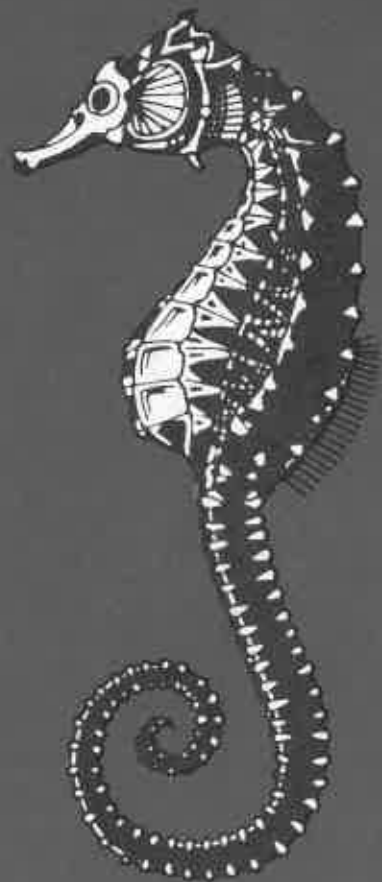


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AUSTRALIAN
MARINE SCIENCE
BULLETIN



No. 50

April 1975

\$1.00

Registered for posting as a periodical (Category C)

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Annual Conference Papers

LOCATION AND DISTRIBUTION OF HEAVY METALS IN THE CELLS OF THE MUSSEL MYTILUS EDULIS. AN ELECTRON MICROSCOPE STUDY

by J. D. POPHAM

Department of Anatomy, Sydney University

Abstract

Accurate estimation of the location and distribution of heavy metals within cell components using atomic absorption spectrophotometry or radioactive tracer techniques (both combined with cell fractionisation techniques) is difficult because of the exacting preparative methods which are required. An alternative method, as used in this present study of mussels collected from a suspected polluted environment, the Cooks River, N.S.W., is to preserve the tissues with a fixative saturated with hydrogen sulfide to precipitate *in situ* any metals in the cells as sulfides. Metallic silver is then deposited on the sulfides by exposing embedded tissues to a solution of silver nitrate and hydroquinone. As a result of this method, deposits of metallic silver were found to be associated with membranes of the rough endoplasmic reticulum, the nuclear envelope and the mitochondria, as well as being found in membrane-bound dense bodies of oocytes and epithelial cells of the mantle margin. Deposits of silver were also found on necrotic muscle cells but not on healthy muscle cells. Since many necrotic cells were found in the same place as the deposits of silver, it is suggested that the histological technique can be used as one of a number of procedures for monitoring the quality of the marine environment.

INVESTIGATION OF WASTEWATER TREATMENT AND DISPOSAL OPTIONS FOR DARWIN EAST NEW TOWN

by J. T. BELLAIR

Caldwell Connell Engineers, Melbourne

Abstract

The marine sciences have an important role to play in the development of design concepts for wastewater management in the coastal zone. An example of this philosophy is provided by an investigation being conducted into coastal waters in the Darwin area by Caldwell Connell Engineers for the Department of Housing and Construction.

The study has been designed to provide, within approximately 12 months, a sound basis for the development of a wastewater management strategy for Darwin East New Town. This proposed growth area will be located 20 km east of Darwin and will be bounded by Hope Inlet to the north and the East Arm of Darwin Harbour to the south.

The wide range of factors to be investigated and evaluated will include the physical, chemical and biological characteristics and present and future beneficial uses of the receiving waters, projected wastewater loadings, pollutant loads of stormwater origin, and the topography and climate of the development area. The study of the marine environment is aimed at developing a broad understanding of the various processes which will deter-

mine future waste concentrations for a number of treatment and disposal options and the likely response of the biota to these conditions.

Investigations of the physical characteristics of East Arm and Hope Inlet include current meter and float studies, dye dispersion experiments, tide height studies and the determination of channel cross-sections. These data are being collected during four study periods covering both the dry and wet seasons and will be used in the development of numerical waste transport models for East Arm and Hope Inlet.

Information on the concentration of nutrients and other wastewater constituents is being obtained, with the assistance of the Department's laboratory staff, through the collection and analysis of water samples from areas which are adjacent to, and distant from, existing waste inputs. These data will be important in developing an understanding of the dynamics of nutrient cycling and waste decay in the study area.

The biological studies have been designed to provide data on the bioenergetics of the marine ecosystem and the likely qualitative and quantitative effects of future waste loadings. The investigations include the estimation of algal standing crop using a portable 12 V d.c. fluorometer and ¹⁴C primary productivity studies. Drs Peter Attwill and Barry Clough of Melbourne University are participating in an investigation of the mangrove communities, aimed at providing data on species diversity, biomass, litter production, the distribution of nutrients in leaves, roots, sediments and interstitial water, and the response of mangrove communities to long-term enrichment with wastewater.

The final phase of the study will represent the utilisation of the data collected in the development of a wastewater management program for Darwin East New Town which will be consistent with sound environmental and engineering principles.

MARINE RESEARCH TRENDS

by R. J. MACINTYRE

School of Zoology, University of New South Wales

Abstract

Many students now seem to have a desire to carry out research in fields which appear to them to have some social relevance. This is a fortunate tendency today when on the one hand university research funds are at woefully low levels and on the other industry is in great need of biological research: many of its problems require relatively small research efforts and fit the size of a thesis admirably while they do not warrant the appointment of permanent research staffs.

Rarely does the thesis of a graduate student in biology answer the specific question asked by industry. The student is properly engrossed in the problems of the animal or ecosystem which he is studying: his thesis enlarges the knowledge or understanding of the problem area to such an extent that industry is often then in a position to provide a quick and sensible solution to its own problem or more commonly they may need to call on the student's supervisor to explain the relevance of the thesis and work towards a joint solution. This price an academic supervisor must be prepared to pay if he wishes to support the research of his students on the fringes of industry.

In the School of Zoology, University of New South Wales, a number of ecological theses have been supported in this manner: they have included studies on fouling organisms, shipworm, mussel culture, estuarine studies on plankton, benthos and productivity as well as thermal tolerance, fish, plankton, and benthos.

