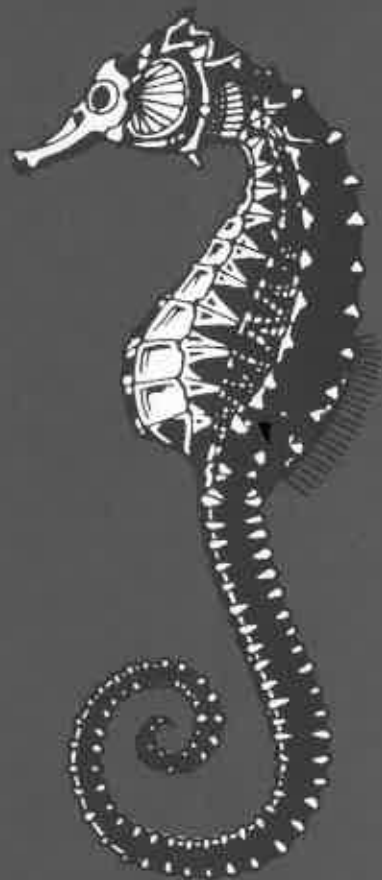


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1976

AUSTRALIAN
MARINE SCIENCE
BULLETIN



No. 54

April 1976

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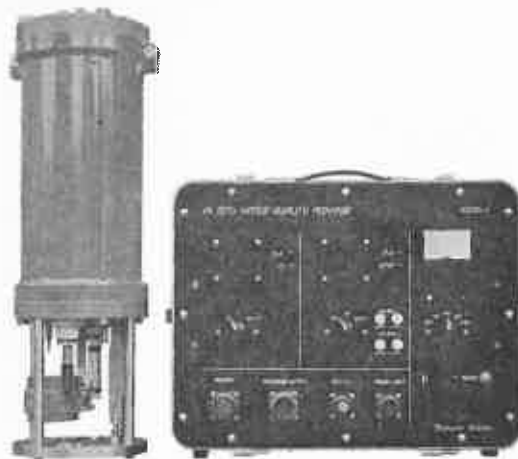
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BULLETIN CORRESPONDENTS

Mr L. C. Collett
N.S.W. State Fisheries
211 Kent Street
Sydney, N.S.W. 2000

Dr R. P. Kenny
School of Biological Sciences
James Cook University
Townsville, Qld. 4811

Dr J. D. Kudenov
Fisheries and Wildlife Division
605 Flinders Street Extension
Melbourne, Vic. 3000

Mr R. C. J. Lenanton
W.A. Marine Research Labs
P.O. Box 20
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University of Adelaide
North Terrace, S.A. 5000

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Dept of Zoology
University of Queensland
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NEWS

An oriental goby *Acanthogobius flavimanus* has, for the first time, been caught outside Port Jackson, where the species is now well established. The specimen, which was received by Dr Douglas Hoese of the Australian Museum, was taken near Taren Point Bridge, Botany Bay, N.S.W., by an amateur angler using a line baited with prawn. The explosive spread of *Acanthogobius flavimanus* in San Francisco Bay was documented in 1963 by Brittain *et al.* (*Calif. Fish Game* 49(4), 302-4) and its colonisation of other Californian estuaries by Kukowski (*Calif. Fish Game* 1972, 58(4), 326-7). Transport of its eggs or larvae in ballast water of ships is the most likely explanation for the arrival of this species in Australia, although Hoese (*Koolewong* 1973, 2(3), 3-5) discusses other possibilities. People dealing with estuarine fish are asked to keep a special look out for this species and to inform Dr Hoese of their presence.

The Oceanographic Buoy Program is continuing to operate very successfully in the Indian Ocean. Of the six satellite buoys placed in the Ocean only one has failed. A second one operates intermittently and a third one, which ran aground on a reef, has been repaired and re-released. The buoys provide information on a variety of meteorological and ocean surface conditions.

Reef Biogenesis Symposium. On 15-16 December 1975 an eminently successful symposium on reef biogenesis was held at Townsville, Queensland, under the sponsorship of AIMS. The symposium attracted world recognised research workers in algal, microbial and coral physiology, calcification, coral reef structure and geology from Australia and overseas. Some of the interesting lessons arising out of the symposium were that productivity and calcification rates per m² are about the same for all parts of the reef, quite independent of whether the substrate is living coral or dead or algal ridge, etc. Another major theme voiced by several speakers was that far more emphasis should be placed on coralline algae and other microflora in future reef research.

Coastal Management. *The Californian Coastal Plan*, a document of some 440 pages including maps, has just been published. This Plan gives a series of 162 specific policies that should apply in planning of the Coastal Zone, and then goes on to develop strip maps showing important areas. Many of the policies are relevant to the Australian needs. The report is available from Documentation and Publications Office, P.O. Box 20191, Sacramento, California 95820, U.S.A. Cost (including surface mail to Australia): \$US4.50.

