



DIVISION OF

Marine and Freshwater
Science

ANNUAL REPORT
1985-86



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Director's Remarks

In handing over my responsibilities as Director to Dr Ron Heath, despite the fact that the past nine years have seen major changes for the Division, I am very conscious that the greatest changes are yet to come and we are rapidly being catapulted into a period quite different from that of the past.

Perhaps the most important change during my period as Director was the move from Thorndon Quay to the new site at Greta Point. This not only gave us the new buildings, which some of us feared we would never see, but new opportunities and new challenges. (It also relieved us of the frequently recurring chore of wandering up and down Thorndon Quay looking for acceptable office space to replace whatever we were about to lose.)

This year, thanks to John Hunt and Ken Grange, we have effective control of the seawater system, the last hurdle in achieving full commissioning of services at Greta Point. This, ironically, coincides with the appearance of the first major problems in service replacement.

Amalgamation with the Freshwater Laboratory at Taupo must rank high in the events of those nine years. Bringing two apparently quite disparate groups together in a joint enterprise is a highly risky undertaking and thanks are due to Dr Eddie White and the staff at Taupo for their acceptance of this decision and their willingness to work together in co-operative programmes. There has been some very effective spin-off from this for the Division.

The enforced retirement of R.V. *Tangaroa* was a major event, not entirely welcome, and seemed to some to render the whole viability of the Division at risk. After an initial period during which staff wrote up past work, the lack of seagoing time began to affect morale. Some compensation was provided by work on other vessels but it left a gap in our programme in New Zealand waters. Two years of hard work in committees and working parties produced approval to purchase a replacement. Even though 20 years old, the new vessel *Rapuhia*, once, as R.V. *Meteor*, the pride of the German Hydrographic Institute, is very much more sophisticated than anything we have had previously. It is unfortunate that DSIR funding will not allow it to be used to its full potential and it will have to be laid up for longer periods than we would like. Many individuals played their part in acquiring *Rapuhia*, with those most involved probably being Wilson Bailey, John Troughton, and Doug Tennant in Head Office and Ron Heath and Jack Irwin at DMFS. Jack Irwin took over liaison with the N.Z. Shipping Company who purchased the vessel and Union Steam Ship Company who brought her out to New Zealand and will manage it for DSIR. He supervised remodelling of the ship for DSIR in Germany and, with John Mitchell, participated in her last cruise under the German flag. May her future years be as successful as her first 20 years.

It would be wrong to pass on without a final mention of *Tangaroa*, a vessel which served DSIR exceedingly well. I would like to pay my tribute to her officers and crew and especially to her masters, Tim Nicol, Neil Gillstrom, and Peter Scarrott, who made a major contribution to our research programmes.

Computerisation was only just beginning when I took over from my predecessor, Jim Brodie; it now permeates every activity of the Division. In the early 1970s, instrumentation was barely out of the *Challenger* era and while there are still many items we would like to have, instrumental sophistication is now considerably advanced and the purchase of *Rapuhia* has advanced this still further.

The success of the public open days in September 1985 was very gratifying and a profitable way of making contact with the public. Over the three days, some 3,000 visitors passed through the Institute and some very favourable comment was heard. The fact that the Open Days coincided with secondary school examinations preparation considerably reduced attendance from that source.

With a seagoing vessel, the future looks much brighter but change is very much in the air. One remembers with nostalgia and frustration the way money and resources were in the past strictly controlled from Head Office or by some third party. Frustration at how limited delegations were and how powerless one was at times to do the obvious logical thing because of the checks and balances installed to prevent mishandling of Government resources; nostalgia at how simplified the system was and how few major decisions had to be made by the Director; how international co-operation was encouraged, and how there was more time for science. It was an era of much joint work in the Pacific with CCOP/SOPAC and I would like to thank the CCOP/SOPAC Project Manager, Cruz Matos, for the fine co-operative understanding we have had with them.

The new regime brings with it great opportunities for using resources logically and to the best advantage; it also brings pressures to deal only with the short-term, immediate-return projects, and to opt out of international and Antarctic responsibilities. More important still, is the difficulty in balancing short-term gain with long-term management in the best interests of the nation. The lack of an effective science council at this time to protect the nation's long-term interests is keenly felt by many.

Stepping down is a time for thanking people. While my thanks are due first and foremost to all members of the staff for their co-operation, kindness, and thoughtfulness, a Director comes to feel particular obligations to those on whom he has to rely administratively – his Administration Officer and staff and, in my case, our secretaries, Glenis and Karen. Further afield, I find I owe a debt to my fellow Directors, particularly those in the Resources Group, and to my corresponding numbers in Fisheries Research, the Museums, and the Universities, and my immediate contacts in Head Office. I would particularly like to mention our Chief Director, Dr Hamish Thompson, and his assistants, Dan Doyle, Brian Kilpatrick, and Graham Bates; Accountant John Rees, and the unsung people who get things done, people like Eileen Bell, Mavis Evans, and especially Beth Wilson for whom nothing was too much trouble and no question too trivial.

In returning to research, however effective that transition may be, I wish the Division well in the difficult but, we hope, productive years ahead.

D.E. Hurley

Divisional Objectives

The Division is this country's major oceanographic and freshwater research organisation. It's a challenging role. New Zealand has a 10,000-kilometre coastline, the world's fourth-largest 200-mile Exclusive Economic Zone (15 times the land area), and a high diversity of natural and man-made lakes. The research effort required to study and evaluate this immense aquatic resource is considerable.

We have, therefore, had to establish priorities in our four main sections of research (marine geology/physics/biology, and freshwater studies). Listed below are nine objectives. These will remain valid until about the mid-1990s, when new objectives arising from the development of the earlier ones, may be identified.

THE OBJECTIVES

1. To study the distribution, abundance, and identity of seafloor species in the New Zealand Exclusive Economic Zone in relation to their environment.
2. To study nutrient supply and transfer through the marine food web to animals and plants of economic importance.
3. To study the variability of water properties and movements on New Zealand's continental shelf and slope.
4. To study the sedimentary regime of the New Zealand continental shelf and slope in areas considered to have potential for development.
5. To define the mineral resources of the New Zealand Exclusive Economic Zone.
6. To evaluate the structure and stratigraphy of the New Zealand continental margin.
7. To study interaction between plants and those nutrients of importance in the control of eutrophication.
8. To assess the impact of development in marine and freshwater environments.
9. To engage in research related to international and bilateral co-operation programmes, New Zealand's aid programmes, and the New Zealand Antarctic Research Programme.

How do we go about achieving these objectives? We have a set of 10 research programmes, some sequentially followed, so we can whittle down each objective until it is

completed. Some of these programmes are tackled by individual scientists, other by small teams.

RESEARCH PROGRAMMES

PROGRAMME – Underwater topography and sediment cover

Progress in 1985-86

Mapping of the seafloor, seafloor sediments, and lake morphology continued as data were collected or became available. Eleven charts were published including reprints of three charts covering the central regions of New Zealand – an area in high demand by chart users. Publication of McMurdo Sound bathymetry in collaboration with Victoria University was a milestone in that it was our first Antarctic chart and the first chart to use computer graphics developed within the Scientific Mapping Unit of the DSIR. The Lake Series was expanded with the addition of four new charts and the programme to chart the fiords headed towards completion with charts of Bligh and Milford Sounds.

PROGRAMME – Marine minerals

Progress in 1985-86

A cruise of HMNZS *Tui* to the Manihiki

Plateau was undertaken in order to search for cobalt-rich manganese crusts. Because of mass wasting from the various seamounts dredged, thicknesses of crusts were much less than expected. A detailed study of the plateau, including seismic, sedimentological, and geochemical work, is now being carried out.

Programme – The seafloor life of the New Zealand Exclusive Economic Zone

Progress in 1985-86

All identified species of all groups, along with published records, have been entered into the computer file concerning the biology collections. Work is now concentrating on the Mollusca, aiming at input to the "Serial Atlas of New Zealand Marine Flora and Fauna".

Manuscripts were prepared on the echinoderms from the northwestern Tasman Sea and crinoids from the Kermadec Ridge, and work was done on fragments of a stalked crinoid, from near the Antipodes Islands, which is unusually large for its family (Bathycrinidae).

Work progressed on the *Tawera/Pleurogens* taxonomic problems in conjunction with Applied Mathematics Division.

A manuscript was completed on additions to the known range of the crab *Plagusia*. Work continued on the *Neolithodes* revision and a parasitic barnacle found on this genus. A bibliography of king crabs and their fisheries was completed.

Further progress has been made on the second volume of the bryozoan fauna of western South Island for the New Zealand Marine Fauna Series and a taxonomic survey of the deep-sea Bryozoa of the New Zealand region was begun.

Several manuscripts on New Zealand seaweeds were in various stages of completion, the macroalgal flora of Antipodes and Bounty Islands was in preparation, and work on a new species of *Lessonia* from the Snares Islands was completed, as was an annotated checklist of macroalgae from New Zealand subantarctic islands.

PROGRAMME – Ocean climate

Progress in 1985-86

Analysis of seven years of daily sea-surface temperature measurements from twelve coastal locations around New Zealand was completed. The purpose of this analysis was to assess the significance of temperature variations, which occur over a wide range of time scales, from daily periods to periods of a few years.

PROGRAMME – West Coast ecosystem

Progress in 1985-86

Records from three current-meter arrays moored simultaneously in 1984 are allowing further interpretation of any flow associated with propagating shelf waves contributing to the observed 1-4-weekly flow variability on the South Island west coast. Analysis this year concentrated on current-meter records and hydrological stations from the region of the Kahurangi upwelling plume. Present indications are that the plume is largely wind driven.

Work on the biological aspects of the system progressed on several fronts towards completion of the descriptive phase. A manuscript was completed on summer phytoplankton standing stocks and primary productivity, and work continued on the analysis of the summer phytoplankton and microzooplankton species composition. The preparation of manuscripts on the distribution and biomass of the zooplankton and nitrogen cycling in phytoplankton and zooplankton in western Cook Strait in late summer 1983 was begun. A manuscript was also completed on the meiofauna off Westland.