Looking towards future improvement in support it is desirable to repeat here a proposal previously submitted to the last AMSA meeting in Brisbane. This simply suggests the establishment of regional marine research facilities in the form of adequate land with wharf facilities, and perhaps a large research vessel owned by the Commonwealth and operated for them by a small treasury-orientated committee based in Canberra. No single agency so far has the funds to operate such a system. The role of the various marine agencies is then to use their own funds to establish facilities on these seaside parks and perhaps engage in co-operative research on the large vessel. The essence of the scheme is that the agencies are autonomous within their four walls, but that proximity suggests some degree of economical co-operation and makes it easy. Even if no formal co-operation emerges the all important individuals will be within walking distance of one another.

MARINE SCIENCE AND MATERIALS RESEARCH

by A. T. PHILLIP

Materials Research Laboratories, Department of Defence Melbourne, Vic. 3032

Abstract

The interests of the Australian Defence Scientific Service cover several areas of marine science, including marine chemistry, marine biology, marine corrosion and fouling, marine physics and underwater acoustics. At the Materials Research Laboratories, only the first three of these topics are being actively studied, although two other research establishments are interested in the remaining subjects.

Marine chemistry

The study of the chemistry of Australian coastal seawater is relevant to an evaluation of the performance of materials in the ocean environment and to obtaining base-line information to meet environmental protection measures. The deterioration of plastics, organic polymers, metals, electronic instruments and coatings is influenced by several seawater parameters, especially temperature, salinity, alkalinity and dissolved oxygen. The quality of the marine environment is being monitored by determining the variations in significant components, especially trace metals, oils and pesticides. Sophisticated analytical equipment is being used to measure the concentration of these chemicals in seawater, frequently in parts per billion.

Marine biology

Three marine stations in Garden Island (N.S.W.), Williamstown (Vic.) and Clump Point (Qld) are being investigated to obtain base-line data on the marine ecology of these different coastal waters. This information is valuable in relating the significance of the chemistry of the seawater to the marine biota living therein and to assessing the severity of marine fouling at the three sites. Data is being obtained on microfouling organisms (especially diatoms and bacteria) as well as on macrofouling species (barnacles, serpulids, bryozoa, ascidians) settling on inert panels. Estimation of seasonal variations in settlement of biota is being obtained from panels immersed for one month, and successional processes are being studied on panels immersed for long periods

of up to three years. A large number of the principal fouling species found in the waters of the east coast, ranging from tropical to temperate conditions, have been identified by investigators at the Materials Research Laboratories.

Marine coatings

A significant research effort has been applied to the development of improved underwater marine coatings for use in Australian waters. The Navy has a requirement for preventing marine corrosion and fouling on the surfaces of ships, buoys, cables and underwater instruments immersed for prolonged periods. From knowledge acquired during the environmental studies, coatings which will prevent the attachment of all marine biota during three years immersion have been developed with the aid of organotin polymers containing phytostatic additives. These coatings have the added advantage of requiring smaller amounts of active components which are environmentally acceptable because of their rapid chemical degradation in seawater.

MARINE SCIENCE AND THE COMMUNITY

by I. G. O'BRIEN

Warrnambool Institute of Advanced Education
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Abstract

Present indications within Government and the scientific community suggest that in the next decade the cost of marine science to the Australian taxpayer will be measured in hundreds of millions of dollars. The additional cost of probable overlapping developments in limnology will increase this amount significantly.

Marine science is a young science in Australia in terms of relative development and world standing, and therefore the opportunity to develop marine (or aquatic) science in a responsible way still remains. Perhaps marine science can also avoid the alienation of the community which has been the misfortune of some sciences, a result related to enormous expenditure in areas yielding dubious social return, and to a reluctance by scientists to communicate their aims, strategies or progress to the people.

The pattern of development of marine science in Australia to date is not encouraging. Groups, institutions and even States are vying for funds and prestige, often through political pressure and with little concern for, and probably at considerable cost to, the national good.

It would not be difficult to ensure that Australian marine science developments occurred under clearly stated and openly reviewed aims — broad and specific, long and short term. National goals and the allocation of national resources need a national policy and a national co-ordinating body (with insight into its field of recommendation or decision).

Rational planning and development presently suffers at the hands of unsupported opinion and emotive rhetoric. If the proponents of a particular development will not take it upon themselves to support their claims by quantifying the factors underlying their opinions, they must be challenged to do so.

The present system which requires proposed major developments to be supported by an environmental impact statement is a positive development. It is deficient, however, in that such statements may make no attempt to quantify any of the factors listed, so that the cost/benefit of the proposal or the alternative means of achieving the aims remain hidden leaving the way open for further intuitive judgements.

It is not unreasonable therefore to expect that proposals for developments in marine science (at least) be supported by cost/benefit and cost/effectiveness analyses (in their broadest definitions, to include social and extra-market benefits), especially as they relate to the siting of institutions to achieve defined and foreshadowed goals. This form of social planning is now a highly developed and widely used social science. A valuable spin-off will be the emergence of a clear statement of the relative value of the various extra-market benefits which are presently afforded lip-service in certain quarters; for example, decentralisation, the establishment of institutions close to their field of interest rather than to the 'facilities' of a major city, the role of CAE's in areas of applied research and developments, and so on.

The scientific community will serve itself and the community-at-large better if it seeks and facilitates its accountability. A useful contribution will be to take the initiative in the assessment of cost/benefit as it relates to the fulfillment of community-scientific goals.

MARINE SCIENCE AND GOVERNMENT

by J. M. THOMSON

Department of Zoology, University of Queensland

Conference Paper

By far the greater part of marine science in Australia is Government sponsored. Even the little that is not is in a sense subsidised by Government through taxation concessions. Government support is channelled in two forms.