Some copies of *Coastal Zone Management: The Processes of Program Development* are also available from Peter Cullen, P.O. Box 145, Jamison Centre, A.C.T. 2614. Price: \$9. This a manual for interpreting the U.S. Coastal Management Act and again has points of interest for Australian coastal managers.

Dr K. R. Allen, Chief of the CSIRO Division of Fisheries and Oceanography, who is also Chairman of the International Whaling Commission, went to La Jolla in March for a meeting of the Commission. The meeting was held specifically to discuss the current status of sperm whales. An *ad hoc* subcommittee of the Commission also met to discuss measures for the protection of marine mammals generally.

Dr John Caperon from the Department of Oceanography, University of Hawaii, is visiting the CSIRO Division of Fisheries and Oceanography for a year as a Research Fellow. His work forms part of the South-west Arm Ecosystem Project. He has been studying the dynamics of zooplankton grazing and the rates of phytoplankton carbon fixation. Dr Caperon's year at Cronulla will end in August.

Mr Malcolm Castle of the CSIRO Division of Fisheries and Oceanography is visiting Halifax, Nova Scotia, to gain experience in the operation and maintenance of echo sounding equipment which is being used aboard the CSIRO charter vessel *F. V. Courageous*.

Professor R. A. Davis has recently arrived to spend six months at the University of Melbourne as a Senior Fulbright Scholar sponsored by the Australian American Educational Foundation. This award was granted to the University of Melbourne for Professor Davis to undertake research and teaching with the Sedimentology group of the Department of Geology, and also to assist the Committee on Marine Science (Faculty of Science) in planning the development of marine science undergraduate teaching and interdisciplinary research. Professor Davis, who is Chairman of the Geology Department, University of South Florida, has had wide experience in various aspects of marine science, including close ties with the Department of Marine Science at the University of South Florida, and research activities sponsored by the Office of Naval Research. The Marine Science Committee will gain from his advice regarding the role, structure, and research programs in interdisciplinary marine institutes which have proved successful in the United States.

Professor Davis will undertake teaching in sedimentology and in marine science undergraduate units within the Department of Geology, and also will be involved in the research programs of the Department. He has had extensive experience in process-response and time series studies of beach and nearshore sedimentation, and of marine environments generally. He has worked extensively in the Great Lakes and in many coastal environments in the United States. His interests extend to stratigraphic and sedimentological studies of modern and ancient carbonate rocks, particularly in the Bahamas and Florida.

He has published widely in these fields, is the author of a text book *Principles of Oceanography*, is currently editing a Special Publication for the Society of Economic Palaeontologists and Mineralogists on *Beach and Near-shore Processes*, and is editing a book on *Coastal Sedimentary Environments*.

Professor John Day of the University of Cape Town recently returned to South Africa after spending about a year at the Australian Museum. Prof. Day carried out a compilation of literature on Australian polychaetes, tidied up the taxonomy of local worms and examined a large amount of material in the Museum's collections. He also carried out a survey of the Merimbula Estuary (far south coast of N.S.W.) and in due course will be writing up the results of the four quarterly surveys which were conducted. Prof. Day's visit to Australia was funded by an ARGC grant awarded jointly to him and Dr Patricia Hutchings of the Australian Museum.

Dr R. K. Dell, Director of the National Museum of New Zealand, Wellington, visited the Australian Museum for four days in March. He is one of the world's leading authorities on Antarctic and sub-Antarctic mollusca and has been responsible for several major publications on their taxonomy, distribution and zoogeography. He has

also been active in other areas of research on molluscs. Dr Dell addressed the Sydney Branch of the Malacological Society of Australia on the 'Zoogeography of Antarctic Mollusca'.

Dr Malcolm Gordon of the University of California is currently visiting Australia as a Senior Queens Fellow in Marine Science. After visiting the Australian Institute of Marine Science in Townsville and the Department of Zoology, University of Queensland, Dr Gordon will spend most of 1976 at the Australian National University, working with Adrian Horridge's group on nerve physiology. While in Brisbane Dr Gordon gave a seminar on amphibious fishes.

