 37 have survived the journey and these have been incorporated into their collection.

Dr D. P. Wilson and Mr F. A. J. Armstrong, continuing their investigations concerning biological differences between sea waters, have published in Vol. 41, No. 3, of the *Journal* an account of their work in 1960 referred to in the last Report of Council. This year they have been able to confirm that the morphological form of the *Echinus esculentus* pluteus is influenced more by the particular water in which it develops than by variations in copper concentration. In their 1960 experiments they had compared water from the Firth of Clyde with water from E1; in their 1961 experiments they used coastal water from the French side of the Channel and water from mid-Channel.

The former gave a better type of larva than the latter irrespective of changes in the amount of dissolved copper. They also demonstrated that while chelation with E.D.T.A. worsens rather than improves a natural water with low copper concentration, it certainly improved a water to which copper had been added to raise the concentration to a level much above the normal. In addition they made observations on the effect of salinity differences and tested the influence on the larvae of other modifications of the sea water. Preserved larvae from all these experiments await examination and the detailed records have still to be studied.

Dr Wilson has turned his attention to the larvae of *Sabellaria alveolata* and

problems concerned with rearing them. The initial purpose was to investigate the conditions under which metamorphosis occurs and to determine the manner in which the very large colonies of this polychaete, which are so abundant on inter-tidal rocks along much of the north coast of Cornwall, are maintained and renewed. There has been little advance in our knowledge of the biology of the species since Dr Wilson published in the *Journal* in 1929 his account of the development, and many problems remain to be solved. The larva has a pelagic life of several weeks and this summer attention has been concentrated on finding a good method of rearing the larvae in large numbers through to metamorphosis. While attempting to do this it has been discovered that the larvae, at least the early stages, normally do best when extremely crowded, frequently becoming abnormal quickly and ultimately dying when sparsely distributed in the rearing vessels. This is more true of some sea waters than of others and seems to be related to some toxic property which may or may not be present. A swarm of larvae will render innocuous a water known to be toxic to a few larvae; after removal of the swarm by filtration such a water becomes an excellent medium for larvae however few are put into it. Filtrates from the known poisonous dinoflagellate *Gymnodinium veneficum* have an immediate immobilizing effect on *Sabellaria* eggs and larvae; if they are relatively few in number the eggs and larvae disintegrate, but if sufficiently crowded few do so and the majority recover and subsequently appear none the worse. Several observations of this kind have been made and it is hoped to publish a preliminary report soon. Some exploratory experiments on metamorphosis have also been made but the larvae available for these have so far been few and no certain conclusions can yet be drawn.

Dr E. D. S. Corner has continued his investigation of the nutrition of the copepod *Calanus helgolandicus*. Studies using adult females kept in the dark at 10° C have shown that *Calanus* fed with diatom cultures have a respiration significantly higher than that of starved animals, an effect which is sustained throughout the summer months. It is hoped to continue these observations during winter months so that a reliable seasonal picture can be obtained.

In collaboration with Mr C. B. Cowey (National Institute for Research in Dairying, Reading) Dr Corner has completed a two-year investigation of the relative quantities of amino acids in members of the oceanic food chain phytoplankton-zooplankton-fish. In spite of month by month variations in the amino-acid composition of phytoplankton and *Calanus*, a broad measure of agreement has been found between the relative amounts of fifteen amino acids present in the three groups of organism, a result which indicates that protein of a certain amino-acid composition may be typical of food chains in the sea, and adds further emphasis to the importance of phytoplankton as a food for *Calanus*. An account of this work was presented to the International Council for the Exploration of the Sea Symposium on Zooplankton Production at

Copenhagen (October, 1961). It is hoped to extend the work to include studies of more detailed aspects of nitrogen metabolism in copepods.

Dr A. J. Southward has almost completed his second paper on the distribution of macroplankton indicator species in the English Channel and Western Approaches. On the basis of this report it is planned to replace the routine hauls of the stramin ring-trawl with high speed sampling.

Macro-fauna and Flora

The regular observations carried out by Dr A. J. Southward on the distribution and abundance of intertidal barnacles show a slight increase in the northern form, *Balanus balanoides*, in S.W. England in 1961, and slight decreases in *Chthamalus stellatus* and *Elminius modestus*, which are essentially southern forms in Britain. This trend may be attributable to the poor summer of 1960. Work is now in progress on inherent rhythms in the feeding and respiratory processes of barnacles and on details of the mechanism of feeding, with apparatus purchased by means of a grant from the Royal Society. Further work on temperature effects on barnacles was carried out on material sent from Trinidad, W.I. Sub-tropical species were also investigated during a visit to the Laboratoire Arago, Banyuls-sur-Mer in April, made possible by a grant from NATO funds for scientific research. The results of the research on cirral activity of barnacles in collaboration with Dr D. J. Crisp were published in *Phil. Trans.* series B, vol. 243.

In June Dr and Mrs Southward were able to visit Prof. A. V. Ivanov at the University in Leningrad to discuss their work on Pogonophora. The visit was made under the scheme for exchange of research workers, travelling expenses being met by the Royal Society.