First, by direct subventions to Government departments, including CSIRO and to semi-governmental institutions, such as universities and other tertiary organisations. We tend to think of support of research in terms of recurrent expenditures on particular programs, but there are heavy periodic expenditures by Government on capital grants for buildings and boats, not only for obvious Government agencies such as CSIRO, but through the Australian Universities Commission to support Universities. Both James Cook and Queensland Universities have sea-going trawlers provided by special AUC grants as well as speed-boats and dinghies. Most existing field stations were built by Government funds. The joint University of Queensland/Great Barrier Reef Committee research station at Heron Island was largely built on donated funds from a private foundation and from an industrial firm (Hoffman La Roche). The University of Queensland's field station at Dunwich, Stradbroke Island, was built originally by the Queensland Government as a field station for joint use by CSIRO and Queensland fisheries inspectorial staff. The problem with all field stations is to find sufficient recurrent maintenance funds with which to run the stations.

Second, Government also supports marine research indirectly through research grants to individuals or groups of individuals, for example through ARGC, which has earmarked special funds for marine research. Government has also supported marine research by direct contract works: for example, the Botany Bay project in New South Wales; the Westernport project in Victoria, the Coastal management survey in Queensland, the Australian Museum's study of the effects of sewage outfalls off Sydney; the survey of the Blackwood estuary in Western Australia and a number of others; all mostly funded by State Governments, though some, such as the surveys of Cockburn Sound, the airport extensions studies in Brisbane and the Botany Bay project, are also supported directly by Australian Government funds. Finally we must recognise that through their contributions to the United Nations and its agencies, Australia supports marine research in the international sphere, for FAO

and UNESCO support a number of research projects directly and provide facilities for specialist groups to meet to thrash out problems.

I offer this brief run-down on the ways in which government supports marine research only because earlier speakers whom I expected to cover this aspect more fully failed to do so. But for most of my address I want to pursue an aspect of the topic of government and research which is often neglected, the history. Only by a knowledge of the history of events can we understand the existing situation as we see it today.

Our nation owes its origin to marine science, for when His Majesty's ship *Endeavour* under the command of Lieutenant James Cook, as he then was, left England with a cargo of scientists to observe the transit of Venus, the commander of the expedition carried further secret orders which expressed 'the desirability of the discovery of countries hitherto unknown and also the gaining of further knowledge of places imperfectly known', which my Lords said 'would rebound greatly to the honour of the nation, as well as to the dignity of the Crown', and might also, they suggested, lead to the advancement of trade. After orders about charting such lands to aid navigation, the orders continued, 'You are carefully to observe the nature of the soil and the products thereof, the beasts and fowls that inhabit or frequent it, the fishes that are to be found in the rivers or upon the coast and in what plenty; and in case you find any mines, minerals or valuable stones, you are to bring home specimens of each, as also such specimens of the seeds of trees, fruits and grains as you may be able to collect and transmit them to our secretary that we may cause proper examination and experiments to be made of them.' In this we can see the hand of Joseph Banks who spent ten thousand pounds of his own money in outfitting the ship for its voyage and who also paid the salaries and board of the naturalists and artists who went on the ship. Even in those days Governments were loath to spend more than they had to, even on voyages from which they hoped to gain new trade.

Nevertheless the willingness of the Government to permit the scientists to accompany the ship was immensely significant. Until then the Pacific had hardly been touched by either botanists or zoologists. Even if the astronomical observations had failed or the geographical discoveries had proved disappointing, the voyage in modern eyes would have been a success because of the wealth of natural history material collected. What was perhaps of more significance historically is that this carefully assembled collection of specimens, drawings and notes set the example for the later great voyages of scientific discovery, such as those of the *Beagle* and the *Challenger*.

This voyage sponsored by a Government, albeit British, provided the first observations of the Australian marine fauna. Botany Bay was originally called Sting-ray Bay by Captain Cook because of the large numbers the members of the crew netted and harpooned there. Banks recorded and described the mode of life of the mudskipper *Periophthalmus* in the Endeavour River; he also recorded sea-snakes, turtles and crocodiles in Queensland waters. He observed that the abundance of fish was not as great as in temperate waters, but that they never failed to catch from 50 to 200 pound of fish whenever they hauled a net. There is no record extant of the number of species of fish collected on the voyage; the collection itself was later dispersed and largely lost. But 162 drawings of the fishes survive in the collections of the British Museum and most are identifiable. Banks was largely responsible for urging upon the British Government the potential of New South Wales as a penal colony

to replace the lost opportunities of the Americas. He recognised the importance of a fishing industry to the infant colony and at his insistence the Admiralty reluctantly included fishing gear in the commissariat of the First Fleet. For this Captain Phillip was profoundly thankful for a time, as fishing provided a considerable proportion of the settlers' protein, but then fish became scarce just when things were really bad. Perhaps because of this disappointment at a crucial time, neither Phillip nor other governors showed much more interest in the sea except for whaling and sealing and even this rapidly ceased because the British Government granted to the India Company an exemption from tariffs on the import of whale products into Britain, and the Company could undercut competition. This was why so much of the early whaling and sealing about our coasts was carried out by American ships and not ships of British origin.

Despite rhapsodic claims from time to time that Australian waters abounded in fish, none of the infant colonies did much about founding a fishing industry. From the first, the South Australian Company, which was responsible for much of the early settlement of that State, supplied equipment to found a fishing industry with the intention of supplying white fish to India and Ceylon.

This again was frustrated by the India Company, which obtained from the British Government a franchise bestowing on them a monopoly of trade to India and Japan.

Official disinterest in the fishing industry continued for a long time. Tasmania had adopted a whaling act as early as 1838; but the first enactment concerned with fisheries, as distinct from whaling, did not take place until 1865 when the New South Wales Government moved to control the dimensions of nets and certain fishing practices. So unimportant did the fishing industry remain that a publication 'An Australian Dictionary of Dates and Men of the Time' published in 1879 makes no mention of a fishing industry. A subsequent publication 'Fifty years of Progress in Australia 1878-1928' makes no mention of fisheries either.

Despite this the belief that Australian seas teemed with fish persisted. One of the founding fathers of the Commonwealth, Henry Parkes, put forward as one of his arguments for federation of the colonies of Australia a plea that the splendid sea-fishing of Australia would not be developed except by a strong central government. Would that he had been listened to! In the event power over fisheries remained with the States after federation.