Dr Douglas Hoese, Fish Dept, Australian Museum recently spent three weeks aboard the Japanese Fisheries Research vessel *Kaiyo Maru* during a cruise between Adelaide and Sydney. This trip was part of a more extensive research program being carried out by the Japanese to study benthic fish. The Japanese research team has spent the last five or six years working off South Africa and New Zealand. The present cruise is being devoted to Australian waters. Dr Hoese reports that the Japanese, as usual, were charming and co-operative, and that the *Kaiyo Maru* was the most comfortable and well equipped research vessel he has seen. Dr Hoese was able to obtain a photographic record of the 40 or 50 species of fish which were taken during the three-week period and through the kindness of his hosts obtained duplicate specimens of some of the material. These specimens have been lodged with the respective State museums. Some difficulties were experienced during the trawling operations because of the uneven submarine terrain in Bass Strait, where nets were damaged occasionally. Nevertheless much useful and interesting material was obtained, particularly off Tasmania and N.S.W.

It is a matter of some concern that original type material collected in Australian waters should be finding its way into laboratories and collections overseas, rather than into Australian research establishments. There may have been no alternative to this unfortunate practice during Australia's discovery and early settlement. However, its continuance into the last quarter of the 20th century can be attributed to the deplorably poor development of marine science generally and oceanographic research in particular in Australia and to the slowness of the Government in providing funds for research vessels capable of doing this type of work.

Dr Patricia Hutchings, Curator of Worms at the Australian Museum, left Sydney recently on a four-month study tour. She plans to spend two months at the Smithsonian Institution examining type material and will also visit the British Museum and the museum at Leiden. On her way back to Australia, she will deliver two papers at the International Symposium on the Ecology and Management of some Tropical Shallow-water Ecosystems, which is being held in Djakarta, Indonesia. One paper will deal with mangroves in urban environments and the other will discuss the cryptofauna at Lizard Island, Great Barrier Reef.

Dr Hutchings, with the assistance of Penny Weate, continued her work on the cryptofauna of coral reefs during a recent field trip to the Lizard Island Research Station. Pat's work on coral reef biology is being funded by a grant from ARGC.

Mr Hugh Kirkman, CSIRO's long-distance runner, is travelling to Boston in April to take part in the Boston Marathon. He will visit several laboratories in Canada and on the East, Gulf and West coasts of the U.S.A. to meet people working on sea grasses.

Dr Angela Medvick, a recent Ph.D. graduate of the University of Hawaii, has visited James Cook University and Queensland, discussing her research on the effects of thermal pollution on inshore coral reefs.

Mr Juan Paez, a scientific officer attached to the Fisheries Research Centre, National Fisheries Institute of Cuba, is visiting the CSIRO Division of Fisheries and Oceanography, Cronulla, for three months to gain experience in the study of prawn populations. His trip is being funded by FAO.

Dr John Paxton, Fish Dept, Australian Museum, recently spent twelve days aboard the Russian research vessel *Dmitri Mendilyeev* on its cruise between Hobart and Perth. He continued his study of the pelagic mid-water myctophids during the cruise and obtained a culture of the symbiotic bacteria responsible for the luminescence of a number of bottom fish (mainly macrourids). From the Bight, Dr Paxton also obtained a splendid assortment of fish, many of which had not been reported since the *Endeavour* cruises of the early 1900s. Several species never before recorded from Australian waters were also obtained. Otter trawls were taken to a depth of 1100 m and beam trawls to 5500 m. It is interesting that no Australian vessel has the capability of working at these depths.

Mr Gary Richardson of CSIRO Division of Fisheries and Oceanography has just returned from a one-month visit to Vancouver, where he attended an exhibition of electronic and other oceanographic and marine instruments. While in Vancouver as a guest of the Canadian Government, he acquainted himself with the maintenance and operation of some of the gadgets which the Division may acquire in future.

Dr Klaus Rohde completed his three-year term as Director of the Heron Island Research Station in February and has taken up a position as lecturer at the University of New England. The control of the University field station at Arrawarra will be one of his concerns. The new Director is Dr A. J. (Sandy) Bruce who many AMSA members will remember as Officer-in-Charge of the CSIRO prawn research group in Moreton Bay several years ago. Dr Bruce has more recently been in Africa and Britain. He will take up duty at Heron Island in April.

Dr Clyde Roper, Curator of Mollusca, U.S. National Museum, visited Australia during December and January to inspect the specimens of cephalopod molluscs (especially squids) in Australian Museum collections. He was one of the participants in the International Mollusc Workshop held on Lizard Island, Great Barrier Reef, during December 1975.

Dr Yuri Sorokin, a member of the Academy of Sciences of the U.S.S.R., has just completed a three-month visit to Queensland as a guest of the Department of Zoology, University of Queensland. Most of his time was spent at Heron Island studying the productivity of the coral reef system. After delivering several seminars at Brisbane, Sydney and Canberra, Dr Sorokin returned home late in March.

Dr William Weike, a microbiologist from the University of Georgia, has completed a year as a visiting Research Fellow at the CSIRO Division of Fisheries and Oceanography and returned to the U.S.A. early in February. Dr Weike made a significant contribution to the development of the research programs on which the 'Ecosystems Group' is currently working.