PROGRAMME – Continental margin geological mapping (CONMAP)

Progress in 1985-86

Work has continued on selected areas of the CONMAP region including the Northland

Margin; the Hikurangi Margin east of North Island; western Chatham Rise and the eastern South Island Margin incorporating the Bounty Trough. Such studies have involved a range of publications relating to bathymetry, geological structure, identification of geological hazards such as mudslides, slumps, and faults, evaluation of the margin, and evaluation of the sedimentary processes that help shape the ocean floor.

Already sufficient data are accruing in the CONMAP chart area of eastern Hikurangi and Bounty to contemplate syntheses that will culminate in the CONMAP Series.

PROGRAMME – Cook Strait geological and physical regime

Progress in 1985-86

A numerical model has been completed which documents the changes in the tide-dominated currents under calm and varying windy conditions. The model was also used to demonstrate changes in tidal flow over the last 20,000 years when sea level dropped 120 m and Cook Strait was blocked by a land bridge joining Cape Farewell and Cape Egmont. Under such conditions, the tidal flow decreased and much sediment was deposited; when rising seas breached the land bridge a strong tidal flow was reinstated and the seabed underwent an erosional phase.

Geologists from this Division and Geophysics Division have solved the age-old geological question of how the major fault lines of North and South Islands correlate across the strait. The study reveals the linkage is more complex than previously thought and sheds new light on the structure of this geologically active area.

PROGRAMME – Lake and harbour sedimentation processes

Progress in 1985-86

The New Zealand fiords came under attention, with a completed work on suspended sediment in

five of the southern fiords. This is the first part of a comprehensive study of sedimentation and geological evaluation of these deep inlets. Evaluation of the sedimentary processes operating in South Island lakes continued with studies of river/lake interactions in Lake Wakatipu and mapping the trace of the Alpine Fault across Lake McKerrow.

PROGRAMME – Aquatic environmental assessment

Progress in 1985-86

Data collection was completed on the distribution, size structure, and biomass of horse mussels in Marlborough Sounds and field work continued on their growth rates, recruitment, and mortality.

Field work continued on growth rates of tagged black coral colonies in Doubtful Sound. Exploratory work sponsored by the US/NZ Co-operative Science Programme culminated in the submission of a joint proposal to study black coral growth using the incorporation of radioactive isotopes into the skeleton. Spawning was observed for the first time in late summer.

A manuscript is in preparation on animal/sediment relationships and littoral communities of Manukau Harbour.

Two contracts were completed for Lands and Survey on the possible ecological effects of a tourist wharf development in Milford Sound.

Thirty-six environmental impact reports were received and commented on using the wide variety of expertise available within the Division.

Analysis of Marlborough Sounds sediments for dinoflagellate cysts continued; no cysts of toxic species have been discovered so far. Further attempts have been made to culture the toxic dinoflagellate *Dinophysis fortii*.

PROGRAMME – Eutrophication of fresh waters

Progress in 1985-86

Further progress was made towards identifying

those nutrients which limit algal growth in specific New Zealand lakes, a feature of fundamental importance wherever control of eutrophication is contemplated.

The development of an automated system for the analysis of urea in natural waters allowed studies of the role of this organic nitrogen

compound as a plant nutrient to proceed.

A major study aimed at quantifying the effect of Lake Rotorua water on Lake Rotoiti was carried out in collaboration with the University of Canterbury and the Bay of Plenty Regional Water Board.

Sectional Activities

NEW ZEALAND OCEANOGRAPHIC INSTITUTE

The Institute's interests are naturally centred within New Zealand's Exclusive Economic Zone, but range from the Equator to the Antarctic, and from the East Australian coast into the central South Pacific, far to the east of New Zealand. Studies extend over a comprehensive variety of marine and lacustrine environments that include lakes of fluvial, glacial, volcanic, and man-made origin, coastal inlets, fiords, harbours, and estuaries, and the seafloor down to abyssal depths, and environments ranging from tropical atolls and lagoons to the seafloor beneath the Ross Ice Shelf in Antarctica.

BIOLOGICAL OCEANOGRAPHY

Paul Anderson completed the cataloguing and entry of all benthic specimens, including miscellaneous material, into the biology collections. The computer entry to higher taxonomic group has also been completed. Paul has begun the detailed identification file; the "A" register is completed and others were begun. Paul also dealt with the final editorial questions on his joint manuscript with Keith Probert on the quantitative distribution of West Coast benthic macrofauna.

Ruth Baldwin put a good proportion of her time into the laboratory work connected with her project on the identity and distribution of dinoflagellate cysts in sediments from Marlborough Sounds. Ruth also pulled together information for data reports on cruises 1131 and 1142 on the West Coast and did the routine work to keep the small phytoplankton culture collection going.

Janet Bradford and Hoe Chang submitted a manuscript on the summer data on phytoplankton primary productivity off Westland. Janet also did further work on the manuscripts concerning the distribution of zooplankton collected on cruise 1144 and off East Cape. Janet also co-ordinated a first draft of a manuscript on physical, chemical, and biological data collected in Pelorus Sound as an adjunct to other cruises (with Hoe Chang, Ron Heath, Malcolm Downes,

Paul Woods, Ruth Baldwin, and Bruce Chapman).

Hoe Chang spent more than half the year at the Bigelow Laboratory for Ocean Sciences, Maine, USA. There he studied the interactive effects of temperature and three trace elements (zinc, manganese, and iron) on the growth rates of phytoplankton species. Hoe also conducted experiments on the effect of light quality on the growth of selected species of phytoplankton. He attended the Third International Conference on toxic dinoflagellates in St Andrews, Canada, in June. Since returning to New Zealand he has been preparing a manuscript on the summer abundance and size composition of phytoplankton and microzooplankton off Westland, assisted by Ruth Baldwin. Hoe also dealt with editorial matters with Bob Wear (Victoria University) for a paper on growth rates of *Dunaliella* from Lake Grassmere.

Bruce Chapman completed an assessment and cataloguing of the NZOI microscope equipment. He also completed a course on routine microscope servicing and light-microscopy techniques. Bruce also began experiments aimed at rearing Wellington Harbour copepods to investigate the influence of temperature on development.

Elliot Dawson completed work on the description of a new species of crab in the genus

Plagusia and a revision of the genus; the description of the new species was accepted for publication in the *National Museum Records*. He also finished a bibliography of king crabs and has a manuscript in preparation with John Yaldwyn of the National Museum which reviews the species of *Neolithodes* and includes records of *N. brodiei* from Australian waters. Elliot worked with Paul Anderson on the preparation of Serial Atlas manuscripts on eight species of mollusc.

Dennis Gordon, after editorial and other duties, is continuing to work on the second volume of the bryozoan fauna off western South Island for the New Zealand Marine Fauna series. He is also working on the deep-sea Bryozoa of the New Zealand region.

Ken Grange continued the field work and analysis of growth rates and breeding cycles of black coral in Doubtful Sound, assisted by Dick Singleton. Additional work was carried out under the US/NZ Co-operative Science Programme with Walter Goldberg (Miami) and Dennis Opresko (Tennessee) on skeletogenesis and taxonomy of black coral. Ken completed two contracts for the Department of Lands and Survey on the effects of proposed development in Milford Sound and a manuscript on a project in Manukau Harbour. He attended the International Coral Reef Congress in Tahiti in May-June and presented a paper on the New Zealand black coral resource.

Cameron Hay, assisted by Paul Anderson, Dick Singleton, John Hunt, Ed Arron, Ruth Baldwin, and Bruce Chapman completed four field trips and laboratory analysis on horse mussel population dynamics, distribution, abundance, and condition. Cameron completed a manuscript on the seaweed flora of New Zealand subantarctic islands with Nancy Adams (National Museum) and Murray Parsons (Botany Division) and sent off a manuscript on the description of a new species of *Macrocystis*. Field work on the Snares Islands confirmed the presence of a new species of *Lessonia* and material collected there will be used to describe the marine flora and fauna of the Snares Islands with George Knox

(Christchurch). Cameron also has a manuscript in preparation on the sublittoral flora and fauna of Tristan da Cunha and Gough Islands and completed a paper on the productivity of the macroalga *Desmarestia* in the South African kelp beds, with R.J. Anderson (University of Cape Town).

Penny Luckens completed two Serial Atlas manuscripts on *Tawera mawsoni* and *T. bollonsi* and worked on the detailed study of distribution and growth rates in *T. mawsoni*. Penny also worked on a review of the taxonomic status of species in the bivalve genus *Tawera* and dealt with 36 environmental reports.

Don McKnight worked up manuscripts on the identities of northern Tasman Sea echinoderms and stalked crinoids of the New Zealand region. Don also began work on the composition and associations of the New Zealand offshore benthos (100-1000 m). This analysis is being carried out on approximately 100 randomly selected stations from the Division's benthos collections.

Bill Main has largely completed the re-organisation of the type collections and dealt with requests for biological materials from the collections. Bill contributed to the seismic-reflection field work on Lakes Manapouri and Pukaki with Dick Pickrill and Jack Irwin, and the Manukau/Waitemata Harbours pollution survey for Geoff Glasby. He has also been sorting microbenthos samples as a contribution to work on the West Coast benthos with Keith Probert.

Rob Murdoch spent much of his time on the preparation of a new project proposal on the interactions between fish larvae and their planktonic prey and predators, with particular attention to hoki off the West Coast. Rob and Bruce Chapman overhauled nets and pumps and made new nets ready for Rob's first cruise in winter 1986. He also prepared papers from his thesis for publication.

Mark Ohman finished the laboratory and field work (assisted partially by Ruth Baldwin and

Bruce Chapman) on an assessment of "split" life history and relationships between feeding, lipid storage, and recruitment in *Neocalanus tonsus*, a dominant species of suspension-feeding zooplankton in subantarctic waters south-east of New Zealand. Janet Bradford described developmental stages of this species and closely related *Calanus australis* and *Calanoides macrocarinatus*, found in the same environment, as part of this project and also assessed the taxonomic status of copepods known as *N. tonsus*.

Dick Singleton's data-processing skills were used on the biology collection in retrieving information and in work on species diversity and community-score analysis. Dick contributed an analysis of West Coast fish-catch data to work by Keith Probert on the West Coast macrobenthos.

Alistair Jerrett, from the Division of Horticulture and Processing, is being hosted by NZOI while he studies the post-capture metabolism of fish muscle.