Up until the period of the First World War, the only developments beyond the shore-line and estuarine scratching, which passed for fisheries, were the growth of the pearling and trochus and beche-de-mer gathering industries of the tropics. The first major step forward in Australian fisheries was taken by the Government of the State of New South Wales. It brought out an experienced Norwegian scientist, Harold Dannevig, who at first carried out some attempted importations of the eggs and fry of various European fishes in the belief that all Australia needed to achieve a major fishery comparable to those of the north Atlantic was to import the North Atlantic fishes. When I joined the CSIRO Fisheries thirty years ago, locals still called their place in Cronulla 'the Hatcheries' for it was there that Dannevig did his work. But the new Commonwealth Government decided to get into the act and persuaded Dannevig to accept Commonwealth employment as Commonwealth Director of Fisheries and they provided him with a vessel named the *Endeavour* to explore the fishing potential of the continental shelf. From 1909-14 this vessel trawled over much of the shelf from southern Queensland across the Bight to Sharks Bay. But in 1914 she was lost with all hands, including Dannevig,

when the vessel was diverted from the research to Macquarie Island to relieve a wireless operator at the weather station which the Government maintained there in those days. Two days after the vessel left the island a violent storm blew up. Presumably it overwhelmed the 132-foot, 330-ton vessel.

But Dannevig's work lived on. A score or more of the scientific results of the collections of the *Endeavour* were published, and in 1915 the Government of New South Wales brought out three North Sea steam trawlers to found a trawling industry on the stocks he had located. Having demonstrated that it could be done the Government handed the industry over to private enterprise in 1923.

The Commonwealth had lost its first Director of Fisheries as the First World War started and showed no interest in fisheries or marine science in general for some 13 years. Then in 1927, in conjunction with the States, the Federal Government organised a widely publicised conference which passed various pious resolutions about the need to encourage exploratory fishing and to sponsor research into fisheries. By the time they had spent two or three years arguing at intervals about whose was the responsibility, the Great Depression was on.

However, it was as a direct result of that conference that a decade later the Council for Scientific and Industrial Research, which later became the Commonwealth Scientific and Industrial Research Organisation, founded its Division of Fisheries, which had hardly got into its stride when another world war caused work at sea to come to a halt. Under Harold Thompson, its first Chief, the CSIRO Division of Fisheries pursued not only fisheries research but also physical and chemical oceanography and studies that properly might be regarded as marine biology.

The next major Government initiative was after the war when the Federal Government started a whaling station at Carnarvon in Western Australia and after a number of profitable years fortuitously or otherwise sold out to private enterprise just as the first signs of the depletion of the stocks became apparent. However, the proceeds of the sale were invested in a fund, the Fishing Development Trust Account to finance both fishing ventures and to support research to aid fisheries. I shall have something to say about this fund and its operation later.

Thanks to the encouragement of the CSIRO and of the Government of New South Wales, a tuna industry was established in southern New South Wales waters. The fishery was subsequently extended to south Australian waters, and has become the largest of Australian fisheries apart from those for the crustaceans: crayfish (or rock lobsters as the dollar-hungry industry wants us to call them) and prawns.

Another event which I believe has had a major impact on the development of fisheries research in Australia was the appointment of a new chief of Division of Fisheries of CSIRO in 1958. To what extent the new policy adopted then, was that of the Chief and how much that of the CSIRO executive of the time I have never been able to ascertain. I have heard different versions from different members of that executive. But the crucial decision was that the Division would abandon all inshore and estuarine work and concentrate on high-seas marine biology, fisheries and oceanography.

This was disheartening to those in the Division who had planned a continuing program of research on estuarine ecology, hoping to follow on the major Lake Macquarie study with work on another estuary of a

different character, such as the Hawkesbury River. But for Australia as a whole it had a good effect I believe for it more or less forced the State Governments to start or expand their own fisheries laboratories to cope with the fields vacated by CSIRO. The earlier tendency to let CSIRO do the work, while evidence of great trust in that Organisation's efficiency, had resulted in the number of workers in the marine biological field being very few indeed.

Today every State and Territory in Australia has its own fisheries research group, and I would remind you that fisheries work automatically implies work on other aspects of marine biology, hydrology and oceanography that are more or less germane to it. Although I have named Dannevig as the first major figure in marine research in Australia, it would not be just to ignore some of his predecessors. In the last decade or so of the nineteenth century and on into the first decade of the twentieth a number of biologists were appointed by State authorities to work on fish biology. Tension-Woods and Stead in N.S.W., Saville-Kent, Ogilby and Tosh in Queensland spring to mind, ignoring those, such as Castelnaud and Macleay, who were purely taxonomists. Within the financial limitations imposed upon them they laid solid if unspectacular foundations to Australian marine research.

I would stress the point that individuals not only do the research but are responsible for policy on research. We hear a lot about the Government or that a department of Government has done this that or the other; but all these initiatives have originated in some individual, Government-employed or not, who has pushed his idea (which of course may or may not be originally his) and persuaded the right people to accept them. I have mentioned the Commonwealth-State conference on Fisheries in 1927. It was very much the result of years of pushing by William Dakin that this was brought about and Dakin was later named as Government adviser in the drawn-out wranglings that went on about which department was to implement the policies reached and how. For those who may be ignorant, William Dakin was an Englishman who was successively Professor of Biology in W.A. and Professor of Zoology at Sydney University. He was certainly the first academic in Australia to devote himself wholeheartedly to marine biology, though his predecessor in Sydney, Haswell, of Parker and Haswell textbooks fame, and T. Harvey Johnston, while in Queensland, had carried out some marine work.

Similarly to give one or two other examples, I believe it is true to say that whoever else has contributed to its formation the Australian Institute of Marine Sciences would not exist today if it had not been for the solid lobbying of Professor Burdon Jones. Equally, as one who was there to watch, I would say that the Commonwealth Fisheries Office, now a division of the Department of Agriculture, was created by the lobbying of Geoffrey Kesteven, although I have no doubt that the official record shows that the Minister of Post-war Reconstruction at the time is credited with its creation.