Mr G. M. Spooner has examined more samples of coarse deposits from the sea bed for interstitial animals, and material has been sorted for further study. The interstitial isopod *Microcharon harrisi* has been found to be a regular inhabitant of the Eddystone shell gravel at a density of about 2 or 3 per litre of gravel to at least the depth reached by an anchor dredge. It has now also been found in three other localities—at Tresco, Scilly, in clean coarse intertidal sand, off the N. Cornwall coast below 41 fm. in fine shelly gravel, and at the edge of the Hurd Deep (in mid-Channel) in shelly gravel below 45 fm. The two latter records indicate quite a wide distribution off shore.

It is hoped that the description of two new species of Bogidiellid amphipods will be ready for publication shortly. They are the first members of the family to be found in deposits off shore, and one of them is being ascribed to a new genus.

It has, incidentally, been found that it is not only the deposits of the sea bed which provide new fields for exploration, but that the fauna of the more accessible terrestrial gravels has been much neglected in this country. A few

simple trials in washing gravel where ground water reaches to or near the surface has produced some interesting crustacean records, including the formerly elusive *Bathynella natans* in three separate localities. Attention has been drawn to these finds in a letter to *Nature* (published 1 April 1960).

In collaboration with Dr E. Naylor of the University College of Swansea and D. J. Slinn of the Marine Biological Station, Port Erin, a paper has been published in Vol. 41, No. 3, of the *Journal* on the occurrence and distribution of *Jaera nordmanni* in Britain, with observations on the so-called subspecies of *Jaera albifrons*. Four of the different forms of the male, already distinguished on the continent, have been found by them in Britain, often in close proximity. Though the females cannot be distinguished by any known characters, there seem to be four distinct populations which behave as distinct species. These may occasionally hybridize, but show little evidence of so doing. All four occur, for example, in Plymouth Sound.

Mr P. G. Corbin has continued to collect data on lucernarians. The best time to make any survey of the populations of the four species is at the spring and autumn equinoxial spring low tides. In April 1961, at Wembury, the proportions of the species were very much as has been previously found: *Halicyclystus auricula* and *Lucernariopsis* sp. were numerous (100-200) while *L. campanulata* and *Craterolophus convolvulus* were present in small numbers (4-8). It has been found that in autumn the numbers of the two commoner species are less than in spring although still numerous (30-50). The populations also contain mainly larger mature or maturing individuals. But in September 1961, the proportions of the four species differed greatly from the usual autumn composition. At Wembury, on a very good low tide less than half a dozen specimens of *Halicyclystus* and *Lucernariopsis* sp. were noted and half of these in each case were small or very small; and no *L. campanulata* or *Craterolophus* were seen. At Looe, on the following day, no *Halicyclystus* or *Craterolophus* were seen; a single *Lucernariopsis* sp. was noted, the second record for Looe; and *L. campanulata* was numerous (40-60) and all specimens were very large with ripe or ripening gonads. This scarcity of *Halicyclystus* and *Lucernariopsis* sp. and the abundance of *L. campanulata* was very unusual.

Mr N. A. Holme has continued his survey of the bottom fauna of the English Channel, with the object of extending the survey published in Vol. 41, No. 2, of the *Journal* to the remainder of the Channel. During the year a further number of dredge stations have been worked in the western half and central portion of the Channel. Results obtained so far show an eastward penetration of some 'Western' species right up the middle of the Channel to the Straits of Dover, and there are suggestions of Western influence, as shown by dead shells of indicator species, off the French coast in the eastern Channel. One or two Western species, however, appear to be restricted to the western half of the Channel. It is still considered that the Western species are

indicators of mixed Atlantic water entering the Channel from the westward, but their distribution does not appear to be specifically associated with either Western or South-Western water. Most of the West Channel species are absent from all parts of the eastern Channel, indicating that their boundary is of quite a different nature from that restricting the Western species. Some appear to be absent also from the Channel Islands–St Malo region, which suggests that their restricted distribution may be related to the strong tidal currents or to the absence of a thermocline. The distribution of these species seems to differ from that of the intertidal species restricted to the Western Channel which penetrate eastward to the region of Cap de la Hague. Results of a study of the shell proportions of *Venerupis rhomboides* in relation to depth of water, and on the burrowing of certain tellinid molluscs appeared in Vol. 41, No. 3, of the *Journal*.

Mr G. R. Forster has continued diving from March onwards. Much of the material he has collected has been of value to the sale of specimens department. The *Echinus* and *Holothuria* taken by diving are normally quite undamaged, unlike trawled or dredged specimens. An underwater survey had been planned in the vicinity of Mounts Bay, but this could not be undertaken as R. V. 'Sula' was undergoing repairs.

Four further shots were made with the deep-sea long line (referred to in last year's report) during a cruise of R.V. 'Sarsia' in the vicinity of La Chapelle bank. The most successful catch was ten fish taken in little over an hour from 625 fm, when the line was hauled at twilight. The catch consisted of four *Mora mediterranea*, two *Deania calceus*, and one *Centroscyminus coelolepis*. In addition one *Deania* was lost on the surface and several hooks were missing. The stomach contents of these fish, though not often present, are being examined. With further results it will be possible to ascertain whether the different squaloid dogfishes have varying depth ranges. One of the objects of the deep long line, which was to bring up the fish sufficiently quickly so that they may be used for physiological experiments, has already been achieved.