J.M. Bradford

MARINE GEOLOGY

The past year has been highly productive. A significant number of projects have been completed on a diverse range of topics that include harbour pollution, mineral surveys, sedimentation in lakes and fiords, deep-ocean sediment transport, and geological activity at the plate boundary; all of which considerably add to our understanding of the aquatic environment. In addition, the geologists have been heavily involved in applied work relating to coastal- and harbour-engineering problems as part of the Government's directive towards revenue-earning science.

We welcomed visits by a number of scientists and old friends. Julianne Fenner (Kiel University) provided micropalaeontological expertise to assist our understanding of the history of the Western

Boundary Current, east of New Zealand. Jack Dymond brought his suspended-sediment traps from Oregon State University to investigate the sediment flux in Lake Taupo.. The Cook Strait project received a boost with the arrival of Roger Proctor (Bidston, U.K.) who has provided a numerical model of the strait which portrays the water circulation over the last 20,000 years. Bob Norris (Santa Barbara), Loren Kroenke (Hawaii) and Bob Carter (Townsville) renewed acquaintances and, in the case of the latter two, continued collaborative research with NZOI scientists.

Outside of revenue earning, Lionel Carter has completed a study of sediment transport east of New Zealand where sediment particles have been traced at least 2000 km away from their South Island source. Work continued with Keith Lewis and Fred Davey in Cook Strait where an analysis of the geological structure has been resolved. A collaborative study of the deep-ocean Western Boundary Current is underway with Julianne Fenner (Kiel) and Bob Stewart (Massey University).

Dave Cullen continued work on various aspects of the Chatham Rise phosphorite resource and on tropical Pacific seamount phosphorites as well as expanding our understanding of recent phosphatisation with a study of more accessible concretions in Raglan Harbour. He also attended the International Symposium and Field Workshop of IGCP Project 156 (Phosphorite) in Greenville, North Carolina, and Tallahassee (Florida), visiting several major phosphate mines in North Carolina and Florida.

Jim Eade continued his work with the University of Auckland on sediments of the North Fiji Basin. Latest work includes a detailed study of the origin and transport of volcanic glass grains common in many sediments of the Southwest Pacific. As part of CONMAP, a new interpretation of the bathymetry of the Three Kings oceanic chart area has begun. In co-operation with Scripps Institution of Oceanography, a study of Seabeam bathymetric swaths, collected by R.V. *Thomas Washington*

in February 1986, is helping to establish the bathymetric and tectonic fabric of that part of the Havre Trough which lies on the Three Kings chart. He has also continued to manage technical matters relating to New Zealand's involvement in marine geological, geophysical, and mineral studies in the South Pacific carried out for CCOP/SOPAC, of which New Zealand is a member.

Keith Lewis (with John Mitchell) reported on sediment samples collected in northern Tonga aboard the Geological Survey of Japan's R.V. *Natsushima*. He reviewed structural interpretations of northern Tonga and edited a report on initial results of the Japanese expedition by 20 participating scientists. In co-operation with Fred Davey (Geophysics Division), Monty Hampton (USGS) and Jarg Pettinga (University of Canterbury), he has interpreted migrated seismic profiles from the Hikurangi Margin to show the structure of the earth's crust beneath eastern North Island. In March 1986, he completed a two-year stint as Section Leader of Marine Geology.

Geoff Glasby has been involved in sediment-geochemistry studies, in particular the effects of heavy metal pollution in Auckland and Wellington Harbours. He is currently investigating metalliferous sediments in back-arc basins north of New Zealand with assistance of the Royal New Zealand Naval vessel *Tui*.

Dick Pickrill studied contrasting fiords to define the dynamics of suspended-particle distribution, the history of deposition, and the effect of active-fault disturbance (with the Earth Deformation Section of NZGS) on sedimentation in the fiords. In close co-operation with Jack Irwin, he is continuing an examination of the role of high-density underflows in South Island lakes and reservoirs and their role in lake-delta slumping, channel formation, and depositional infilling. Jack Irwin has also completed bathymetric surveys of Pelorus Sound. Recent commissioning of an accurate trisponder (range-range) navigational system will facilitate future lake, harbour, and near-shore surveys.

Much of Jack Irwin's time has been taken up with negotiations concerning the acquisition and management of *Rapuhia*, while Dick is helping manage contractual work carried out by the Institute.

In the technical service area, John McDougall retired and was replaced by Sally Hughes. The initial direction of her work has been in computers. She is producing header files of oceanographic cruises so as to make the underway data files readily accessible, and is helping to develop procedures for plotting this information.

Ed Arron, in conjunction with Bill Main, conducted a survey of Manukau and Waitemata Harbours for Geoff Glasby. He completed the Oamaru sediment chart and assisted in several projects involving SCUBA diving when needed.

John Mitchell completed sediment and bathymetric charts of the Tasman coastal area. He visited West Germany with Jack Irwin, to participate on the last cruise of the *Meteor* before it changed owners to become the DSIR's R.V. *Rapuhia*. He is involved in contractual surveys in the Ivory Glacier area of the Southern Alps and on Manukau Harbour.

L. Carter

PHYSICAL OCEANOGRAPHY

This year we were all saddened by the sudden death in February 1986 of Norman Ridgway, a member of the physics team since the inception of NZOI. Norm's contribution to New Zealand marine science and specifically to NZOI has been immense. Some measure of the respect with which he was held is given in an obituary in this report.

In 1985-86, modelling studies at NZOI had a boost with the visits of Roger Proctor, from the Institute of Oceanographic Sciences, Bidston, on a New Zealand National Research Advisory

Council Fellowship, and Jim Richman, on sabbatical from Oregon State University. Both Roger and Jim expanded our capability in the modelling areas, with Roger concentrating on modelling of Cook Strait and the South Island West Coast, and Jim concentrating on current-meter analysis and development, with Janet Bradford, of a mixed-layer model. Malcolm Greig has 'sat alongside' Roger while developing a numerical model of the Hauraki Gulf. Malcolm has also been analysing climate observations in collaboration with Norm Ridgway and Bruce Shakespeare and continued the current-meter analysis.

Bruce Shakespeare has had a full year with several current-meter deployments, servicing of NZOI's and other current meters, collection of coastal data, organising the new pressure-test facility, and deploying radio-tracked buoys.

Alex Gilmour and Ron Heath have continued with their analysis of West Coast currents, concentrating on the Kahurangi upwelling plume observations. Alex has been continuing his 'update' of the New Zealand tsunami travel chart and has been involved with several basic mathematical physics problems.

Norm Ridgway continued his work on coastal climate but had an increasing involvement as Chairman of the International Co-ordination Group for the Tsunami Warning System in the Pacific.

Basil Stanton has been co-ordinating the introduction of a CTD system and laying the

base for future research on the three-dimensional structure of the hydrological field on the South Island West Coast. He has also been bringing to completion his past research in the southern fiords.

Anthony Cole has continued to maintain and 'expand' our computing capacity. This year has seen the introduction of a Calcomp plotter, capable of displaying cartographic data on paper up to full navigational chart size.

Engineering Services and Electronics

The absence of a ship, and the consequent reduced maintenance load, has allowed for complete servicing of our scientific mechanical equipment and the building of extra equipment. John Hunt has been involved with this servicing and had increased responsibility with the building and machinery maintenance at Greta Point and involvement with Marlborough Sounds field work. Bruce Johnstone, besides his regular workshop input, has been increasingly involved with Alistair Jerrett's fish transportation project.

Peter Hill and Ted Barnes have also had a reduced electronics maintenance load and have used the opportunity well - Peter being involved with production of his diver log and co-ordinating the planned shipboard data-retrieval system (with Anthony Cole and Keith Lewis) and Ted with remote-sensing matters both within the Division, with MAF, and as vital input to remote sensing at the Division of Information Technology.

R.A. Heath

TAUPO RESEARCH LABORATORY

Research in fresh water totalled twelve man-years for the year 1985-86. Marine research occupied four man-years.

A major study aiming to quantify the effect of Lake Rotorua water on Lake Rotoiti was carried

out in collaboration with the University of Canterbury and the Bay of Plenty Regional Water

Board.

A number of contributions were made to the understanding of the structure and function of wetlands, culminating in a major international review of cycling and retention of nitrogen and phosphorus in wetlands from both a theoretical and applied perspective.

A study of the chemistry and availability to phytoplankton of organic nitrogenous compounds in atmospheric precipitation was completed. The study encompassed sites in Japan and New Zealand and showed that the organic compounds in rain can stimulate algal growth.

Further progress was made towards identifying those nutrients which limit algal growth in specific New Zealand lakes, a feature of fundamental importance wherever control of eutrophication is contemplated.

Studies on the influence of herbivorous animals on algal and bacterial biomass were completed.

The development of an automated system for the analysis of urea in natural waters allowed studies of the role of this organic nitrogen compound as a plant nutrient to proceed.

In addition to the above subjects, site-specific studies on aspects of the limnology of Lakes Rotokuru, Dry, Rotoaira, Rotongaio, Titicaca, some Westland lakes, and the hydrolakes of the Waikato River, were reported in publications and file reports.

Laboratory staff were involved in the organisation of the XXIII Congress of the International Association of Limnology which will bring about 1000 scientists to New Zealand in 1987. A book describing New Zealand limnology, which emphasises its special features, is also being prepared for this meeting. The laboratory provided both the editor and authors for seven of the chapters.

Important environmental impact assessments included consideration of the effects of gold-mining activities on aquatic environments, and the importance of remaining wetlands to New Zealand.

The water-level regime of Lake Poukawa was the subject of a special tribunal of the Hawkes Bay Regional Water Board. Staff contributed to the determination of levels and control mechanisms with the object of satisfying the conflicting requirements for water use.

Marine research occupied four man-years. Field studies were carried out in Marlborough Sounds on the distribution of nutrients and planktonic algae, with a view to assessing food availability to the green-lipped mussel industry. Similar studies in the Hauraki Gulf aimed to improve environmental understanding relevant to the snapper resource assessment by MAF were also carried out. Information was published about nitrogen cycling in the waters of western Cook Strait.

E. White

Special Reports

Presented below are examples of research studies involving divisional scientists during 1985–86.

PHOTOSYNTHESIS AND UNDERWATER LIGHT

In contrast to the clear waters of the open ocean, inshore marine waters and lake waters contain dissolved and particulate material in relatively high concentrations. This reduces light penetration and the depth to which aquatic plant life can actively grow. A knowledge of the factors affecting underwater light and the relationships between light and photosynthesis is fundamental to our understanding of the natural productivity of our waters.