Research cannot thrive without financial support. That the membership of our society includes more marine biologists than other marine scientists reflects, I am sure, what Bruce Morton referred to in his paper entitled 'A step towards a National Policy for the Marine Sciences' delivered to the Symposium on Marine Sciences in Canberra in 1970, namely, that in marine biology there are plenty of projects which can be carried out along the shoreline with relatively little expense. It is difficult for physical and chemical oceanographers and geologists to

carry out any substantial work without large expenditures of money. Having said that marine biologists can carry out studies relatively cheaply, let me hasten to add that for deep- or high-seas research they too need the large expenditures of magnitude equal to the studies of physical and chemical oceanographers.

What are the sources of financial support for marine science in Australia? They are almost exclusively Governments. Naturally all the relevant Government departments are funded basically by direct contributions from their respective treasuries. There was a time when this was wholly their source of funds. But today they share in grants from other sources, which are also Government funds earmarked for special purposes. One of these sources I have mentioned: the Fishing Development Trust Account. I believe that the disbursement of money from this fund suffers from all the allegations which the newspapers have aired in recent months about interdepartmental committees. I do not speak as an outside observer misinterpreting what goes on, though I confess I have not served on such a committee in the last few years. But I happened to be Acting Chief of the CSIRO Fisheries Division when the first few policy defining meetings of the interdepartmental committee were held. I have also served on several other interdepartmental committees. I say categorically that the members of these committees seek to preserve or to foster their own department's interests first. In fact, in my opinion, the national needs are often completely ignored. This may not be the case with interdepartmental committees where the top men, the permanent secretaries, meet, I do not know. But my impression of the second- and third-rung men who generally represent their departments at these meetings, is that they are so afraid of putting their feet wrongly with either minister or secretary, that they move with the utmost caution and seek the biggest slice of cake they can get for their department rather than taking the bold step of asking what does the country need? What should be our priorities?

As well as the earlier Development Trust Account, research is now subsidised by the Fishing Industry Research Trust Fund which is partially financed by the Commonwealth and partly by the States by a levy on licence fees. If you look at the disbursements from these particular funds you will find that almost all of them in the years in which they have operated have gone to Government departmental agencies. In the early years, the CSIRO Division of Fisheries and the Commonwealth Fisheries Office, as it then was, received most of the benefits. Government has remained the major recipient of its own research funds, with the State departments also coming in for a share of the cake since an agreement several years ago, after establishment of the Fishing Industry Research Fund. A small proportion has gone to private individuals or firms, mostly for exploratory fishing; but as far as I am aware only one university project has ever been supported, and even that is a joint one by the Department of Fisheries of New South Wales and John MacIntyre of the University of New South Wales on trials of mussel culture. I believe that if the intentions of the legislature, as expressed by the ministers who introduced the bills, are considered, then the intentions have been in large part thwarted by the self-interested approach of the committee. Obviously as a university person I would like to see Universities get a larger measure of support from the Fund, but as a citizen my main grouse is that there has not been more support to simple financing of private fishing ventures. I am confident that the intention of the Government that brought in the Development Trust Account Bill was to set up an equivalent of the British Whitefish Authority,

which besides fostering research, richly finances individual fishermen and firms in new ventures. I know that the argument accepted by the original interdepartmental committee was that banks would undertake this kind of financing. Banks being the cautious institutions they are, I do not think this is so. The Minister's introduction of the Bill made it clear that one of the hopes of the Government of the day was to finance enterprises which normal lending authorities would consider too risky. It seems to me that in practice the interdepartmental committee has been more cautious about such ventures than the banks.

Perhaps you may argue that exploratory fishing or financing fishermen is not really research; in which case I apologise for wasting your time. So let me turn to a consideration of direct Government support of marine research.

The major source of all research funds for university researchers is the ARGC (Australian Research Grants Committee). As members of this Committee cannot embrace all disciplines, they have built up a system of peer-group evaluation, with both nominee and Committee-nominated referees.

This is excellent as far as it goes, but it has its drawbacks too. The head of one of our marine-oriented institutions in the early days of ARGC was automatically consulted on all marine applications. He said to me not once, but several times, that he was not going to recommend any application — if there was spare money for marine research, he wanted it for his own institution. Similar drawbacks exist in most fund-awarding systems. But it is difficult to suggest anything better. The Australian Water Resources Council is primarily concerned with fresh water, but they have funded studies on estuaries which receive pollutant material from freshwater sources.

The Crown of Thorns Advisory Committee disburses funds for a specific area of marine research — on the crown of thorns starfish and related topics, such as coral regeneration. This source of specifically marine research will probably not continue much longer. No other research source, except the fisheries-oriented Fishing Industry Research Trust Fund, is solely applied to marine work, though the ARGC is experimenting at present with funds earmarked for marine science, as well as upper atmosphere and multi-disciplinary research.

Apart from this, marine workers compete for funds with other disciplines. They receive relatively little support not, I believe, because of the calibre of the workers, but because of an insufficient awareness or recognition by the awarding bodies that marine research — particularly in biological fields — is in a relatively early stage of development and cannot aspire to the sophistication of techniques and theory which attracts favourable attention to fields which were developed earlier.

I should like to refer to the ABRS (Australian Biological Resources Study) which has become a source of research funds. When its formation was first announced I wrote to the Minister of Science pointing out that although there were three members from CSIRO, two from Museums and two from Government herbaria, the wide University community and the wider tertiary education community were not represented, nor were marine biologists, and I also expressed the hope that the study of marine resources would be sponsored by the administering council. The Minister at first replied that he would refer my letter to the interim council for its advice and later wrote that he had no doubt that the interest of the universities would be adequately looked after by the

distinguished members of the council, and (I quote) 'In relation to the study of the marine biological resources, there is no reason why the study should not comprehend the specific fields you have mentioned. However, it will be for the interim council to consider and make recommendations on the relative effort to be devoted to terrestrial and marine biological resources'.

As far as I can ascertain the expert committee considers that the relative effort for terrestrial work should be almost 100%. The only non-terrestrial project to be funded, of which I am aware, is on a river survey which does reach down to the estuary of the river. Private sources fund some research on marine fields, for example, Hoffman La Roche, the Swiss pharmaceutical firm, whose vested interest is to find useful natural products from the research they sponsor.

The Universities have their own research funds in their budgets which of course are Government supplied. These are pitifully small and cannot support the big sea-going projects we would like to see. In the University of Queensland, the staff gets about \$400 a head for research and this after the funds have been almost doubled in an effort to give increased support to research. A few private endowments help. The University of Queensland's Feehan bequest has provided research funds and I suppose other universities have similar small endowments. The Feehan, I might say, provides only about \$750 a year.