In October Mr Forster carried out a preliminary underwater survey on the distribution of *Haliotis*, the Ormer, on behalf of the States of Guernsey Committee for Agriculture and Fisheries.

Physiology of Fish and other Marine Organisms

Further experiments have been carried out on the chorioidal tapetum or reflecting layer in the eyes of selachians by Dr J. A. C. Nicol. Additional specimens have been collected in order to determine how widespread is the occurrence of an oclusable tapetum in these animals. In the spur dog, *Squalus acanthias*, it has been discovered that movement of the chorioidal pigment, so as to cover the tapetum, is not consensual, that is it can take place independently in each eye. Also, shining a light in part of one eye elicits

pigment movement in only that portion of the eye that is illuminated. It appears, from present evidence, that the mobile chorioidal pigment migrates outwards in direct response to incident illumination. Relative spectral measurements of the reflexion are being undertaken to determine the usefulness of the tapetum in scotopic vision. A first account of the elasmobranch tapetum has appeared in Vol. 41, No. 2, of the *Journal*.

A study of retinomotor changes in an extensive series of flatfishes has been carried out by Dr Nicol. It has been shown, contrary to previous report, that cones as well as retinal pigment move when the eye is illuminated. There are species differences in the local behaviour of different parts of the retina, diurnal rhythmicity is lacking. A description of retinomotor changes in the sole *Solea solea* has been published in Vol. 41, No. 3, of the *Journal*. Experiments have been performed to discover the nature of the controlling mechanism; interpretation awaits preparation of the material for microscopic examination. Other experiments of a like nature are being performed on sand gobies and wrasse, as alternative experimental animals.

Dr Nicol spent two months in Woods Hole at the Oceanographic Institute, where he worked with Dr G. L. Clarke on luminous animals, especially luminous copepods. Recordings of the light of deep-sea copepods of the family Augaptylidae were made, the disposition of luminous glands was mapped out by fluorescence microscopy, and histological studies were undertaken. It is planned to publish this work in the near future.

Dr Nicol has also contributed a chapter on luminescence to a forthcoming book on 'The Physiology of Mollusca' edited by Prof. C. M. Yonge, F.R.S., and Prof. K. Wilbur.

Dr E. J. Denton, in collaboration with Dr J. B. Gilpin-Brown, has continued to study the buoyancy of the cuttlefish, paying special attention to the distribution of gas and liquid between the different chambers of the cuttlebone. They find that the gas pressure is extremely low in the most newly formed chambers; this is expected on the hypothesis that liquid is pumped out of the chambers by some osmotic mechanism leaving a space behind into which gases diffuse. Although the cuttlefish retains the power to pump liquid from all the chambers of the cuttlebone the usual distribution of water is such that the older and more posterior chambers are full of water whilst the newest ones are completely dry. This distribution enables the cuttlefish to remain with its body horizontal in the sea. When the cuttlebone is made less dense the change in distribution of liquid tends to tip the tail of the animal upwards. The work on the buoyancy of the cuttlefish has been published in Vol. 41, No. 2, of the *Journal*.

In collaboration with Dr D. W. Taylor of Aberdeen University, Dr Denton has analysed the gas taken from the cuttlebone. This gas in the older chambers is almost entirely nitrogen. In the spring of the year when these experiments were made the chambers being laid down were so thin that insufficient gas

could be extracted for analysis. This suggested that the cuttlebone could be used to determine the age of the cuttlefish. This animal has increased greatly in numbers and in distribution around our coasts in the last few years, and in some areas forms a large portion of commercial trawl catches in certain seasons. It appears that most of the cuttlefish live only two years before spawning and dying; only a few go into a third year. Similar conclusions have been reached on other grounds by Dr D. P. Wilson, and Dr Denton and Dr Wilson are collaborating in writing up their work.

Dr Denton and Dr T. I. Shaw have continued their studies on gelatinous planktonic animals. They find for all species studied, including ctenophores, medusae, heteropod and pteropod molluscs and tunicates, buoyancy is given by having the concentrations of the common ions in their body fluids different from the concentrations of these ions in sea water. The 'lifts' which these fluids give in sea water are principally achieved by the partial exclusion of sulphate, other ions playing a relatively minor role.

Dr E. D. S. Corner, Dr Denton and Mr G. R. Forster have extended their studies on the buoyancy of deep sea sharks to the three species *Deania*, *Etmopterus* and *Centrophorus*. They find for all three species that neutral buoyancy is achieved by storing large amounts of low density fat in the liver. This fat is principally squalene, and hitherto the reason for the occurrence of squalene in such large amounts in shark livers has puzzled biochemists. These sharks unlike other animals do not use their fat simply as a metabolic reserve. They must regulate very exactly the ratio of fat to other structural elements. It is also interesting that no metabolic pathway is known by which squalene can be usefully metabolized; in mammals it is the precursor of cholesterol. These fish, therefore, either have a large reserve of energy stored in an unavailable form or they can in some way metabolize squalene.

Dr Denton and Dr Shaw took the opportunity of examining the retinae of the deep sea sharks caught. They all have golden colours similar to those found previously in deep sea teleosts.

Dr Denton has written a general review on 'The Buoyancy of Fish and Cephalopods' in *Progress in Biophysics*, Vol. II.