New Zealand has a wide array of optically diverse waters which allow us to test the effects of particle composition, and the type of dissolved material in the water, on photosynthesis. Reflected or scattered light is particularly important in certain inland waters where suspended particles are more concentrated than they are in the sea. An algal cell in suspension can therefore receive light from all around, not just from above, so traditional measurements of light travelling downwards underestimate the actual amount which the cell is receiving. In Lake Tekapo, for instance, an algal cell at 5 m depth is receiving almost three times more light than is detected by a traditional upward-facing light meter. Research by the Taupo Research Laboratory has been aimed at accounting for these discrepancies. Special Scalar Irradiance meters which simultaneously read light from all angles over an underwater sphere are used in conjunction with computer models to assess the total available light for photosynthesis at various depths and to determine the relationship between this measurement and that recorded by conventional light meters.

Calculation of available light for growth is much simpler for fixed aquatic plants (seaweeds, waterweeds, etc.) than for plankton which continuously move through the water whether by swimming, by buoyancy changes, or by water turbulence and mixing. Therefore the light regime a plankton cell experiences will be a result of light penetration and scattering as well as the depth of wind-induced mixing of the water. A knowledge of mixing patterns of lakes and their 'stability' (i.e., their capacity to resist wind mixing) is therefore critical in calculating available light regimes over long periods. Taupo Research Laboratory staff have therefore been studying physical stability of New Zealand lakes with a view to understanding its effect on seasonal changes in planktonic plant growth. This work links in with other studies on shade adaptation, whereby aquatic plants can optimise their growth at different depths. In deep clear lakes (e.g., Lake Waikaremoana) stable layers of water can occur at depths where light is still sufficient to allow algal photosynthesis. In these conditions, we find a major proportion of plant production to be at depth, well below the surface layers of a lake.

Co-operative research between DMFS and scientists from the Water Quality Centre, Ministry of Works and Development, has resulted in considerable advances to our understanding of the optical properties of New Zealand waters over the last few years. While the Ministry of Works and Development is now centering research on the visual (to man) aspects of water clarity and colour, DMFS work continues on the influence of water clarity and colour on plant growth and freshwater and marine productivity.

SILTATION IN THE UPPER WAITAKI POWER SCHEME

Sediment deposition in Lake Benmore should not create any problems to the efficient running of the Benmore power station during its design life. Studies on siltation rates in Lake Benmore, the largest artificial lake in New Zealand, have shown that sediment is forming at a rate of only 3 mm per year, compared with rates of 10 and 14 mm per year for Lakes Tekapo and Pukaki, respectively.

The Waitaki River was first harnessed for hydro-electric power generation in the 1930s. Since then, major power stations have been built and planned, culminating in the Upper Waitaki scheme which is still under construction. A major part of these projects has been the controlling of levels and outflows from natural lakes and the formation of new storage lakes downstream. Siltation has been a problem for storage lakes in New Zealand, and the Lake

Benmore study is one of a series being done by DMFS.

The lake has two arms which have quite different inflows in terms of volume, temperature, and suspended particulate matter. The Ahuriri Arm is fed by natural runoff from unglaciated catchments, whereas the Waitaki Arm receives the outflow of three large glacial-fed lakes which filter out suspended particles and moderate the temperature range of water entering it.

Shoreline erosion has contributed less than one-tenth of the sediment filling the lake, nearly all of which is carried as fine suspended particles while the coarser silty material is trapped in the upstream lakes or the upper reaches of the two arms of Lake Benmore.

The contacts for this work are R. Pickrill and J. Irwin, Division of Marine and Freshwater Science.

Update on Charting

In the late 1950s, the N.Z. Oceanographic Institute began a bathymetric survey programme to chart and contour water depths in the ocean and coastal waters and later in lakes. Charts depicting various biological, geological and geophysical, and hydrological data were also planned. To the end of 1985, the Oceanographic Institute has produced 226 marine charts at various scales.

Coastal Series Charts

These consist of two subseries, each of 37 chart areas, at a scale of 1:200,000. One subseries illustrates the bathymetry, the other the sediments on the continental shelf and most of the continental slope around New Zealand.

Oceanic Series Charts

These comprise two subseries, each of 72 chart areas, at a scale of 1:1,000,000. One subseries illustrates the bathymetry, the other the sediments on the floor of the Tasman Sea and Southwest Pacific Ocean.

Island Series Charts

These cover the near-shore bathymetry around islands in the South Pacific Ocean and in the New Zealand region at a scale of 1:200,000.

Miscellaneous Series Charts

These illustrate at various scales:

1. the bathymetry of sediments of areas outside the scope of the other series;
2. details of physical, chemical, and biological parameters;
3. geological structure of the ocean floor;

4. analyses and distribution of minerals in ocean-floor sediments.

Lake Series Charts

These cover, at various scales, the bathymetry of New Zealand lakes, large and small.

In 1985, seven charts were published. Four Lake Series charts, showing the bathymetry of inland Canterbury lakes (Lyndon, Catherine, Ida, Selfe, Evelyn, Georgina, Clearwater, Camp, Maori, Roundabout, Emma), following on from Lake Heron published the previous year. All these lakes are popular for fishing and other recreational activities.

Bathymetric charts of Bligh Sound, and Milford Sound, second edition, based on more recent bathymetric data, extend the coverage of the fiord region to eight of the twelve main fiord complexes. These charts are part of the Miscellaneous Series, which also featured in 1985 our first-ever chart of a part of the Antarctic continent, the bathymetry of McMurdo Sound.

Jack Irwin

New Research Ship for DSIR

NEWS RELEASE

FROM THE OFFICE OF THE MINISTER OF SCIENCE & TECHNOLOGY,
22 OCTOBER 1985

After a world-wide search, the DSIR is buying a German research ship.

This was announced today by the Minister of Science and Technology, the Hon. R.J. Tizard.

"The Government believes the work being done by the DSIR Marine and Freshwater Science Division is very important and must be continued. New Zealand has claimed the fourth-largest exclusive economic zone in the world, and the DSIR has the massive task of researching our seas and seafloor, including sea plants and animals, physical and sedimentary processes, and biological and mineral resources. The research ship is an absolute necessity, and I know the scientists are keen to get back to sea on their own ship," Mr Tizard said.

Current programmes include study of physics and biology controlling the lower end of the food chain on the West Coast, which is important to many of New Zealand's economic fish species, sediment movements and sea currents in Cook Strait, which affect engineering structure[s] including the present Cook Strait cable, exploration of potentially retrievable marine

minerals, shape and structure of the seafloor, identification of the major animals found on the seafloor, and investigation of their ecological importance.

"The ship is a bargain at only \$3.1 million and the DSIR will be able to buy it without special funding. It was the only ship like this on the market anywhere in the world and is in very good condition," Mr Tizard said.

The DSIR is buying the 20-year-old *Meteor* from the German Research Council with the help of the Shipping Corporation and the German Embassy. The final contract will be officially signed this week and the *Meteor* will probably arrive in Wellington next February.

Mr Tizard said the *Meteor* is a purpose-built oceanographic research vessel, with specialist winches, cranes and research equipment as well as 15 laboratories.

It will replace the Department of Scientific and Industrial Research's research vessel *Tangaroa* which was declared unseaworthy nearly two years ago.

Facilities and Services

LIBRARY

It is encouraging to see that usage of the library by staff members is increasing. There has been a steady demand for assistance with bibliographic verification and literature searching.

There is a continuing disparity between inter-loan requests received from other libraries (1610) and requests made by us (583). This places a heavy load on us to service these requests.

Over the past year a review of journal subscriptions received has been carried out. Various titles have been cancelled, but additional reviews will be necessary as the resources allocated to the Division diminish.

Work continues on inputting the 1800 current serial titles into the DSIR Bibliographic Network. In addition, retrospective inputting of the Division's publications into SIRIS has commenced.

More shelving has been placed in the upstairs section of the Library and this has helped to reduce some of the congestion on shelving through most of the library.

Extra assistance by way of PEP schemes has all but disappeared which means that various projects in the Library have been delayed, or their progress considerably slowed.

M.G. Hardy

PDP-11 minicomputer systems, one at Greta Point (NZOI), another at the Taupo Laboratory, and the third soon to be placed aboard R.V. *Rapuhia*. The Division also has a number of data communications links to the DSIR VAX computers from both the Greta Point and Taupo sites.

The systems are used intensively for many purposes, including recovery of data from oceanographic and laboratory instruments, analysis and plotting of scientific data, information retrieval, and numerical modelling of coastal tides and currents. Revenue-earning work for other Government departments, universities, local bodies, and private industry is now a significant use, particularly in the processing of current-meter data. Administration and library staff are also connected to appropriate software packages on the VAX computers.

A major acquisition during the last year has been a large plotter capable of displaying map-related data on paper up to full navigational chart size. With its arrival anticipated, student workers had been employed over the last two summers to enter twelve years accumulation of underway data from R.V. *Tangaroa*.

Usage of the DSIR's centralised VAX computers is consistently high, with large-scale scientific processing and software-package use taking place along with increased use by administration and the library.

A major effort in the next year is expected to be devoted to data capture and processing for a new CTD system, and to a highly flexible data-logging system for R.V. *Rapuhia*.

COMPUTING FACILITIES

DMFS owns three Digital Equipment Corp.

A.G. Cole

EDITORIAL AND PUBLICATIONS

The Division of Marine and Freshwater Science annually produces a number of publications. From the Oceanographic Institute have come various series of charts as well as *NZOI Records*, *Memoirs*, *Field Reports*, *Summaries*, *Miscellaneous Publications*, and *Hydrology and Biology Station Data*. Unpublished File Reports are produced by the Taupo Research Laboratory.

During the calendar year 1985, 65 publications were produced by the Division, as well as 7 charts and 11 unpublished reports. Since its inception in 1954, the Oceanographic Institute alone has produced, to the end of 1985, directly or indirectly (including non-Institute staff working on Institute material) 1183 published papers and reports, and 226 charts.