CURRENT MARINE RESEARCH AT THE UNIVERSITY OF QUEENSLAND

by J. M. THOMSON

Dept of Zoology, University of Queensland

Jim Thomson is working on the effects of sublethal doses of pesticides in estuarine fishes, a project funded by the Australian Water Resources Council. He is also currently a member of a joint Commonwealth-Queensland group examining potential development of north-west Queensland and the adjacent part of the Northern Territory, including the fisheries and the possible effects of industrial and agricultural development on biotic resources.

Postgraduate students working with him include: Brian Lassig, who is studying habitat selection in a coral-inhabiting goby; Vu Long, the biology of catfish; Tim Bade, the biology of Tailor; Leo Lee, schooling in selected species of fish; and Dylan Webb, the biology of a Scorpaenid.

Bill Stephenson continues to unravel the complexity of benthic communities using the numbers game. He has projects in Moreton Bay and in Gladstone Harbour. Associated with him are Ian Poiner, studying small scale variability in the benthos; Leigh Park, studying the localised effects of sewage discharge on the benthos; Debbie Burgess, applying computer techniques to the identification of trawled fish associations; Norm Quinn, doing similar work on the fish in a tidal creek; and Mike Johnston, continuing his work on the taxonomy and ecology of Cumacea.

Bob Endean continues his studies on toxicology (supported by Hoffman-La Roche) as well as his special project on the sea-wasp funded by ARGC. Working with Bob, Clive Wilkinson is conducting a microbiological assay of a coral reef area; Ann Bothwell is studying interspecific aggression and competition for space among the haematypic corals of a reef crest.

Don Fielder, together with Malcolm Thorne and Jack Greenwood, is supported by ARGC to study larval development and behaviour, particularly as they relate to aquaculture of commercially important decapod crustaceans of the families Portunidae, Penaeidae and Palaemonidae. Postgraduates working with Don include Richard Martin, working on ecological and physiological aspects of the nutrition, growth and reproduction of *Patiriella calcar*; Meryl Williams, studying the feeding behaviour of several portunid crabs; and Ross Quinn, looking at the role of water in the feeding of soldier crabs.

Under the auspices of the ABRS, Jack Greenwood is studying the zooplankton of the Calliope River. This is of particular interest as a before-the-event study of a stream that may be affected by thermal pollution following a new power-house development. Jack's postgraduates include Jack Marsh, working on the nutritional value of plankton species; Abdul Aziz, working on the larval development of prawns; Don Munro, studying the Pericaridean fauna of the Brisbane River; and Mike Dredge, looking at the ecology of three species of estuarine fish.

Malcolm Thorne is currently on study leave in Wales. Tom Hailstone is writing up his earlier studies on the effects of the Luggage Point sewerage discharge for publication and meanwhile has become interested in the interstitial fauna of sandy beaches. Under Tom's supervision are Carden Wallace who is studying *Acropora* spp.; and Stuart Cameron, working on the fauna of tide pools.

Ann Cameron continues her interests in the toxicology of poisonous fishes. Her students include Pat Mills, studying the buccal organs and feeding of selected

molluscs; Russell Reichelt, working on the specialisation and genetic variability of some predatory gastropods; and Vicki Harriott, looking at biochemical polymorphism in selected fishes.

In the Department of Physics, Stan Milford and his associates are studying the water currents and dispersion patterns of Moreton Bay and are constructing a computer model. In the Department of Civil Engineering Colin Apelt is looking at the dispersion and transport of pollutants in tidal estuaries. Mike Bryden of the Department of Anatomy is working on the structure and function of the integument of Antarctic seals.

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1975 REPORT OF THE AUSTRALIAN NATIONAL COMMITTEE FOR OCEANIC RESEARCH

by D. J. ROCHFORD

Chairman, Australian National Committee for Oceanic Research

Meetings

One meeting of the Committee was held in July 1975. Items of major interest at this meeting were:

(a) The Law of the Sea Conference, Third Session at Geneva. The Committee was concerned about the possible implications of the 200-mile Economic Zone and the International Sea-bed Authority concept for future marine research. The Committee's viewpoint on the potential problems arising from these concepts has been given to the Australian Academy of Science and directly by the Chairman and some other members of the Committee to the Department of Foreign Affairs and the Australian Taskforce.

(b) Education and training of Asian marine scientists in Australia. The Committee felt that in some cases the training being provided was inadequate or inappropriate, and that the trainee in many cases did not properly use his training on returning to his native country. Suggestions about ways of improving this situation have been conveyed to the Academy and to the Department of Education.