In an investigation of the factors regulating the rate of heart-beat of Crustacea Dr D. B. Carlisle has observed that a prawn's heart (*Palaemon serratus*) responds by a brief acceleration followed by a gradual return to normal during the next 20 min, to any form of non-specific stress. The response is the same in magnitude and time-scale whatever the stress, whether it be encountering another prawn, being handled, being injected with distilled water or being dropped on the floor. Repeated stressing leads to a prolonged high rate of heart beat. The initial response to a single stress stimulus has been shown to be mediated via the indolic secretions of the pericardial organs (particularly 5,6-dihydroxytryptamine), while the prolonged response appears to be mediated through the two polypeptides secreted by the same organs.

Dr Carlisle has now established the basic response curves required for a consistent assay (albeit in terms of 'animal units') of the red chromactivating substances of Crustacea. *Palaemon serratus* and *P. squilla* are roughly equally sensitive, while *P. elegans* is about three times more sensitive. Using the resultant assay technique it was found that the amount of chromactivator per animal varied from 50,000 *Palaemon serratus* units in *Pandalus borealis*, 5.6 units in *Meganyctiphanes norvegicus*, 6.5 units in the copepod *Euchaeta norvegica*, to 0.14 units in *Calanus*. It was also possible to localize the part of the animal which contained the active material in the copepods. Lysergic acid and reserpine had no influence on the response to subsequent injections of chromactivating substances, although they modify profoundly the response of the animal to the heart-beat hormones.

Dr Carlisle and Dr P. E. Ellis of the Anti-Locust Research Centre, London, are continuing their exploration of the comparative and behavioural endocrinology of locusts and prawns. The Y-organ of Crustacea appears to be homologous with the prothoracic gland of insects and to function in a similar manner. A note on this work has appeared in *Nature*, Vol. 190, p. 368.

The locomotory powers of adult ascidians have been the subject of a paper published by Dr Carlisle in *Proc. zool. Soc. Lond.*, Vol. 135, p. 141, and read before a meeting of the Zoological Society.

Observations made with underwater swimming gear have established the existence of defended territory in two species of fish, bass and grey mullet. Territorial behaviour does not appear to have been previously described in non-breeding marine fish, though it may indeed be widespread in coastal fish. A note on this topic has been published by Dr Carlisle in *Anim. Behaviour*, Vol. 9, p. 106.

A hermit crab new to Britain has been the subject of a note published in *Nature*, Vol. 190, p. 931, by Dr Carlisle and N. Tregenza. *Clibanarius misanthropus* appears to have arrived on our coast from France and may be spreading.

Dr Carlisle has been investigating the composition of the organic fossil remains of graptolites. Hydrolysates have yielded alanine and glucosamine, while digestion with chitinase has given acetylglucosamine. The material does not, however, give a chitosan reaction and cannot therefore be natural chitin, though the possibility cannot be excluded that it contains chitin which has been slightly modified by geological processes. The editorial board of *Zool. Rec.* has recognized that the graptolites are more likely to be related to the Protochordates than to the Coelenterates, so that in the next issue, the Protochordate section, which continues to be recorded by Dr Carlisle, will include the Graptolithoidea. The issue of this section for 1959 has recently appeared.

Dr E. D. S. Corner, in collaboration with Dr A. D. Boney of Plymouth Technical College, has continued studies of the influence of light on sporelings

of the intertidal red alga, *Plumaria elegans*. It has been found that sporeling growth is normal even when as much as 75% of incident green light (480–570 m μ) is removed by screening with concentrated solutions of the dye eosin yellow: moreover, that growth is markedly increased when the sporelings are screened with very dilute solutions of the dye, or of phycoerythrin, which remove a very small fraction (3–4%) of incident green light. This indication that light energy in the wave-band 480–570 m μ is inhibitory to the sporelings has been confirmed by the further finding that supplementing the light source with green light in the wave-band 500–540 m μ greatly retards sporeling growth. It is concluded that sporelings of mid-littoral red algae such as *Plumaria* do not need phycoerythrin as an accessory pigment in photosynthesis: it functions instead as a means of protecting the plants against excess green light, early stages of growth being dependent on a critical balance between energy in the wave-band 500–540 m μ , and that present at other wave-lengths. An account of this work is being published in the *Journal*, Vol. 42, No. 1, and a further investigation is planned, which will include studies of the effect of green light on photosynthesis by sporelings of *Plumaria*; growth of the sporelings under green light when treated with various auxin-like substances; and a closer examination of ecological aspects using other red algal species as test material.

Dr Boney and Dr Corner have continued their work on the use of red algal sporelings as test material for carcinogens. To facilitate this study large numbers of compounds have been kindly supplied by workers in other laboratories, particularly the Carcinogenic Substances Research Unit at Exeter (Dr W. Carruthers), the Cancer Research Unit at Sheffield University (Dr G. Y. Kennedy) and I.C.I. Pharmaceuticals Division. Of the thirty-three compounds so far tested, eighteen carcinogens have been found to stimulate sporeling growth, but no such effect has been observed with any of the non-carcinogenic analogues. Particularly high stimulations of growth have been obtained with 20-methylcholanthrene, 9:10-dimethyl-1:2-benzanthracene, 6-methyl-1:2-benzanthracene, 1:2:7:8-dibenzanthracene and 3:4-benzpyrene. In addition, degrees of stimulation appear to vary with the metabolic activity of the plant material, effects with rapidly growing 'Southern' species such as an *Antithamnion* being much more marked than those observed with slower growing 'Northern' species such as *Plumaria*. It is hoped to continue this investigation by studying chemical changes (e.g. rates of photosynthesis) occurring in sporelings treated with carcinogens which caused a marked increase in growth rate.