Memoirs and/or *Charts* and *NZOI Records* were sent to 697 institutions. From most of these we received in exchange, valuable publications in the field of marine sciences which assist in maintaining our library's standing as a centre of excellence in this field. Some of our publications are sent on a gift basis to smaller institutions, especially in the Third World, while a list of publications is sent on an information basis to 834 addresses (in 86 countries and dependencies). These include individuals as well as institutions.

D.P. Gordon

PUBLIC RELATIONS

Two major public relations events scored the 1985-86 calendar – the Fourth Biennial Fishex Exhibition, and public open days at the Oceanographic Institute.

The fishing exhibition, held in Nelson's Trafalgar Centre 23-25 April 1985, included a manned booth featuring the work of the Institute as it relates to the fishing industry. The display

showed oceanography from space by satellite remote-sensing, coastal sea temperatures/Southern Oscillation, an electronic diver log, king crabs, and charts. Sales of charts exceeded those at the previous such exhibition and partly defrayed the cost of the display.

Public Open Days were held on 19-21 September and 3,000 people toured the Institute. Most interest was generated by the live displays (plankton and coastal marine life) and models (Cook Strait seafloor, an internal-wave tank, and lake-sediment deposition). Reporters from 2ZB radio and TV's *Video Despatch* covered aspects of the displays and articles about the Division's research were featured concurrently in newspapers.

The Division's routine public relations activities covered a number of avenues: disseminating information material in response to enquiries from the public; newspaper and magazine articles; magazine and television interviews or features; lectures and talks; tours; and exhibits and displays. Newspaper articles during 1985-86 featured the gigantic Taupo-area eruption a quarter million years ago and its significance to nuclear-winter scenarios; the West Coast ecosystem supporting the hoki fishery; king crabs; deployment of sea-surface ocean/atmosphere research buoys; recovery of lost current meters; cartographic training for Cook Islanders; the Institute's Open Days; the stepping down of Des Hurley as Director and the appointment of a new Director; invasion of Wellington-area beaches by salps; New Zealand midges; the death of Norman Ridgway; mammoth mudslides on the Otago-Canterbury seafloor; the deterioration of Lake Rotoiti; purchase of a new research vessel.

The July edition of *Readers's Digest*, in an article about the use of glass, mentioned the Oceanographic Institute's use of glass buoys in vertical current-meter arrays.

In all, 1985-86 saw the most press coverage in a number of years.

D.P. Gordon

In-House Seminars

During the year, in-house seminars are held at both NZOI and Taupo. These are contributed by staff and visitors and focus on work in progress or recently completed.

NZOI

1985

- 17 May *Variability in the currents of western Cook Strait*
R.A. Heath, NZOI
- 22 May *Real and apparent wave measurements*
M. Longuet-Higgins, Institute of Oceanographic Sciences, U.K.
- 23 May *Distribution, standing crop, population structure and growth rates of black coral in fiords*
K.R. Grange, NZOI
- 14 June *Northern Tongan arc – preliminary results from the Natsushima cruise*
K.B. Lewis, NZOI
- 28 June *Horse mussel (*Atrina zelandica*) research*
C.H. Hay, NZOI
- 12 July *Dynamics of suspended-sediment transport in New Zealand fiords*
R.A. Pickrill, NZOI
- 26 July *West Coast primary production – where do we do from here?*
J.M. Bradford, NZOI
- 21 August *Mixing in stratified fluids*
A. Tsinober, Tel-Aviv University
- 10 September *Abyssal circulation in the Tasman Sea*
C. Jenkins, University of Sydney
- 18 October *Low-frequency currents in the central equatorial Pacific Ocean: an interpretation as equatorially trapped waves*
J. Richman, Oregon State University
- 4 October *"Information takeover" – the impact of computer technology - video*
Arr. E.J. Barnes, NZOI
- 11 October *King crabs*
E.W. Dawson, NZOI
- 25 October *Storm-generated continental-shelf waves*
R. Proctor, NZOI

- 1 November *Red-tide research/Bangkok meeting*
R.P. Baldwin, NZOI
- 8 November *Principles of computer mapping*
A.E. Gilmour/A.G. Cole, NZOI
- 22 November *Impact of lakes on shelf sedimentation*
L. Carter/R.A. Pickrill, NZOI
- 6 December *Fiords - facts and fantasies*
B.R. Stanton, NZOI
- 11 December *R.V. Meteor - new oceanographic research vessel*
J.S. Mitchell, NZOI

1986

- 28 February *Dive Fiordland - video*
K.R. Grange, NZOI
- 3 March *Recent oceanographic research, west coast of Canada*
R. Burling, University of British Columbia
- 7 March *Ocean particle collection with sediment traps; biological and geological implications*
J. Dymond, University of Oregon
- 21 March *Seabeam in the Havre Trough and Tonga Trench-Louisville Ridge area*
J.V. Eade, NZOI; R. Herzer, NZGS

TAUPO

1985

- 13 May *Limnology of the Vestfold Hills area, Antarctica*
H. Burton, Australian National Antarctic Research Organisation, Hobart
- 7 June *Aspects of the limnology of some small lakes in the high Arctic*
M. Ouellet, University of Quebec, Quebec City
- 26 June *Oxygen budgets and photosynthesis in fresh waters*
J. Pokorny, Czechoslovakian Academy of Science, Trebon

- 2 July *Recruitment, diapause, and lipid storage of the copepod Neocalanus tonsus*
M. Ohman, Friday Harbor Laboratories. University of Washington
- 2 August *Hydrological optics*
R. Davis-Colley, Water Quality Centre, Ministry of Works and Development, Hamilton
- 17 August *Spatial variability in chlorophyll and nutrients in the Hauraki Gulf*
M.B. James, Taupo
- 17 August *Inorganic nitrogen variations off the South Island west coast*
A.B. Viner, Taupo
- 11 September *Phytoplankton and water movement in Lake Rotoiti*
W.F. Vincent, S.J. Dryden, M.M. Gibbs, Taupo
- 20 September *Use of short-lived radio-isotopes in biology – review of a workshop*
M. Downes, Taupo
- 1 November *Lake Biwa*
S. Ichiki, Shiga Prefectural Institute, Japan
- 13 December *²¹⁰Pb dating of lakes*
P. Appleby, University of Liverpool
- 17 December *Dependence of bacterioplankton on extracellular organic carbon released by phytoplankton*
M. Sondergaard, University of Aarhus, Denmark
- 1986
- 14 March *Dynamic systems of aquatic microbial mats*
R. Castenholz, University of Oregon, Eugene
- 21 March *Particle collection with sediment traps: biological and geological implications*
J. Dymond, Oregon State University, Corvallis

Staff Activities and Visitors

OVERSEAS TRAVEL

- E.J. Barnes* 3–15 April 1985 Familiarisation with remote-sensing ground-station technology, Canberra, Alice Springs, Hobart
- J.M. Bradford* March 1986 Australian Marine Sciences Association Conference, Hobart
- F.H. Chang* October 1984–November 1985 Bigelow Laboratory for Ocean Sciences, Maine, USA
- D.J. Cullen* 6–17 May 1985 Eighth International Field Workshop and Symposium, International Geological Correlation Program (IGCP) Project 156, Greenville, North Carolina, and Tallahassee, Florida
- J.V. Eade* 24 June–4 July 1985 Scientific Ocean Drilling Subcommittee Workshop, Scripps Institution of Oceanography, La Jolla, California
- 8–19 September 1985 Annual Meeting CCOP/ SOPAC, Honiara, Solomon Islands
- 20–30 September 1985 Submersibles Workshop, Suva, Fiji
- G.P. Glasby* August–October 1985 Geological Survey of India, Calcutta, University of New Delhi, and Imperial College, London, to see colleagues; University of Heidelberg, West Germany; U.S. Exclusive Economic Zone Conference, Washington, D.C.; University of Southern Mississippi, Hattiesburg; U.S. Geological Survey, Menlo Park, California; Hawaii Institute of Geophysics, Honolulu – primarily to organise the cruise of HMNZS *Tui* to the Manihiki Plateau
- K.R. Grange* 26 May–2 July 1985 Fifth International Coral Reef Congress, Tahiti
- M.G. Hardy* 28–30 August 1985 CSIRO/DSIR Information Services Workshop, Melbourne; 1–6 September 1985 First Asian-Pacific Special and Law Librarians Conference, Melbourne
- R.A. Heath* October 1985 Familiarisation and management visit concerning R.V. *Rapuhia*, Hamburg, West Germany
- J. Irwin* 25 October–19 December 1985 Famil-

iarisation and purchase of new R.V. *Rapuhia*, Hamburg, West Germany

N.M. Ridgway July–August 1985 Tsunami Workshop, Tenth Session of International Tsunami Warning System, Victoria, British Columbia

B.R. Stanton 2–9 January 1986 Institute of Oceanographic Sciences, Wormley, and Operation Raleigh, London

R.M. Thompson 8–19 September 1985 Annual Meeting CCOP/SOPAC, Honiara, Solomon Islands

A.B. Viner June 1985 SCOPE Workshop on Nitrogen Dynamics in Coastal and Estuarine Environments, Aarhus, Denmark

March 1986, to develop a numerical model of the mixed layer and an analytical model of density-driven currents off the South Island West Coast

Mr Vaitoti Tupa, Department of Internal Affairs, Cook Islands, 15 April–24 May 1985, on a training course in marine mapping and surveying

TAUPO

Professor Richard Castenholz, University of Oregon, Eugene, for four months, studying the ecophysiology of thermal algae

Dr S. Ichiki, Shiga Prefectural Institute, Japan, for two months, 1985, working on nitrogen cycling in lakes

HONOURS AND AWARDS

L. Carter N.Z. Geological Society's Hochstetter Lecturer for 1984–85

C. Howard-Williams, J. Davies, S. Pickmere, Ravensdown Prize, awarded for best session paper at N.Z. Institute of Agricultural Sciences Symposium 1985

VISITING WORKERS

NZOI

Dr Jack Dymond University of Oregon, Eugene, for six months, January–June 1986, to study sediment trapping and sediment fluxes in Lake Taupo

Dr Julianne Fenner University of Kiel, for six months, February–August 1986, applying micropalaeontology to understanding the history of the Western Boundary Undercurrent

Mr Aturangi Hosking Lands and Survey Department, Cook Islands, 15 April–24 May 1985, on a training course in marine mapping and surveying