(c) The Australian Science and Technology Council. The Committee expressed interest in the Council's review of the needs of marine science in Australia. Some members of the Committee have been involved in submissions to the Council. The same members will also be asked to criticise the final report prepared by the Council on marine science needs.

Membership of the Committee

Professor B. R. Morton retired as Chairman and was replaced by Mr D. J. Rochford. Professor Burdon-Jones was replaced by Dr Gilmartin, Mr B. W. Logan by Professor L. V. Hawkins, and Dr R. Radok by Professor G. Krause. Professor J. M. Thomson was elected in place of the retiring Chairman. Dr D. Griffin replaced Dr A. J. Gilmour as the representative of the Australian Marine Sciences Association. Dr G. F. Humphrey, Professor G. Krause and Mr D. J. Rochford were appointed Australian members of SCOR.

SCOR Meetings

The 19th Executive Committee meeting of SCOR was held in South Africa on the 12-15 November 1975. Dr G. F. Humphrey represented ANCOR at this meeting. There was nothing of direct interest to ANCOR discussed at this meeting.

Intergovernmental Oceanographic Commission

The Chairman attended the Executive Council meeting of the Commission held in Venice in March 1975. Dr G. F. Humphrey was Chairman of this Session. The Executive Council and General Assembly of IOC, held in Paris in October-November 1975, was attended by Dr Humphrey as Chairman of the Commission. At this Session he was re-elected as Chairman for a further two year term.

Other Marine Science Meetings

The Pacific Science Association held its 13th Congress in August 1975 in Vancouver, Canada, and the 16th General Assembly of the International Union of Geodesy and Geophysics met at Grenoble on the 25 August-6 September 1975. The international Association of Physical Sciences of the Sea held meetings during this IUGG Assembly. ANCOR was not represented at either of these meetings, although Australian marine scientists participated.

Membership of SCOR Working Groups

The only Working Group with Australian representation is Working Group 27—Tides of the Open Sea, of which Dr R. Radok is a member. However, this Working Group has served its term and is being disbanded.

Australian Marine Sciences Association

The Annual General Meeting of AMSA was held in Canberra on 18-19 January 1975. The theme for the papers presented was 'Marine Science and Government'.

REPORT OF THE AUSTRALIAN NATIONAL CORRESPONDENT, INTERNATIONAL ASSOCIATION FOR BIOLOGICAL OCEANOGRAPHY

by D. J. TRANTER

CSIRO Division of Fisheries and Oceanography, Cronulla, N.S.W.

The momentum of biological oceanography in Australia is heavily dependent on the availability of resources, particularly marine laboratories by the sea and 'oceanographic' research vessels. Australia has yet to commission its first oceanographic research vessel, although one for CSIRO is currently at the design stage. By contrast, several marine laboratories are currently under construction, one at Perth, one at Cleveland (Brisbane) and one at Turtle Bay (Townsville). There are plans for another at Portsea (Victoria).

As a consequence, most of the biological oceanography in Australia in the 1970s has been shore-oriented, the open-ocean phase of Australia's involvement having largely come to an end (except for fisheries oriented biological oceanography) with the laying up of the naval oceanographic vessels *Gascoyne* and *Diamantina*.

The state of marine science in Australia is currently under review by the Australian Science and Technology Council and there could therefore be substantial changes in future major Australian developments and research projects in the broad field of biological oceanography (i.e. both nearshore and open-ocean) which are:

(a) An Australian Institute of Marine Science (AIMS) has been established at Townsville (north Queensland). The research of the Institute includes studies of the Great Barrier Reef, the Coral Sea area and the north Queensland coast north and south of Townsville. The Institute is currently housed in temporary premises (Cape Pallarenda), but will shortly occupy a permanent site at Turtle Bay (south of Townsville) where a laboratory complex, aquaria and berthing facilities for the Institute's vessels are being built. The Director is Dr M. Gilmartin. Senior staff include Dr J. S. Bunt (Inshore productivity), Dr W. Hamer (Zooplankton), Dr R. Olafson (Pollution), and Drs C. Crossland and D. Barnes (Calcification). Current programs include a mangrove study at Hinchinbrook Is., and coral reef studies in collaboration with other

Australian laboratories at Lizard Is. (The 'LIMER' Expeditions).

(b) CSIRO Northeastern Regional Laboratory (Cleveland, Brisbane). A new biological laboratory for CSIRO Division of Fisheries and Oceanography is nearing completion. The group at Cleveland (Head: Dr W. Dall) are concerned primarily with crustacean biology and, in particular, with the various species of tropical prawns in northern Australian waters.