Dr T. I. Shaw has continued to investigate the properties of giant nerve fibres of *Loligo* when their protoplasm has been replaced with artificial solutions. The studies have been carried out in collaboration with Prof. A. L. Hodgkin, F.R.S., and Mr P. F. Baker and brief accounts have been published in the *Proceedings of the Physiological Society* and in *Nature*. The work has

shown that, providing the protoplasm is replaced with roughly isotonic solutions, buffered to between pH 7 and 8.5 and rich in a potassium salt, the fibres can remain excitable for several hours and can conduct many, substantially normal, action potentials. It has therefore been demonstrated that the great bulk of the axoplasm is of no immediate importance in the conduction of nerve impulses. The preparations have also been used to demonstrate that the resting potentials of these nerve fibres originate from a disparity between the potassium concentrations inside and outside the fibre.

It is a matter of interest to determine whether, and under what conditions, the perfused fibres will carry out an active transport of sodium and potassium. This particular problem is currently being examined, and is fundamental to an understanding of salt balance in marine fishes.

Mr J. V. Howarth has pursued his investigation into the thermoelastic properties of *Mytilus* muscle. The results have relevance to the disputed question of how that muscle maintains high tension for long periods without fatigue. Stimulated with acetylcholine the muscle can shorten and perform work against a load and in that state the thermoelastic heat is similar in sign and magnitude to that found for active striated muscle. From this it can be inferred that the protein bearing the load has a cross-linked structure like that of the thermosetting plastics. When the acetylcholine is removed the muscle can still bear the full load without stretching but is not capable of shortening or doing work. In this condition the thermoelastic heat is initially the same as before, but changes gradually as the muscle reverts to the resting state. This is consistent with the view, held by some authors, that the cross-links of the actomyosin system persist in the tonic state and are destroyed piecemeal. Further experiments are in progress to measure the thermoelastic heat under conditions where hydrogen bonding is inhibited.

Mr Q. Bone has continued work upon the histology of the nervous system of cyclostomes, using *Myxine*, *Petromyzon* and *Lampetra*. Results so far obtained include the discovery of proprioceptive terminations amongst the myotomes, which can be traced to their cells of origin in the spinal ganglia, and the probable identification of the cells of origin of the dual motor system supplying the myotomal muscles. The arrangement of the dual motor system in the cyclostome is expected to throw light upon conditions in teleost and elasmobranch fish, where a similar dual innervation of the myotomal muscles is found but where little is known of the central organization of the system.

Co-ordinating systems in the cyclostome cord have been studied, and Mauthner cells identified in late stage ammocoete larvae. Further material is awaited to confirm the existence of this system in the adult petromyzont. In both *Myxine* and *Lampetra*, a giant cell system has been found in the cord, which appears to be homologous with the Rhode cell system in the Acrania; it seems that the cyclostomes illustrate intermediate stages in the regulation of locomotion to those found in the Acrania, and in teleost fishes. Other observa-

tions have been made upon the autonomic nervous system, and in *Myxine* a complicated system of peripheral neurons regulating the secretion of slime has been discovered.

Dr G. W. Bryan has continued his work on the accumulation of radioactive caesium by invertebrates in relation to potassium balance. Experiments on the metabolism of ^{134}Cs in *Carcinus maenas* and other crabs have been finished and the results have been published in Vol. 41, No. 3, of the *Journal*. A comparative study of ^{137}Cs accumulation in relation to K metabolism in lobsters, prawns and freshwater crayfish, carried out in collaboration with Mrs E. E. Ward of the United Kingdom Atomic Energy Authority Radiobiology Group, Windscale, is also being prepared for publication. This work comprises experiments on the uptake and loss of ^{137}Cs in all three species, experiments on the excretion of ions in the urine and experiments on the effects of feeding on ^{137}Cs accumulation in prawns and crayfish. Results for *Homarus vulgaris* and *Palaemon serratus* are comparable with those found using ^{134}Cs in *Carcinus*, in that, despite selective excretion of ^{137}Cs , plasma/sea water ratios for the isotope exceed those for K. Also, in most cases, higher tissue/plasma ratios are attained at equilibrium for ^{137}Cs than for K. In the crayfish, ^{137}Cs is distributed between the plasma and tissues in a comparable manner but in 0.1% sea water plasma/medium ratios for ^{137}Cs at equilibrium are about 17 compared with about 400 for inactive K. This limits the whole animal concentration factors which can be reached by unfed animals to about 200. In prawns in a constant environment, feeding is probably less important than uptake over the body surface in ^{137}Cs accumulation, while in crayfish feeding is probably more important. Work has been continued with the squat lobster *Galathea squamifera* and also with the brackish water species, the isopod *Sphaeroma hookeri* and the gastropod *Potamopyrgus* (= *Hydrobia*) *jenkinsi*. These experiments should be finished during the winter.