We have tended to think selfishly of what the Government provides for us. But we should also recognise that the Government of Australia participates in a number of international programs which include marine research, through the agencies of FAO, UNESCO and international bodies, such as the International Council of Scientific Unions, either by money grants or by providing fares and allowances for Australian experts to attend overseas meetings. On the other hand United Nations nations often sponsor attendance of Australian experts at meetings connected with marine research; interestingly the people they select as worth consulting are not infrequently people who, like the prophets of old, are not often consulted in their own country.

I have meandered; so may I just summarise a few points. We need to look at history to understand our present position. An abundance of red meat at reasonable prices has until recently kept Australians from bothering much about the edible marine resources. The lure of the post-war Yankee dollar stimulated the first big Australian fisheries, for crayfish, tuna and prawns. What progress has been made has usually come from the enthusiasm and persistence of individuals. This is not meant to detract from the solid sensible work that subsequent advisory committees have done in advising Governments, but I think we too often in egalitarian Australia give too little acknowledgement of the urgers who get things started.

I think there are drawbacks to all methods of providing research funds, but I confess that human beings being the weak reeds they are, I can see no better ways of handling research funds. As our population grows, and particularly if beef and mutton shipments overseas increase again, as I believe is inevitable, we shall need to turn more and more to the sea. It would be a wise investment for the Government to sponsor a major research effort now so that we have adequate data when the food crunch comes, as come it must. I have done little more than refer to the needs of chemical and physical oceanography or to marine geology; but they all, particularly the first two, have an influence on fisheries and need to be studied for that practical reason as well as for their own intrinsic interest.

MARINE SCIENCE AND GOVERNMENT: 1975-84, THE DECADE OF DECISION

by D. J. TRANTER

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Conference Paper

Government comes in many forms, and marine science interacts with each of them. To show some of the interfaces that exist, I have chosen a vantage point in 1984 and, with the aid of a somewhat muddy crystal ball, traced the 'history' of those interactions from the present time. This history deals with four basic questions:

1. What can marine science do for Government?
2. What can Government do for marine science?
3. What can marine science do in spite of Government?
4. What can Government do in spite of marine science?

1975

The decade began in Australia with the formation of the Marine Science Council. Comprised of scientists — marine scientists would you believe — from both State and Federal laboratories, from private industry and from Academia, this Council received from the marine science fraternity that sort of grudging acceptance which, in this country, passes for enthusiastic confidence. Surviving the stifling embrace of Commonwealth midwifery and the icy atmosphere of State suspicion, the Marine Science Council (MSC) grew in strength to become in later years a major force on the Australian scene at the interface between marine science and Government.

1976

The major marine science issue in 1976 was the debilitating Commonwealth-State confrontation on sovereignty of coastal waters, a problem which the embryonic Marine Science Council steered well clear of. The Australian Marine Sciences Association (AMSA), on the other hand, was better placed to bridge the gap. AMSA set up a Working Group with the specific purpose of buffering the erosion of State-Commonwealth collaboration in marine science. This Working Group, the first of its kind in the Association's history, was singularly effective in promoting unofficial co-operation in marine science, in the face of bureaucratic constraints, and in exposing political pettiness to public scrutiny. In this climate of clandestine co-operation, the concept of the 'Management Plan for Metropolitan Waterways' was born.

Although the population of Australia was concentrated around the coast, the management of coastal waterways was *ad hoc*, piece-meal, and relatively ineffective; the 'artery' philosophy had not yet replaced the 'sewer philosophy'. Having completed its Town Plan, Sutherland Shire Council had turned its attention to Port Hacking, one of its internal waterways. Drawing on the individual expertise of dozens of marine scientists operating outside the bureaucratic structure, and encouraged by AMSA and the Australian Littoral Society (ALS), Sutherland Council produced a Management Plan for Port Hacking based on N.S.W. Management Plans for National Parks. This Port Hacking model was eventually approved and appropriated by the N.S.W. Government, extended to Sydney Harbour and the Hawkesbury, and widely advertised as evidence of N.S.W. pre-eminence in management of land and water.

In this respect, the N.S.W. strategy for management of coastal waterways differed significantly from that of Victoria. In Victoria, marine research was the cornerstone of management, whereas, in N.S.W., research was considered to be peripheral to management. Victoria set

out to amass new information, N.S.W. preferred to act on the information already in hand. In the long-run, each system drew strength from the other.

By the time the High Court brought down its verdict on the sovereignty issue, the outcome had become a foregone conclusion. The Law of the Sea negotiations had reached such an advanced stage that the 'internal ructions' within Australia were treated by the world at large as a parochial anachronism. Scanting defeat, the Premier of Queensland unilaterally gazetted a Great Barrier Reef National Park, an unconstitutional move widely acclaimed in Queensland as politically astute, even statesmanlike. Faced with the real responsibility for managing the marine environment to the 200 mile limit, including fisheries, the Australian Government was forced to seek the co-operation of the States. Had the situation really changed?

1977

In response to the flow of Commonwealth money to States and Local Government for environmental management of metropolitan beaches, bays, estuaries, coastal lagoons, and rocky shores, 1977 saw the proliferation (? blossoming) of private enterprise in the shape of marine science consultants. The first flood was drawn from the United States which, as in all things good and bad, was 20 years ahead. Before too long, latent Australian nationalism took offence at the shaping of Australia by foreign experts, in which climate AMSA was wooed by Government and industry alike for an Australian point of view. It was this pressure, above all, that persuaded the Association (President from USA; Secretary from UK; Treasurer from NZ) to lobby Government for an Australian postgraduate school in marine science.

But this was not the only marine lobby in 1977. The conflict between competing interests for the Victorian Institute of Marine Science (VIMS) had not yet been resolved; pressures were mounting for Australia to maintain a research presence in Antarctic waters, currently the centre of attention of the Law of the Sea convention; the Australian Department of Agriculture was promoting the establishment of a tertiary Fisheries College; and the expanding tourist industry in the Great Barrier Reef National Park was placing greater demands on the Australian Institute of Marine Science (AIMS) in Townsville.