Dr Roger Proctor Institute of Oceanographic Sciences, Bidston, for 11 months, September 1986–August 1986, to work on numerical models of the hydrology of Cook Strait, western South Island, and Hauraki Gulf

Dr Jim Richman, Oregon State University, Corvallis, for six months, September 1985–

OTHER VISITORS

Several day or short-term visitors from overseas toured the Division's Greta Point or Taupo facilities during 1985–86. These included:

Australia

Dr Lynnath Beckley, Murdoch University, Perth (Taupo)

Dr Harry Burton, Australian National Antarctic Research Organisation, Hobart (Taupo)

Dr Bob Carter, James Cook University, Townsville (NZOI)

Dr Chris Jenkins, University of Sydney, Sydney (NZOI)

Dr Michael Pittman, Chief Director, Institute of Biological Sciences, CSIRO, Canberra (Taupo)

Canada

Professor Ronald Burling, University of British Columbia, Vancouver (NZOI)

Dr David Huntly, Dalhousie University, Halifax (NZOI)

Dr Marcel Ouellet, Université du Québec, Quebec City (Taupo)

Czechoslovakia

Dr Jan Pokorný, Hydrobotanical Institute, Czechoslovak Academy of Sciences, Trebon (Taupo)

Denmark

Dr Morten Sondergaard, Aarhus Universitet,
Aarhus (Taupo)

Fiji

Mr Jioji Kotobalavu, Director, CCOP/SOPAC,
Suva (NZOI)

Mr Cruz Matos, Project Manager, CCOP/
SOPAC, Suva (NZOI)

Israel

Dr A. Tsinober, Tel Aviv University, Tel Aviv
(NZOI)

Philippines

Mr Mario Berbano, Environmental Management
Division, Philippine National Oil Company
(Taupo)

United Kingdom

Dr Peter Appleby, University of Liverpool
(Taupo)

Dr Alan Baker, River Laboratory, Freshwater Bio-
logical Association, Wareham, Dorset (Taupo)

Professor J.T. Furtado, Secretary, Common-
wealth Science Council, London (NZOI)

Mr E.G. Hobhouse, Marconi Underwater Sys-
tems, Waterlooville (NZOI)

Dr Michael Longuet-Higgins, Institute of Ocean-
ographic Sciences, Wormley, and Cambridge
University (NZOI)

United States

Dr Eduardo Feller, National Science Foundation,
Washington, D.C. (NZOI)

Dr Walter Goldberg, Florida International Uni-
versity, Miami (NZOI)

Dr Loren Kroenke, Hawaii Institute of Geo-
physics, Honolulu, (NZOI)

Mr A.W. Milsap, National Science Foundation,
Washington, D.C. (NZOI)

Professor Bob Norris, University of California,
Santa Barbara (NZOI)

Dr Dennis Opressko, Tennessee National Lab-
oratories, Oak Ridge (NZOI)

Dr Ross Vinnel, Woods Hole Oceanographic
Institution, Massachusetts (NZOI)

USSR

Scientists from the Akademik Korolev, Vladivo-
stok Far East Hydrometeorological Institute

OFFICES HELD

List of staff holding office in International
Bodies, Scientific Societies, Committees, etc.
1985-86

International Bodies

L. Carter, *International Union of Geological Sci-
ences (IUGS)*

National Representative, Commission for Mar-
ine Geology

D.J. Cullen, *International Geological Correlation
Programme (IGCP) Project 156 (Phospho-
rites)*

National Representative/Correspondent for
Working Group on "Young Phosphogenic
Systems" (UNESCO-IUGS)

*Society of Economic Paleontologists and
Mineralogists*

Trace Fossil Research Group with special
interest in animal/sediment relationships

E.W. Dawson, *Pacific Science Association
(PSA) Scientific Committee on Coral Reefs*
Chairman of Special Working Group on
South Pacific Reefs

*International Association of Biological Ocean-
ography (IABO) Coral Reef Committee*

Member

Editorial Board of
Journal of Coastal Research

J.V. Eade, *Committee for the Co-ordination of
Joint Prospecting for Mineral Resources in
South Pacific Offshore Areas (CCOP/
SOPAC)*

New Zealand Representative

*Inter-Union Commission on the Lithosphere
(ICL) Co-ordinating Committee 3. Geo-
sciences within Developing Countries*

Corresponding Member

G.P. Glasby, *Editorial Board of*
Marine Geology

D.P. Gordon, *International Association of Biological Oceanography (IABO-IUBS)*
National Correspondent

R.A. Heath, *International Union of Geodesy and Geophysics (IUGG)*
Tsunami Committee
International Oceanographic Commission (IOC)

1. WESTPAC – Technical Correspondent for Physical Oceanography
2. WESTPAC – Chairman of Task Team on Coastal Continental Shelf Oceanography
3. Member – Scientific Committee on Oceanic Research Working Group "General Circulation of the Southern Ocean"
4. Member – Climate Changes in the Ocean Working Group on "Critical Aspects of the T and S Distribution"

C. Howard-Williams, *Editorial Board of Revue d'Hydrobiologie Tropicale*
UN/SCOPE Committee on African Wetlands
Member

D.E. Hurley, *Intergovernmental Oceanographic Commission (IOC)*
Joint National Contact
IOC/WMO – IGOSS Bathy/TESAC Operational Programme
National Co-ordinator
Advisory Editor
Crustaceana

K.B. Lewis, *Intergovernmental Oceanographic Commission (IOC)*
New Zealand Correspondent on Geoscience for WESTPAC
Japan-Australia-New Zealand Joint Indian-Pacific Plate Boundary Project
New Zealand Scientific Co-ordinator
Inter-Union Commission on the Lithosphere (ICL)
Convener of National Committee for the Lithosphere

N.M. Ridgway, *Intergovernmental Oceanographic Commission (IOC)*
1. International Co-ordination Group for the Tsunami Warning System in the Pacific

(ICG/ITSU) – Chairman and National Contact
2. WESTPAC – Member of Programme Group

B.R. Stanton, *International Association of Physical Sciences of the Oceans (IAPSO)*
National Correspondent
International Oceanographic Commission (IOC)
1. WESTPAC – Scientific Committee on Ocean Circulation, Member
2. Bathy/TESAC Operational Programme, National Co-ordinator
Responsible National Oceanographic Data Centres (WAVES)
National Correspondent

A.B. Viner, *Editorial Board of Revue d'Hydrobiologie Tropicale*

New Zealand Bodies

J.M. Bradford, *National Committee on Oceanic Research*
Convener

L. Carter, *N.Z. Marine Sciences Society*
Vice President
N.Z. Geological Society
Hochstetter Lecturer 1984–85

F.H. Chang, *Shellfish Sanitation Committee*
Member

E.W. Dawson, *National Museum of New Zealand*
Honorary Research Associate

J.V. Eade, *Scientific Ocean Drilling Sub-Committee of the National Committee for Geological Sciences*
Chairman
N.Z. National Committee for the Tripartite Joint Programme of Marine Geoscientific Research and Mineral Resource Studies of the South Pacific Region
Member

K.R. Grange, *Wellington Shell Club Committee*
Member

M.G. Hardy, *SLISS Wellington Chapter to the N.Z. Library Association Working Party on Interloan*
Committee Member

R.A. Heath, *National Committee on Oceanic Research*
Member

D.E. Hurley, *Royal Society of New Zealand*
Honorary Librarian; Chairman of Library Committee
Ross Dependency Research Committee
Appointed Member and Convener, Biology Working Group

K.B. Lewis, *Scientific Ocean Drilling Subcommittee of the National Committee for Geological Sciences*
Member

P.A. Luckens, *N.Z. Ecological Society Council*
Member

R.A. Pickrill, *N.Z. Marine Sciences Society Committee*
Member

R.J. Singleton, *N.Z. Underwater Photographic Society, Wellington Branch*
Newsletter Editor

Interdepartmental Committees

L. Carter, *Hydrographic Policy Working Party*
Member
DSIR Cartographic Management Committee
Member

A.G. Cole, *DSIR Users Network Committee*
Chairman

E.W. Dawson, *Outlying Islands Reserves Committee*
Member

D.E. Hurley, *Hydrographic Policy Working Party*
Member
N.Z. Journal of Marine and Freshwater Research
Chairman of Advisory Board

N.M. Ridgway, *National Civil Defence Warning System Planning Committee*
Member

E. White, *Freshwater Fisheries Advisory Council*
Member
NWASCO – Research and Survey Committee
Member

Research Contracts

Two research contracts to universities were current during 1985–86. These were:

UV/5/21 to Dr K.A. Hunter, Chemistry Department, Otago University
Trace Metals Essential to Phytoplankton

Aim – To determine the systematic relationships between the classical micronutrients (phosphate, nitrate, silica) and biologically important trace metals like Cu, Ni, Cd, with a view to understanding the micronutrient role of trace metals in

productivity and their usefulness as oceanographic tracers. °

D-39 to Mr A.J. Macpherson, Geology Department, Victoria University, Wellington
Granite Harbour Sedimentation Study

Aim – To identify the main sources, transport processes, and sinks in the Mackay Glacier/Granite Harbour system (Antarctica), and to determine rates as far as is possible in order to construct a sedimentary model for this system.

Obituaries

NORMAN McK. RIDGWAY 1924–1986

Norman Ridgway passed away in his sleep at home on 16 February, 1986. He is survived by his wife Olwen and daughter Jane.

Norman McKillop Ridgway was born in Scunthorpe, England, on 29 October 1924. He obtained the Oxford School Certificate in 1940 and commenced work as a technician in Lysaght's Steelworks Laboratory in Scunthorpe. He served in the Royal Navy from 1942–46 as a Petty Officer Radio Mechanic. In 1946–47 he worked as a school teacher preparatory to spending three years in Training College and gaining a Ministry of Education Teaching Certificate. From 1949 to 1951 he taught science at secondary level.

Coming to New Zealand in 1951, he worked with Vacuum Oil Company in their Technical Advisory Service until 1953 when he joined the staff of the Oceanographic Observatory (DSIR) as it was then.

In the 1950s and '60s Norman was involved in the extensive regional oceanographic surveys in New Zealand waters which defined the characteristics of ocean circulation. This work required extensive seagoing often in less than ideal conditions. Norman was involved in all aspects of this work from data collection through analysis to final reporting.