Marine invertebrates which have also been studied include the copepod *Calanus helgolandicus*, the echinoderm *Psammechinus miliaris* and the protozoan *Elphidium crispum*. Results for marine species from different phyla show surprisingly little variation with regard to K balance and the extent to which Cs can be accumulated. This work will shortly be prepared for publication.

Dr G. T. Boalch, International Paints Research Fellow, has carried out further investigation of the toxicity of heavy metal salts to marine fouling algae. The bacteria-free cultures of *Ectocarpus* and *Enteromorpha* used for these experiments do not always show the same response to the poisons, and their reaction is in part dependent on the stage in the life cycle at which the poison is added. The effect of organic compounds, both those released as extracellular products and others added to the culture medium, has also been investigated. Once again the way in which these organic compounds affect the toxicity of the metal salts depends upon the growth stage of the algal material.

Attempts have been made to culture fouling algae collected from contaminated ships. So far this has shown little success. These weeds are usually tropical in origin and it is likely that the conditions maintained for the growth of the established cultures of *Ectocarpus* and *Enteromorpha* are not suitable. In collaboration with the staff of the International Paints Biological Research Laboratory at Newton Ferrers, some experiments have been carried out on the green alga *Cladophora*, using material collected from the shore at Wembury. Routine examination of plates on the test rafts at Newton Ferrers has continued.

LIBRARY

The thanks of the Association are once more due to many foreign Government Departments, to Universities and to other Institutions at home and abroad for copies of books and current numbers of periodicals either presented to the Library or received in exchange for the *Journal* of the Association.

Thanks are also due to those who have sent books or reprints of their papers, which are much appreciated.

PUBLISHED MEMOIRS

Vol. 41, No. 1, of the *Journal* was published in February, Vol. 41, No. 2, in June, Vol. 41, No. 3, in October, and Vol. 40 in November 1961.

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MEMBERSHIP OF THE ASSOCIATION

The total number of members on 31 March 1962 was 1274, being 92 more than on 31 March 1961; of these the number of life members was 154 and of annual members 1120. The number of associate members is four.

GRANT FROM ROYAL SOCIETY

Thanks are also due to the Council of the Royal Society for a generous grant of £1340 from the Scientific Publications Fund towards the cost of publication of the 'Synopsis of the Medusae of the World' by Dr P. L. Kramp which formed a special volume of the Journal (Vol. 40).

FINANCE

General Fund. The thanks of the Council are again due to the Development Commissioners for their continued support of the general work of the laboratory.

Private Income. The Council gratefully acknowledge the following generous grants for the year 1961-62:

Fishmongers' Company (£500), The Royal Society (£100), British Association (£50), Physiological Society (£200), The Cornwall Sea Fisheries Committee (£10), The Universities of London (£210), Cambridge (£125), Oxford (£100), Bristol (£50), Birmingham (£31. 10s.), Leeds (£25), Durham (£10. 10s.), Manchester (£10. 10s.), Sheffield (£10. 10s.), Southampton (£15. 15s.), Reading (£10. 10s.), Nottingham (£10. 10s.), Hull (£10. 10s.), Exeter (£10. 10s.), Leicester (£10. 10s.), Gonville and Caius College, Cambridge (£5) and The Zoological Society of London (£10. 10s.).

PRESIDENT, VICE-PRESIDENTS, OFFICERS AND COUNCIL:

The following is the list of those proposed by the Council for election for the year 1962-63:

President

Prof. C. F. A. PANTIN, Sc.D., D.Sc., Dr. Univ., F.R.S.

Vice-Presidents

THE EARL OF IVEAGH, K.G., C.B., C.M.G.	Major E. G. CHRISTIE-MILLER
Sir NICHOLAS WATERHOUSE, K.B.E.	MORLEY H. NEALE, C.B.E.
Vice-Admiral Sir JOHN A. EDGELL, K.B.E., C.B., F.R.S.	Prof. Sir JAMES GRAY, Kt., C.B.E., M.C., Sc.D., LL.D., F.R.S.
Prof. A. V. HILL, C.H., O.B.E., Sc.D., LL.D., F.R.S.	G. M. GRAHAM, C.M.G., O.B.E.
Sir EDWARD J. SALISBURY, Kt., C.B.E., D.Sc., F.R.S.	Prof. Sir ALISTER HARDY, Kt., D.Sc., F.R.S.
A. T. A. DOBSON, C.B., C.V.O., C.B.E.*	Prof. C. M. YONGE, C.B.E., D.Sc., F.R.S.

COUNCIL

To retire in 1963

G. E. R. DEACON, C.B.E., D.Sc., F.R.S.	M. N. HILL, Ph.D., F.R.S.
F. C. FRASER, D.Sc.	O. D. HUNT, F.R.S.E.
Prof. R. J. HARRISON, D.Sc., M.D., M.R.C.S., L.R.C.P.	

To retire in 1964

Prof. A. V. HILL, C.H., O.B.E., Sc.D.,
LL.D., F.R.S.
J. W. G. LUND, Ph.D., D.Sc.
Prof. J. T. RANDALL, D.Sc., F.R.S.
H. G. VEVERS, M.B.E., D.Phil.
Prof. C. M. YONGE, C.B.E., D.Sc.,
F.R.S.