The time had come for some rationalisation of marine science effort in Australia.

1978

The whole problem was placed before the Marine Science Council. Its moment had arrived. The recommendations were:

1. That VIMS be established at Portsea, as originally planned, and receive matching Commonwealth funds for the specific purpose of developing postgraduate training in marine science,
2. That a Fisheries College be established at Warrnambool in conjunction with the College of Advanced Education,
3. That an Antarctic oceanographic research ship be built for the Antarctic Division now well established in Hobart,
4. That AIMS receive support for the expansion of its research in coral reef ecology,
5. That CSIRO, through its laboratories in N.S.W., Queensland, and Western Australia, continue its traditional role in research on fisheries and the marine environment.

1979

A year later than scheduled, and 20 years behind other comparable countries, Australia's first major research ship was commissioned, the 70 m CSIRO stern trawler *Cluies Ross*. Its arrival coincided with the final

convention and agreement on the Law of the Sea, in which Australia had played such a leading part through its chairmanship of the Intergovernmental Oceanographic Commission (IOC). To mark the event, the Australian Government committed the vessel to a three-year collaborative study of Australia's northern waters in conjunction with Indonesia and New Guinea. CSIRO's carefully nurtured plans for scientific cruises in the Tasman Sea were abandoned.

1980

This was the year of taxonomic reckoning. Up till now, the Australian marine flora and fauna had been ignored by all but a handful of museum specialists, and these not always from Australia. By 1980 the Biological and Ecological surveys of Australia set up in 1974 were drawing to a close with little consideration for the desperate straits of marine taxonomy. At times, the research of AIMS and VIMS and CSIRO was losing credibility for want of systematic accuracy.

Backed by several Australian museums, AMSA placed the matter before the Marine Science Council. No committee is perfect and in this respect the MSC failed to appreciate the magnitude of the problem. It was left to the President of AMSA to find a receptive political ear before the concept of a 'Marine Flora and Fauna of Australia' received Governmental support. A core of taxonomists had to be produced more or less *de novo*. Against stiff resistance, a system of postgraduate fellowships in marine taxonomy at Universities and Colleges of Advanced Education throughout Australia was introduced. By 1984 the training program was in full swing but the rewards were yet to come. This was the price for want of foresight.

1981

Since 1975, the environmental revolution had gained not lost momentum, as many had predicted. Pressures on metropolitan open space had generated an increasingly vocal lobby at Municipal, State, and Commonwealth level. Concern was focused on the playgrounds of the people — the condition of the beaches and the bays, the estuaries and the coastal lagoons. In particular, the practice of discharging sewage wastes into the sea had come in for widespread criticism on a variety of grounds.

In 1981, the Australian Government set up a Committee of Inquiry into Metropolitan Sewage Wastes, an event which could have escaped the attention of industry-oriented CSIRO back in the 1970s. Now, CSIRO had at last caught up with the rest of the community in its appreciation of the social relevance of science and prepared a strong submission to the Committee of Inquiry.

In brief, CSIRO proposed a collaborative research and development program with the States to solve the problems associated with recycling of sewage wastes. The proposal was accepted and within a few years a practical solution was found — a chain of metropolitan wetlands for Australian waterbirds that gradually transformed a drain of the public purse to a source of tourist revenue.

1982

The International Law of the Sea Agreement of 1979 had vested the entire Antarctic Ocean beyond the limit of coastal sovereignty in the United Nations which was charged with the management of Antarctic resources, including whales and seals, for the benefit of all mankind. By 1982, the UN was coming under increasing pressure

to allow unrestricted harvesting of Antarctic krill to provide low-cost protein concentrate for famine areas, a solution which however satisfactory in the short-term, could have disastrous consequences. The problem was to develop and manage the fishery in harmony with the baleen whales and other components of the ecosystem.

Through their membership on international working groups, Australian marine scientists persuaded FAO, UNESCO and IUCN that a more thorough oceanographic study of the Antarctic was required. This conviction gradually filtered back to the Australian Government through the Intergovernmental Oceanographic Commission. So when Australia's new Antarctic research vessel, *Douglas Mawson*, was commissioned in 1982, the stage was set for Australia's participation in the International Antarctic Research Expedition co-ordinated by IOC. The first graduate oceanographers were just now graduating from VIMS. AMSA's first lobby had at last paid off.

1983

The Law of the Sea had vested jurisdiction of waters to the 200-mile limit in the adjacent coastal States, a privilege that carried with it a greater degree of responsibility for research and management than Australia had yet faced up to. Nowhere was the anomaly more marked than in Western Australia where the offshore waters had continuously attracted fisheries interests from South-east Asia since the early 1970s.

In recent years, marine scientists in Western Australia had been campaigning individually and collectively for a Western Australian Institute of Marine Science (WAIMS). By now the problem was not whether WAIMS should be established but in what form and under which particular umbrella. In referring this question to the Marine Science Council, the Australian Government set the stage for a major restructuring of marine science in Australia.

The AIMS in Townsville was a separate entity isolated from the main stream of Commonwealth research administration by its own Act of Parliament. VIMS, although receiving massive support from the Commonwealth, was essentially a State institution and a seat of learning. Since the CSIRO Act was amended to include environmental research, CSIRO had responded well to environmental problems generated by urbanisation and industrialisation and already had a large Regional Marine Laboratory in Western Australia.

There was much debate, but the final recommendations of the Marine Science Council were:

1. That CSIRO consolidate its separate research effort in Fisheries, Biological Oceanography, Physical Oceanography, Marine Meteorology, Coastal Engineering, Marine Pollution, and Estuarine Ecology into a loosely integrated family of Marine Science Laboratories.

2. That geological and geophysical research within the Bureau of Mineral Resources, the oceanographic unit of the Antarctic Division, the Australian Institute of Marine Science be transferred to CSIRO and added to this complex.

3. That WAIMS be established around the CSIRO Regional Laboratory in Perth and be provided with an oceanographic research vessel for its special use.

4. That VIMS be further developed as the primary centre of excellence in Australia for postgraduate training in marine research in all its disciplines.