Monthly cruises are taking place across the Gulf of Carpentaria to study the distribution and abundance of the larval stages of species harvested by the Gulf prawn fishery. These studies are directed towards an understanding of the physical and biological mechanisms by which oceanic larvae move to their estuarine nursery grounds and later stages return from the rivers to the sea. Other study areas include Moreton Bay, on which the laboratory is located, and Princess Charlotte Bay (north Queensland). Complementary studies by the group include research on prawn feeding habits and the ecological genetics of prawn populations.

(c) CSIRO Western Regional Laboratory (Perth). Studies are in progress at Perth (W.A.) on the biology of the western rock lobster and the oceanography of dispersal of the phyllosoma larvae. A series of intensive sampling cruises by charter vessel *Sprightly* is currently in progress, the current emphasis being on the return to the coast of the later (puerulus) stages. Concurrent physical studies on surface currents in the south-western Australian area are being made by drifting buoys in satellite communication (powered by solar cells) with the laboratory.

The group headed by Dr R. G. Chittleborough will shortly be located in a new laboratory, currently under construction in the Perth suburb of Marmion.

(d) Survey of Pelagic Fish resources in the south-western Tasman Sea. Under the direction of Dr G. Murphy, the CSIRO (Division of Fisheries and Oceanography) is making survey cruises by charter vessel *Courageous*. The vessel (a converted prawn trawler) is fitted with midwater trawls and small otter trawls, but the main thrust of the research is on fish detection by computerised acoustics. The oceanographic component of the program is small at the moment, but will gradually be increased.

(e) Ecosystem Study of Port Hacking Estuary. An ecosystems group (Head: D. J. Tranter) is currently engaged in a system study of the ecology of a water body (South West Arm) within Port Hacking (a 'flooded valley') on the shores of which the Central (Cronulla) Laboratory of CSIRO's Division of Fisheries and Oceanography is located. The program includes physical, chemical and biological studies, and both water column and benthos. Energy flow through the system is being accounted for by means of a carbon model.

(f) Port Phillip Bay and Westernport Bay Projects (Melbourne). The Marine Pollution Studies Group (Head: Dr A. Gilmour) of the Fisheries and Wildlife Division, Victoria, is engaged in collaborative studies of inshore water bodies. The emphasis to date has been on Port Phillip Bay, a large (1908 km²) shallow (mean depth 14 m) water body around the shores of which is located the metropolis of Melbourne. Current emphasis is on Westernport Bay a smaller, shallower, less urbanised body of water further east. Scientists from other institutes are working on these projects. For example, the University of Melbourne (Dr B. Grant) is involved in studies on the primary production of Hobsons Bay near the mouth of the Yarra River.

In addition to these larger projects, studies are in progress at James Cook University (north Queensland), Heron Island (Director: Dr A. Bruce), the Australian Mus-

eum (Sydney), University of Sydney (Co-ordinator: Dr P. Sale), One Tree Island Research Station, New South Wales State Fisheries Department (Botany Bay) and coastal areas of Western Australia (Professor E. P. Hodgkin).

RADIOACTIVE POLLUTION OF THE SEA

by J. NOYE

Applied Mathematics Dept, University of Adelaide

The sea is the last part of our environment to feel the effect of the release of waste materials into our lakes, rivers and atmosphere. Most of the DDT used in aerial spraying of crops, most of the sulphur dioxide released from chimney stacks of factories, most of the nitrogenous fertilizers used on farms and most of the radioactive fall-out from the testing of nuclear weapons ultimately finds its way into the ocean.

The sea is the last part of the environment about which people show concern when it comes to pollution, in spite of the fact that most of the world population lives within a few hundred kilometres of the coast and uses the sea as a place of recreation and a major source of food and minerals. In fact, fifty per cent of the world's population gets half its protein from fish. If, through radioactive contamination or other causes, Japan was forced to abandon fish as a source of protein, it would require double its present area of arable land to replace fish with land-produced animal protein.

The effect of radioactive waste on the marine environment is less well known than the action of toxic chemicals such as mercury or DDT. In particular, little is known about the paths of radioactive materials in the sea and their cumulative biological impact. In spite of this dangerous lack of knowledge, large amounts of low-grade radioactive material is released directly into coastal seas in the waste waters from nuclear power generators and nuclear powered ships, and enormous quantities of high-grade radioactive waste in sealed containers is dumped into ocean deeps.

Over a period of millions of years, marine organisms have adapted to a limited range of background radioactivity of certain types. The last thirty years has seen the man-made introduction of a whole new range of radioactive materials at comparatively high levels in both the atmosphere and the ocean. There has been much said about the effect of radioactivity on terrestrial organisms. The effect on marine organisms is more noticeable because they are less accustomed to it, being shielded by sea water from much natural radiation, and marine food chains are longer and more concentrative than terrestrial ones, so the chance of radioactivity reaching a dangerously high level in living organisms is much greater.