To retire in 1965

Prof. J. E. HARRIS, C.B.E., Ph.D., F.R.S.
Prof. B. KATZ, M.D., D.Sc., F.R.S.
R. D. KEYNES, Ph.D., F.R.S.
C. E. LUCAS, C.M.G., D.Sc.
Prof. J. E. SMITH, Sc.D., F.R.S.

Hon. Treasurer

HARRISON S. EDWARDS, Westhumble Lacey, near Dorking, Surrey

Secretary

F. S. RUSSELL, C.B.E., D.S.C., D.F.C., D.Sc., LL.D., F.R.S.

The Laboratory, Citadel Hill, Plymouth

The following Governors are also members of Council:

B. C. ENGHOLM (Ministry of Agriculture, Fisheries and Food)	S. SMITH, Ph.D. (Cambridge University)
The Worshipful Company of Fish- mongers:	EDWARD HINDLE, Sc.D., F.R.S. (British Association)
The Prime Warden	Prof. G. P. WELLS, Sc.D., F.R.S. (Zoo- logical Society)
Major E. G. CHRISTIE-MILLER	Prof. Sir JAMES GRAY, Kt., C.B.E., M.C., Sc.D., LL.D., F.R.S. (Royal Society)
HARRISON S. EDWARDS	
Prof. Sir ALISTER HARDY, Kt., D.Sc., F.R.S. (Oxford University)	

* Mr Dobson died on 19 May 1962.

BALANCE SHEET 1961-62

THE RUSSIAN BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

1. The Association is a charitable organization established for the purpose of promoting biological research in the United Kingdom and abroad.

2. The Association is a company limited by guarantee and is registered in England as a company with limited liability under the Companies Act, 1947.

3. The Association is a charitable organization established for the purpose of promoting biological research in the United Kingdom and abroad.

STATEMENT OF FINANCIAL POSITION

As at 31st December 1962

Assets

Fixed Assets

Land and Buildings

Plant and Equipment

Investments

Other Assets

Current Assets

Stocks

Debtors

Creditors

Other Liabilities

NET ASSETS

RESERVE FUND

STATEMENT OF FINANCIAL POSITION

AS AT 31st DECEMBER 1962

ASSETS

LIABILITIES

1. The Association is a charitable organization established for the purpose of promoting biological research in the United Kingdom and abroad.

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14. The Association is a charitable organization established for the purpose of promoting biological research in the United Kingdom and abroad.

15. The Association is a charitable organization established for the purpose of promoting biological research in the United Kingdom and abroad.

16. The Association is a charitable organization established for the purpose of promoting biological research in the United Kingdom and abroad.

17. The Association is a charitable organization established for the purpose of promoting biological research in the United Kingdom and abroad.

THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

BALANCE SHEET

	£	£
CAPITAL RESERVE ACCOUNT:		
As at 31 March 1961	168,926	
Add: Expenditure on fixed assets recovered	<u>2,834</u>	
	171,760	
Less: Transfer to surplus account being an amount equivalent to the depreciation provided on assets acquired out of Development Fund grants	<u>3,674</u>	
		168,086
SURPLUS ACCOUNT:		
As at 31 March 1961	11,399	
Add: Transfer from Capital Reserve Account	3,674	
Excess of income over expenditure for the year	<u>2,124</u>	
	17,197	
Deduct:		
Increase in provision for diminution in value of General Fund investments	<u>12</u>	
		<u>17,185</u>
		185,271
BALANCES ON SPECIAL FUNDS (see annexed statement)		<u>5,738</u>
CURRENT LIABILITIES:		
Sundry creditors and accrued expenses	2,451	
Subscriptions and grant received in advance	<u>358</u>	
		2,809
<i>Note:</i> Capital commitments outstanding amount to approximately £15,600 (1961 £74,500) of which £15,000 (1961 £73,900) is recoverable		
O. D. HUNT G. E. NEWELL		<u><u>£193,818</u></u>
<i>Members of the Council</i>		

31 MARCH 1962

	£	£	£
FIXED ASSETS:		Cost or Valuation	Depreciation
Boats and equipment:			
At cost:			
R.V. 'Sarsia'	137,761	16,346	121,415
M.F.V. 'Sula'	12,500	2,000	10,500
R.L. 'Gammarus'	<u>200</u>	<u>50</u>	<u>150</u>
	150,461	18,396	132,065
Laboratory apparatus, equipment and machinery:			
At cost	28,115	10,181	17,934
Library at valuation in 1941 plus additions as valued by the Director	<u>26,140</u>	<u>—</u>	<u>26,140</u>
	<u>£204,716</u>	<u>£28,577</u>	
			176,139
INVESTMENTS AT MARKET VALUE:			
General Fund (including Composition Fees) at book amount (Market value £1,712; last year £1,472)		2,271	
E. T. Browne Bequest Funds at cost (Market value £3,654; last year £3,264)		<u>5,317</u>	
		7,588	
Less: Provision for diminution in value of investments		<u>2,222</u>	
			5,366
CURRENT ASSETS:			
Stocks on hand at the lower of cost and estimated realizable value		6,891	
Sundry debtors and prepayments		2,536	
Balances at bankers and cash in hand		<u>2,886</u>	
			12,313
			<u><u>£193,818</u></u>

AUDITORS' REPORT TO THE MEMBERS OF THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM:

Capital expenditure on the erection of buildings on land held on lease from the War Department is excluded. Subject to the foregoing, in our opinion the above balance sheet and annexed income and expenditure account give a true and fair view of the state of the Association's affairs as at 31 March 1962 and of its excess of income over expenditure for the year ended on that date.