At this time, Norman was involved in small-scale nearshore current and dispersion surveys. These were often in relation to proposed effluent outfalls and similar engineering works. He was often involved as an expert witness for DSIR at various planning hearings. This work led him naturally into the field of cooling-water ocean

outfalls when these were first proposed in the late 1960s. He was particularly associated with the investigations for the New Plymouth Power Station. In January 1974 he travelled to Australia to study environmental aspects of thermal power station cooling-water systems.

Norman visited the Antarctic in 1962 on a scientific project and was appointed Station Leader at Cape Hallet for a year in 1963–64. He was unfortunate to lose all his possessions in a fire at Cape Hallet and was hospitalised for a period as a result.

From 1964 Norman was involved as a member of the Tsunami Advisory Panel in evaluating tsunami warnings in terms of their likely effect on New Zealand. In 1977 he was invited to visit the International Tsunami Warning Center in Honolulu, Hawaii for a six-week period as part of their Visiting Scientist Program. This programme provides for individual scientists to visit the center for purposes of co-operative research and training in the operation of the International Tsunami Warning Systems in the Pacific. In 1978 he was appointed Associate Director of the International Tsunami Information Center (ITIC), Hawaii. This appointment was initially for one year but was extended for a further six months in 1979.

In 1982 Norman attended the Eighth Session of the International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) in Suva, Fiji. These meetings are held biennially under the auspices of the Intergovernmental Oceanographic Commission (IOC) of UNESCO. Previously New Zealand did not take an active part in these meetings apart from one held in Wellington in 1974. At the Eighth Session of ICG/ITSU Norman was rapporteur and took an active part in the discussions particularly those relating to the formation of a

regional tsunami warning system in the Southwest Pacific.

At the Ninth Session of ICG/ITSU in Honolulu, March 1984, Norman Ridgway was elected Chairman of the group, a position he still held at the time of his death. In this role he was actively involved in the Tenth Session of ICG/ITSU held at the Institute of Ocean Sciences, Sidney, British Columbia, Canada, in August 1985. This meeting was held in conjunction with a Workshop on the Technical Aspects of Tsunami Analyses, Predictions, and Communications.

In December 1984, Norman undertook a mission to Colombia to investigate and advise on the measures necessary to develop a tsunami warning system for Colombia.

While Norman's time in recent years had been very much taken up with his tsunami work, he was still able to take part in a full range of Oceanographic Institute projects. He was particularly involved in the Coastal Climate Survey whereby long-term measurements of temperature and salinity at a number of coastal stations are being collected. At the time of his death he was analysing these data and was particularly interested in the long-period changes in ocean climate.

B.R. Stanton

DR RONALD G.J. FRASER 1899 – 1985

Ronald George Jutta Fraser was a Scottish scientist who came to New Zealand with a distinguished early research background in physics and an equally distinguished second career in International Science. In fact, he seems to have made a practice of new careers as each previous one came to a natural termination. There is little on his file in the Institute because of the nature of his employment with us but the indefatigable nature of the man is shown in the

only letter on file from him. Dated March 10, 1969, it states simply: "On attaining today the age of 70, I hereby regretfully tender my resignation from service with the Institute. My last day of work will be Wednesday, 12.3.69." What the letter does not state is that he then began work for the Royal Society of New Zealand at the age of 70.

His first sixty years are admirably summarised in the order of service for his funeral at the church of Saints Peter & Paul, Lower Hutt, 10 September 1985.

"Ronald Fraser was born in 1899 and studied for his Doctorate of Physics at Aberdeen University. He studied in Germany under Otto Stern before the First World War and was a notable molecular scientist. He was on Rutherford's team at the Cavendish Laboratory in Cambridge, England.

In the First World War a crash, while in the Royal Flying Corps, cut short his flying. During the Second World War he was involved in the development of airborne radar and mobile ground radar.

After the Second World War, he became scientific adviser to the British Control Commission in Germany; and then Administrative Secretary of the International Council of Scientific Unions in Paris and the Hague, where he was closely involved in the organisation of the International Geophysical Year in 1957 and 1958, and in the foundation of the Special Committee on Antarctic Research.

He was an international scientist with an enormous range of scientific friends and colleagues from many countries but he also enjoyed the Highlands of Scotland and walking on the Downs and the Malvern Hills in England.

He and his wife Isobel came out to New Zealand when he retired in 1965."

This does not tell the full story of his early life. A brief 1967 biography refers to him as

having been closely connected with the science of geophysics for some twenty-five years. "As a member of the Research Division of I.C.I. he used geophysical methods to explore the salt beds of Cheshire; as scientific adviser in the British Element of the Control Commission for Germany he helped organise a survey of the earth's crust and upper mantle in western Europe, taking advantage of the artificial earthquakes triggered by the explosion of war-time ammunition dumps; and as Administrative Secretary of the International Council of Scientific Unions he was involved in the forward planning of the recent International Geophysical Year (1957-58) and subsequently of the recent International Indian Ocean Expedition (1960-65)".

The attraction of New Zealand was the presence here of his son, Canon, daughter-in-law Jackie, and their family. His first contact with the Institute came when he was using our library facilities to revise his book "The Habitable Earth" (Hodder and Stoughton, 1964), which appeared in paper-back version as "Understanding the Earth" under the Penguin imprint. When this was finished, he found work with NZOI, in April 1967, on a temporary six-month appointment. This was later extended, subject to regular review, until his retirement in 1969, nearly two years later. He spent part of that time as special assistant to the Director, but he also began the listing of NZOI Library holdings. During this period he also acted as compiler for the Royal Society Bulletin "Cook Bicentenary Expedition in the South-west Pacific" and wrote a paper, "Global Distribution of Eulerian Poles", a topic which he argued out over many cups of Institute

tea and had the satisfaction of seeing published in *Nature* for February 11, 1972.

Apart from "Understanding the Earth" he was author of three other books, "Molecular Rays" published by Cambridge University in 1931; "Dance Round the Sun: the story of the International Geophysical Year" (Hodder & Stoughton, 1957), and "Planet Earth" (1961).

Ronald Fraser retained a strong interest in scientific problems, reading widely and discoursing knowledgeably on plate tectonics, pentagonal symmetry in marine animals, religious beliefs, science, life, and other topics which caught his fancy. From NZOI, he went on to a roving commission with the Royal Society of New Zealand where he produced the nine parts of the "Catalogue of Holdings in the Library of the Royal Society of New Zealand" published between 1971 and 1974. Here, he also compiled the volume, "Oceanography of the South Pacific, 1972" (New Zealand National Commission for UNESCO, 1973).

Ronald Fraser was an agreeable companion, keen to discuss all manner of things, from the Loch Ness Monster (which, like a good Scotsman, born at Strathpepper, not far from Loch Ness, he not only believed in but had seen) to the latest hot topic in *Nature*. He liked company and liked work but his life was greatly saddened in his later years by the loss of his much-loved wife.

D. E. Hurley

Workshops

LARVAL FISH ECOLOGY SEMINAR AND WORKSHOP 3-5 MARCH 1986

Dr Reuben Lasker, Chief of the Coastal Fisheries Resources Division of the National Marine Fisheries Service, Southwest Fisheries Center at La Jolla, California, participated in a workshop on larval fish held in Wellington 3-5 March. Dr Lasker is a pioneer in the field of study of larval fish and the role of the environment can have on their survival and the effect this has on the size of commercial-fish populations. The workshop was sponsored by DMFS and Fisheries Research Division, MAF, and the meetings were held at Greta Point, Wellington.

Scientists and technicians interested in the subject, from other Government departments, the universities, and museums, were invited to attend. Dr Howard Choat of Auckland University Zoology Department, chaired the workshop session.

More than 30 people attended a seminar given by Dr Lasker on "Recent Advances in Larval Fish Ecology" on the morning of 3 March and in the afternoon there was a group presentation on progress in the Hauraki Gulf and West Coast South Island projects to serve as background against which the workshop sessions the following day could be set.

On 4 March the workshop programme dealt with:

1. Sampling programmes and collection devices (in localised hydrological features; broader-scale surveys).
2. The interpretation and verification of daily otolith increments.
3. Larval-rearing programmes.
4. Sources of mortality in small planktonic fishes (condition, growth, and the detection of starvation; predation).
5. Early life history of fishes and the development of sensory systems.

Each member of the panel introduced and summarised the main points in each topic and discussion was thrown open to the floor.

On the morning of 5 March, time was made available for individuals to give short presentations on recent work, specifically for the purpose of receiving feed-back.

Everyone found the meetings most useful and a lot of up-to-date information was exchanged. I would like to record my thanks to Dr Reuben Lasker, for agreeing to come to give us the benefit of his experience, and Dr Howard Choat, for organising and running a most successful workshop.

Janet Bradford.