In 1964, G. G. Polikarpov, a Russian scientist, published the results of a comprehensive survey of the effect of man's release of radioactive waste into the marine environment in a book titled *The Radioecology of Aquatic Organisms*. In this book Polikarpov stated that: 'further (radioactive) contamination of the sea is inadmissible'. In the ten years since his publication, dumping of radioactive waste in the sea has greatly increased and little evidence has been produced to counter Polikarpov's statement—if anything evidence has been accumulating in support of his charge.

Radioactive Fall-out

Man's first large-scale release of radioactive materials into the environment came from the use and testing of nuclear bombs. When such a device is exploded, large amounts of radioactive dust are blown into the upper atmosphere. Some of this dust remains suspended to contaminate the atmosphere for many years to come; that which slowly drifts back to the surface is known as 'fall-out'.

Since the ocean covers two-thirds of the earth's surface, much more radioactive material is deposited directly on the sea than on land. In addition, fall-out is slowly leached from the land surfaces and reaches the sea via rivers. Unfortunately, man's activities are concentrated around the coast, and it is in estuaries in particular that much of the river-borne radioactive waste material is deposited in sediments formed by the chemical processes which occur when fresh water meets sea water.

Supporters of the testing of nuclear weapons state that underground testing prevents contamination of the marine environment. This is not true. A technical report produced by an American committee on an underground explosion on the island of Amchitka, off the coast of Alaska in 1970, stated that it would take six years for most of the resulting radioactive materials to reach the ocean. The report predicts that once this happens the radioactivity in the coastal waters of the island will remain above the U.S. maximum permissible levels for more than sixty years.

A possible future source of fall-out is the nuclear civil engineering industry. Numerous fanciful and hair-raising schemes have been proposed to explode nuclear devices at the earth's surface in order to create holes for dams, canals and the like. Fortunately, up to the present time there have been only a few small subterranean explosions of this type.

The most dangerous schemes are the proposed surface ones, such as the suggestion to blast a large sea-level canal between the Pacific and Atlantic Oceans. In addition to the damage which would be caused by the high levels of radioactivity released into the environment, there are very strong ecological arguments against the uncontrolled mixing of equatorial Atlantic and Pacific waters. Fortunately, Operation Plowshare, the instigator of most American nuclear excavation plans, has been forced to curtail its activities because of financial cut-backs. It is also comforting to learn that the Soviet Union has abandoned plans to blast a channel between the two enormous Arctic rivers, the Yenesei and the Ob.

Nuclear Power Plants

Increasing amounts of radioactive materials are also being released into the environment in the wastes produced by nuclear power plants. This is a rapidly increasing problem because of the speedy increase in number and size of nuclear power stations, particularly as a result of the increasing cost and decreasing availability of fossile fuel such as oil and coal.

There is grave concern that, for many years to come, increased power production by nuclear reactors will be bought at the cost of dangerous accidents. There have already been several serious accidents. On 10 October 1957, a malfunction at the Windscale plant in England caused the complete destruction of its number-one pile and released more radioactivity into the environment than the explosion of the atomic bomb on Hiroshima in 1945. Fortunately for nearby residents, a major disaster was averted when a local cloud inversion caused the radioactive material to be carried into the upper atmosphere. Even so, it was found that the milk produced by cows eating local grass exceeded the maximum permissible

level of radioactive iodine for consumption by young children, and all milk supplies had to be thrown away.

Then, in 1966, the Enrico Fermi breeder reactor went 'critical'. Had the measures taken to 'quieten' the reactor misfired, one and a half million people could have been threatened with a chain reaction similar to that which occurs when a nuclear bomb explodes. This crisis was caused by something as simple as a badly rivetted metal plate which came loose and interfered with the cooling system.

Nearly all nuclear power stations are situated on the coast, or on rivers or lakes connected to the sea, because of their need for a source of cooling waters. As a consequence, they continuously release small quantities of radioactivity to the aquatic environment in the cooling waters pumped through the condenser units.

Experiments have shown that exposure to low-level doses of radioactivity, besides causing death to various marine organisms, also cause fish and shellfish to suffer reduced ability to tolerate changes in temperature and salinity of sea water. This clearly has its greatest impact on estuarine fish which live in waters of very changeable salinities and temperatures; unfortunately, it is in estuaries where the radioactive wastes brought down by rivers concentrate in the sediments deposited. As a result, oysters and other molluscs which live on the muddy bottom of estuaries are among the first to show signs of radioactive contamination. Polikarpov, the Russian scientist referred to previously, is also concerned that adverse effects of low-level radioactivity on the vulnerable early stages of fish-life could cause noticeable depletion of fish stocks in the near future.