We have obtained all the information and explanations which we considered necessary. In our opinion the Association has kept proper books and the said accounts which are in agreement with them and with the said information and explanations, give in the prescribed manner the information required by the Companies Act 1948.

Norwich Union House
2 St Andrew's Cross
Plymouth
3 May 1962

PRICE WATERHOUSE & Co.
Chartered Accountants

INCOME AND EXPENDITURE ACCOUNT

	£	£
SALARIES (including £343 for previous year) NATIONAL INSURANCE, SUPERANNUATION SCHEME CONTRIBUTIONS AND SUPPLEMENTARY PENSIONS		51,159
LABORATORY AND BOATS' CREWS' WAGES (including £1,132 for previous years), NATIONAL INSURANCE, SUPERANNUATION SCHEME CONTRIBUTIONS, PENSIONS AND EMPLOYERS' LIABILITY INSURANCE		44,131
UPKEEP OF LIBRARY		723
SCIENTIFIC PUBLICATIONS, LESS GRANT FROM THE ROYAL SOCIETY (£1,340) and SALES		1,453
UPKEEP OF LABORATORIES:		
Buildings and machinery	1,278	
Electricity, gas, coal, oil and water	2,097	
Chemicals and apparatus	4,461	
Depreciation of laboratory apparatus, equipment and machinery	1,995	
Rates, less refund including £415 applicable to prior years ...	521	
Rents and insurances	685	
Travelling expenses	1,126	
Audit fee	202	
Stationery, postage, telephone and sundries	1,674	
Specimens	134	
Collecting expenses and upkeep of truck	784	
		14,957
MAINTENANCE AND OPERATION OF BOATS:		
Petrol, oil, paraffin, etc.	1,799	
Maintenance and repairs	13,072	
Depreciation	3,674	
Insurances	2,307	
Hire of Decca Navigator—R.V. 'Sarsia'	395	
		21,247
ENTERTAINMENT EXPENSES	103	
BANK INTEREST AND CHARGES	69	
BALANCE being excess of income over expenditure for the year ...		2,124
		<u>£135,966</u>

FOR THE YEAR ENDED 31 MARCH 1962

	£	£
GRANTS AND TABLE RENTS:		
Ministry of Agriculture, Fisheries and Food—Grant from Development Fund		125,793
Fishmongers' Company		500
Miscellaneous (including Royal Society £100, British Association £50, Physiological Society £200, Zoological Society of London £10. 10s., Universities of London £210, Cambridge £125, Oxford £100, Bristol £50, Birmingham £31. 10s., Leeds £25, Southampton £15. 15s., Durham £10. 10s., Exeter £10. 10s., Leicester £10. 10s., Manchester £10. 10s., Nottingham £10. 10s., Hull £10. 10s., Reading £10. 10s., and Sheffield £10. 10s., and Gonville and Caius College, Cambridge £5)		1,454
		127,747
SUBSCRIPTIONS		1,373
SALES:		
Specimens		3,926
Fish		243
		£
Nets, gear and hydrographical equipment	1,155	
Less: Cost of materials	1,175	
		(20)
		4,149
INTEREST ON BANK DEPOSITS, LESS CHARGES		—
INCOME FROM INVESTMENTS		75
AQUARIUM:		
Admission fees		2,953
Sale of guides		92
		3,045
Less: Maintenance, printing and advertising		423
		2,622
BALANCE being excess of expenditure over income for the year ...		—
		<u>£135,966</u>

MOVEMENTS ON SPECIAL FUNDS DURING THE YEAR TO 31 MARCH 1962

	E. T. Browne Bequest			Library Reserve Fund £	Rockefeller Foundation Fund £	Aquarium Reconstruction Fund £	Main Laboratory Extension Fund £	Research Funds* £	South Building Repair Fund £	TOTAL £
	Library £	Special Apparatus £	Scientific Publications £							
BALANCES AT 31 MARCH 1961 (after providing £1,651 for diminution in value of investments)	978	1,895	808	232	(330)	797	—	194	—	4,574
Add: Income during year										
Grants	—	—	—	—	3,164	—	64,282	4,147	7,000	78,593
Income from investments	40	83	41	—	—	—	—	—	—	164
Bank deposit interest	—	—	—	—	—	42	—	—	—	42
Other income	—	—	66	—	—	—	—	—	—	66
	1,018	1,978	915	232	2,834	839	64,282	4,341	7,000	83,439
Deduct: Expenditure during year										
Increase in provision for diminution in value of investments	5	8	(1)	—	—	—	—	—	—	12
BALANCES AT 31 MARCH 1962	<u>£1,013</u>	<u>£1,970</u>	<u>£916</u>	<u>£232</u>	<u>£ —</u>	<u>£839</u>	<u>£ —</u>	<u>£768</u>	<u>£ —</u>	<u>£5,738</u>

* Including International Paints Limited Research Fellowship.