List of Research Projects 1985-86

- 69-4 *Distribution of New Zealand benthic bivalves* P.A. Luckens
- 70-1 *Lithodid crabs of New Zealand and the Pacific* E.W. Dawson
- 71-6T *Macrobenthos of Lake Ngapouri* D.J. Forsyth
- 73-2 *Sedimentation in Cook Strait* L. Carter
- 74-1 *Chatham Rise benthos and its environmental significance* E.W. Dawson
- 74-11T *Groundwater quality along the foreshore of Lake Taupo* M.M. Gibbs
- 75-3 *Manukau Harbour littoral monitoring* K.R. Grange
- 75-4 *Marsden "B" Power Station baseline study* P.A. Luckens
- 75-20T *Macrobenthos and zooplankton of Lake Rotoaira* D.J. Forsyth
- 76-5 *Northland Plateau geology* J.V. Eade
- 76-6 *New Zealand echinoderms* D.G. McKnight
- 76-9 *Natant shrimps of the New Zealand EEZ* W.del. Main
- 76-12T *Westland forest lakes* G.W. Payne
- 76-13T *Chemical characteristics of short sediment cores from lakes* A.B. Viner
- 77-9 *Fission-track dating of volcanic glass shards in Chatham Rise sediments* D.J. Cullen
- 77-11 *Sedimentation on the South Island continental margin* L. Carter
- 77-13T *Groundwater quality of the Upper Waikato River catchment* M.M. Gibbs
- 77-17T *Variations in C, N, P ratios in phytoplankton* S.E. Pickmere
- 77-18 *Shoreline development on fetch-limited shores* R.A. Pickrill
- 77-19T *Fractionating of soluble phosphorus compounds* E. White
- 77-20T *Sorption of phosphate by lake sediments* A.B. Viner
- 77-21T *Fractionation of sediment phosphate of lakes* A.B. Viner
- 77-22T *Drift fauna of the Mangawhero Stream* D.J. Forsyth
- 77-23T *Ecological consequences of proposed geothermal energy developments in natural fresh waters near sites of development (Lake Rotoiti)* M.M. Gibbs
- 78-3 *Coastal climate survey* M.J.N. Greig
- 78-4 *Tasman Sea hydrology* B.R. Stanton
- 78-11 *Phosphorite deposits of Chatham Rise* D.J. Cullen
- 78-15 *Sediments associated with Chatham Rise phosphorite* D.J. Cullen
- 78-15T *Particle sizes of river suspended load and nutrient phosphate* A.B. Viner
- 78-16 *Structural and sedimentological effects of oblique subduction at the Hikurangi Margin* K.B. Lewis
- 78-17T *Phytoplankton dynamics of Lakes Taupo and Waikaremoana* W.F. Vincent
- 78-19 *Wellington south coast substrates* K.B. Lewis
- 78-22 *Causes of productivity enhancement off East Cape* J.M. Bradford
- 78-22T *C, N, P metabolism of Anabaena* A.B. Viner
- 78-23 *Bathyal fauna of the New Zealand EEZ* E.W. Dawson
- 78-23T *Natural ^{15}N abundance in sediments* A.B. Viner
- 78-24 *Bathycrinids of Indian and Pacific Oceans* D.G. McKnight
- 78-25T *Mercury in aquatic systems* M.H. Timperley
- 79-6 *Chatham Rise glauconite* D.J. Cullen
- 79-17 *Sedimentation in lakes* J. Irwin, R.A. Pickrill
- 79-19.5 *Summer standing stocks and productivity of phytoplankton off Westland* J.M. Bradford
- 79-19.6 *Summer phytoplankton and microzooplankton populations off Westland 1982* F.H. Chang
- 79-19.7 *Distribution of zooplankton and their grazing pressure on phytoplankton* J.M. Bradford

- 79-19.9 *Cruise 1142 result assessment* F.H. Chang
- 79-19.10 *Chemical data from a West Coast cruise* M.T. Downes
- 79-22 *Echinoderm fauna of the Southwest Pacific* D.G. McKnight
- 79-24T *Role of stream-bank vegetation in the long-term removal of nutrients from stream water* C. Howard-Williams
- 79-25T *Growth of *Lagarosiphon major* in Lake Taupo* C. Howard-Williams
- 79-27T *Nutrient dynamics of Lake Rotongaio* A.B. Viner
- 79-29 *Rangaunu Harbour ecology* K.R. Grange
- 79-29T *Limnology of Antarctic lakes* W.F. Vincent
- 79-30T *Algal succession in Lake Okaro* W.F. Vincent
- 79-32T *Denitrification in sediments and lake waters* M.T. Downes
- 79-33T *Zooplankton of Lake Okaro* D.J. Forsyth
- 79-35T *Investigation of nitrification rates in sediments and lake waters* M.T. Downes
- 79-37.1 *Coastal bathymetry charts - northern New Zealand* J.V. Eade
- 79-37.2 *Coastal bathymetry charts - Tasman* J.S. Mitchell
- 80-5 *Southwest Pacific seamount phosphorites* D.J. Cullen
- 80-11 *Pennatulacea (sea-pens) of New Zealand* D.G. McKnight
- 80-13 *Free-living axinellid sponge from Chatham Rise - morphology and ichnology* D.J. Cullen
- 80-14 *Hawke Bay invertebrate communities* D.E. Hurley
- 80-17T *Factors influencing the distribution of aquatic macrophytes in Lake Waikaremoana* C. Howard-Williams
- 80-18 *Deep-flowing Western Boundary Current* L. Carter
- 80-22 *Bryozoa of western South Island* D.P. Gordon
- 80-24 *Southern fjords sedimentology* R.A. Pickrill
- 81-2 *Metalliferous sediments in the Lau Basin* G.P. Glasby
- 81-6 *Shallow rock-wall communities* K.R. Grange
- 81-9 *Catalogue and retrieval system for underwater photographs* R.J. Singleton
- 81-11 *Information required for environmental assessment in coastal inlets* R.A. Heath, K.R. Grange
- 81-12 *Continental shelf and slope currents (Cook Strait)* R.A. Heath
- 81-24 *Diver's data recorder* P.J. Hill
- 81-25T *Particulate matter in lake waters* M.H. Timperley
- 81-26T *Factors controlling algal production in lakes of the Central Volcanic Plateau* W.F. Vincent
- 81-30T *Chemical methods manual* M.T. Downes
- 81-32T *Nitrogen balance for an exotic forest catchment* S.E. Pickmere
- 81-33T *Optical properties of New Zealand lake waters* C. Howard-Williams
- 82-2 *Littoral and infralittoral ecology of New Zealand's southern islands* C.H. Hay
- 82-3 *Marine ecology of South Atlantic and southern Indian Ocean subantarctic islands* C.H. Hay
- 82-6 *North Fiji Basin - geology and geophysics* J.V. Eade
- 82-7 *Charting of coastal sediments* E.S. Arron, L. Carter, J.S. Mitchell
- 82-9T *Ecology and life history of the freshwater mussel *Hyridella menziesi* in Tapuaeharuru Bay, Lake Taupo* M.R. James
- 82-10 *Tsunami risk to the New Zealand coastline* A.E. Gilmour
- 82-10T *Nutrient limitation in Central Volcanic Plateau lakes* E. White
- 83-1 *Prymnesium from the 1983 Northland phytoplankton blooms* F.H. Chang
- 83-2 *Isolation of *Dinophysis fortii/acuminata* from Marlborough Sounds* F.H. Chang
- 83-5 *New Zealand nearshore and estuarine phosphorites* D.J. Cullen
- 83-8 *Use of fluorescence profiles and primary production in contrasting locations of physical disturbance* A.B. Viner
- 83-9 *Metalliferous sediments of the Fiji Plateau* G.P. Glasby

- 84-1 *Biology of the horse mussel (Atrina zelandica)* C.H. Hay
- 84-2 *Factors affecting blue-green algal dominance* W.F. Vincent
- 84-3 *Decomposition and nutrient regeneration in beds of aquatic macrophytes* C. Howard-Williams
- 84-4 *The effect of light quality (spectral composition) on growth of aquatic plants* C. Howard-Williams
- 84-5 *Evaluation of some short-term bioassays as indicators of nutrient limitation to plant growth* E. White
- 84-6 *Design of a long-term monitoring system to assess changes in the water quality of Lake Taupo* E. White
- 84-7 *Analytical methods for ammonia and ^{15}N* M.H. Timperley
- 84-8 *Nutrient availability and cycling in the water column associated with mussel farming in the Marlborough Sounds on a spatial, tidal, and seasonal basis* M.M. Gibbs
- 84-9 *Blue-green algal distribution in relation to thermal stability in lakes* A.B. Viner
- 84-11 *Recruitment and lipid storage in the subantarctic copepod Neocalanus tonsus* M.D. Ohman
- 84-13 *The effect of temperature on the development of neritic copepod eggs* J.M. Bradford
- 84-14 *Seismic survey of Lake McKerrow* R.A. Pickrill
- 84-15 *Manihiki Plateau manganese crusts* G.P. Glasby
- 84-16 *Major water-circulation patterns in Lake Taupo* R.A. Heath, E. White
- 84-17 *AVHRR processing* E.J. Barnes
- 84-18 *Evaluation of coastal zone colour scanner potential in archived chlorophyll data* E.J. Barnes
- 84-19 *Benthos of East Bay, Marlborough Sounds* C.H. Hay
- 84-20 *Identification of biological substrata in side-scan sonographs* E.S. Arron
- 84-21 *North Tonga subduction/transform plate boundary* K.B. Lewis
- 84-22 *Cook Strait temperature and salinity* B.R. Stanton
- 84-23 *Interactive effects of light, temperature, and trace metals on microalgae* F.H. Chang
- 84-24 *Western Cook Strait physical oceanography* A.E. Gilmour
- 84-25 *West Coast continental shelf flow variability* R.A. Heath
- 84-26 *Extreme-wave statistics for New Zealand* B.R. Stanton
- 84-28 *CONMAP North* J.V. Eade
- 84-29 *CONMAP Central* K.B. Lewis
- 84-30 *CONMAP South* L. Carter
- 85-1 *Food preferences of lake zooplankton* D.J. Forsyth
- 85-2 *Algal subsistence quotas and storage capacities for nitrogen and phosphorus* E. White
- 85-3 *Rotorua inflow to Lake Rotoiti* W.F. Vincent
- 85-4 *Seasonal changes in metabolic rates of zooplankton* M.R. James
- 85-5 *CTD commissioning* B.R. Stanton
- 85-6 *Runoff-driven coastal currents on the South Island West Coast* B.R. Stanton
- 85-7 *Resting cysts of toxic dinoflagellates* R.P. Baldwin
- 85-8 *Heavy-metal pollution in Waitemata and Manukau Harbours* G.P. Glasby
- 85-11 *Growth rates of black coral in Doubtful Sound* K.R. Grange
- 85-12 *Lakes Aviemore and Waitaki - bathymetric survey* J. Irwin
- 85-14 *Nutrient and vegetational changes in a retired stream* C. Howard-Williams
- 85-15 *Campbell sediments and bathymetry* J.S. Mitchell
- 85-16 *Distribution of offshore macrobenthos around New Zealand* D.G. McKnight
- 85-17 *Development of the copepod Neocalanus tonsus* J.M. Bradford
- 85-18 *Biological and chemical variability in relation to larval snapper distribution in the Hauraki Gulf* M.R. James
- 86-1 *Deep-sea Bryozoa of the New Zealand region* D.P. Gordon
- 86-2 *Interaction of fish larvae with planktonic prey, West Coast* R.C. Murdoch

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PUBLICATIONS BY OUTSIDE AUTHORS

These publications arise, in whole or in part, from work, material, or data collected by NZOI or Taupo or result from association with the Division.

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