1984

See Orwell, George (1949).

NEWS FROM NEW SOUTH WALES

Dr Frank Talbot has accepted a professorial position at Macquarie University where he will direct a program of environmental studies. He will take up the appointment in the next few months.

Professor Jack Burch, previously of the University of Michigan, has accepted a permanent position in malacology at the Australian Museum. His main taxonomic interest is in land and freshwater molluscs.

Dr Frank Rowe of the Australian Museum is to visit Guam to study the island's *beche-de-mer* industry.

Dr Ezumi Nakamura, who has been studying bill fish at the Australian Museum, will soon be returning to Kyoto University, Japan.

Dr David Pollard recently visited Lord Howe Island to survey the coastline for suitable underwater parks and reserves. His work and the report prepared by the Australian Museum's expedition in 1974 will provide a strong basis for the conservation of Lord Howe biota.

Jervis Bay. On the 8 March the N.S.W. Division of the Australian Littoral Society was represented at a meeting convened by the House of Representatives Standing Committee on Environment and Conservation inquiring into the proposed Jervis Bay deep-water port development. The basis of the ALS's submission was that parts of the Bay be declared a Marine National Park, and during the inquiry the Committee asked for guidance on what constitutes such a Park. Reference was made to AMSA's 'Guidelines for the establishment of underwater parks and reserves in Australian waters', and a copy of the Guidelines has been sent to the Committee. If the Committee decides that Jervis Bay should become a Marine National Park, the area would be the first sizeable one in N.S.W. to be declared a Marine National Park. The recommended area contains extensive stands of mangroves, large areas of weedbeds, rocky shores, beautiful underwater caves, clear water, an estuarine lake used extensively by wading birds and large areas of beach and sand dunes in pristine condition.

NEWS FROM SOUTH AUSTRALIA

Dr John Noye has returned from his six-month stay at the Institute of Oceanographic Sciences in the United Kingdom. During his absence the deputy convenor, Ifor Thomas, ran the Branch meetings.

Branch officers. After three years as secretary-treasurer and last year as secretary, Robert Taaffe has resigned because of other commitments. The treasurer, Paul Zed, is acting-secretary until a new secretary is appointed at the next Annual General Meeting of the Branch.

Branch meetings. The first meeting for 1975 of the South Australian Branch was held on 11 February in the Fisher Building at the University of Adelaide. Dr Alan Baker of the National Museum of New Zealand, Wellington, spoke on 'Blue Ice and Blue lagoons — some aspects of marine research conducted by the National Museum of New Zealand, from Antarctica to the Great Barrier Reef'. Dr Baker is curator of echinoderms and marine mammals and is currently on a 10-month tour of Australian Museums, studying museum education and biological collections. He is the immediate past president of the New Zealand Marine Sciences Society.

John Mitchell photographic award. It was announced at the Branch meeting of 11 February that the scope for this award was being extended to include entries from photographers in other Australian States. This award is presented for the best series of slides, with scientific commentary, illustrating some aspect of marine life or the marine environment. However, the subject of the series must still pertain to southern Australian waters. Details of the competition can be obtained from Scoresby Shepherd of the Department of Fisheries, Gawler Place, Adelaide.

Coorong lagoons. In the near future, several members of the South Australia Branch will be participating in a series of broadcasts about the ecology of the quite unique Coorong lagoons located behind the coastal sand dunes in the south-east of South Australia. Eight half-hour sessions, including three contributions by Dr Noye, one by Professor Womersley and one by Dr Wollaston, will be broadcast by 5UV, the University of Adelaide Radio Station, during May, June and July of this year. At the completion of the series the Department of Adult Education of the University of Adelaide will run a week-end field trip, headed by Dr Noye, to the Coorong.

NEWS FROM VICTORIA

Dr Alistair Gilmour, AMSA's immediate past president, has been promoted to Assistant Director Marine Pollution Studies, Fisheries and Wildlife Division, Ministry for Conservation, Victoria.

Dr Will Barber, until recently with CSIRO Division of Fisheries and Oceanography, Deception Bay, has taken up his appointment as Project Leader, Gippsland Lakes Study, Marine Pollution Studies Group, Fisheries and Wildlife Division, Victoria.

Dr Des Connell has been appointed one of the Project Directors (Environmental Studies) with the Ministry for Conservation, Victoria.

NEWS FROM WESTERN AUSTRALIA

Blackwood River. The Estuarine and Marine Advisory Committee hopes to forward its report on the Environmental Study of the Blackwood River Estuary to the Environmental Protection Authority by June-July of this year.

Reserves. The Conservation Through Reserves Committee recently submitted a report entitled 'Conservation Reserves in Western Australia' to the Environmental Protection Authority.

MEETINGS AND CONFERENCES

The Western Fisheries Research Committee will hold its sixteenth annual meeting at the Western Australian Marine Research Laboratories, 27-29 May.

The Third International Ocean Development Conference with the theme of 'Desirable Ocean Development and Its Future' will be held in Tokyo, Japan, 5-8 August 1975. The official languages will be English and Japanese and simultaneous interpretation between English and Japanese will be available. The Conference will have five main topics: surveying and investigating systems; new materials and marine structures; marine resources; marine pollution; and coastal environment. Further details: The Secretariat, International Ocean Development Conference, c/o Japan Management Association, 1-22, 3-chome, Shiba-Park, Minato-ku, Tokyo 105, Japan.

Underwater activities. The Fourth World Congress of Underwater Activities at Stockholm, Sweden, 12-18 September 1975, is being organised by the Swedish Sport Diving Federation in conjunction with the Swedish Society of Mechanical Engineers, Naval Architects and Aeronautical Engineers. The language of the Congress will be English and French with simultaneous interpretation. One of the main objectives of the Congress is to present a broad documentation of what is going on or what has just been accomplished in traditional as well as in new fields in the rapidly-developing underwater world. The program will include underwater archeology, marine biology, diving physiology, physical oceanography, marine geology, pollution of the oceans, conservation of nature, speleology and underwater technology. Details from The Secretariat, The Fourth World Congress of Underwater Activities, 7c Stockholm Convention Bureau, c/o Strandvagen S-11456, Stockholm, Sweden.