So long as we do not know the full effects of radioactivity on the environment, tight controls should be exercised over existing nuclear power-stations, their future construction should be curbed, and extensive research should be done on alternative methods of power production, such as use of wind power, tidal power and solar power. Present controls, where they exist are aimed at ensuring that no humans are exposed to dangerous levels of radioactivity. Besides being concerned about whether even this is being achieved, we should also realise that what appears to be safe for humans may not be safe for some marine organisms—particularly predators, such as birds, at the top of food chains.

Marine organisms can build up high concentrations of radioactive materials in the bodies in the same way as they can build up concentrations of toxic chemicals such as DDT. In one survey, oysters gathered 400 km from the nearest nuclear source have been found to contain a concentration of radioactive zinc 200,000 times higher than the surrounding ocean. In another survey, it was found that the level of radioactive phosphorus in the Columbia River in western U.S.A. was well below the maximum permissible level for drinking water. But plankton in the river contained concentrations of radioactive phosphorus 2,000 times greater than in the river water, the fish feeding on the plankton contained concentrations up to 40,000 times greater than the river water, swallows feeding on the river insects contained 500,000 times the concentration, and the radioactivity of the yolks of river ducks and geese eggs had accumulation factors of 1,500,000. Unfortunately, mammals are among the least resistant of all animals to radioactivity—certain fish and shellfish can survive while carrying a dose of radioactivity which would kill a person who eats them.

The method of disposal of highly radioactive waste from nuclear reactors provides the most potentially dangerous situation of all. The wastes are usually placed

in steel and concrete containers which are dumped in the sea. These containers do not completely prevent radiation escaping to the environment and do not have a particularly long life in sea water. When they finally corrode and break open, they will release their contents in one catastrophically large dose. Not only will the wastes kill every living creature in the immediate neighbourhood, but because they are not subject to normal biological type degradation, they will take many years to decay to safe levels. Radioactivity spread by currents in the ocean deep would be a global menace.

ADVISORY COMMITTEE ON OCEANIC METEOROLOGICAL RESEARCH (ACOMR)

by B. V. HAMON

CSIRO Division of Fisheries and Oceanography, Cronulla, N.S.W.

ACOMR was set up about three or four years ago by the World Meteorological Organization to advise WMO on the scientific content of the long-term and expanded program of oceanic exploration and research, and to advise the Intergovernmental Oceanographic Commission on meteorological aspects of IOC programs. ACOMR held its second meeting in Geneva, 24-29 November 1975. At the Geneva meeting, it was decided that ACOMR should also serve as a Working Group of the Commission for Atmospheric Sciences.

The meeting dealt with a number of matters arising from planning for the GARP (Global Atmospheric Research Program). These matters included the determination of sea surface currents by various methods, the detailed analysis of air temperature and wind fields over the oceans, intercomparison of instruments and of different techniques to measure the same variable (e.g. conventional and satellite derived sea surface temperatures), the possible value of biological data to meteorological studies and difficulties of determining precipitation amount over the oceans.

The Committee reviewed recent developments in the field on interaction between atmosphere and ocean. Matters discussed under this heading were the bulk exchange coefficients for heat momentum and water vapour, the drag coefficient relating surface stress and wind velocity (a discrepancy was noted). The lack of precision in both the bulk exchange coefficients and the drag coefficient at high wind speeds was noted, and the importance of work in this area was stressed.

The *El Nino* phenomenon was discussed. A recent bibliography of the subject prepared by the Inter-American Tropical Tuna Commission in 1975 was tabled, and the setting up recently of a Working Group by SCOR in co-operation with IAMAP and IAPSO was noted.

On the subject of coastal upwelling, it was the feeling of the Committee that a much more detailed analysis of wind stress field over an upwelling area than can be obtained from the normal meteorological observations will probably be needed in future studies.

The exchange of pollutants between the atmosphere and oceans and the monitoring of pollution were dealt with next. It was pointed out, amongst other things, that careful consideration of current patterns should be made before selecting sampling sites for pollution studies. The main point here is the possibility that changes in the general circulation of the atmosphere and ocean may lead to changes in measured values of pollution and may

mask real trends in pollution or may erroneously be interpreted as such. The difficulties in sampling and analysis for marine pollution studies were noted, and the suggestion was made that monitoring may be best done by one or two very well-equipped research vessels covering the world's oceans.

The final point considered was the historical sea surface temperature data project. This was started about nine years ago by WMO and aims at making available the sea surface temperature data for the world's oceans that have been accumulated in ships' logs. It was noted that progress has been slow, and that publication of the summary data is now expected to take place between 1977 and 1979.

The full report of the session (15 pp.) is available from Mr. B. V. Hamon, CSIRO Division of Fisheries and Oceanography, who is a member of the Committee.

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