Australian Quaternary Newsletter

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EDITORIAL

This is an important issue of the AQN. As editors we feel quite satisfied with the support and encouragement received over the last five years. The newsletter was conceived in an atmosphere of uncertainty, but has prospered along with the current boom in Quaternary studies throughout Australia. We are grateful to many organisations and individuals for their support in this venture.

Time has come to review the present situation. It would be simple for us to continue our current policy of compiling news items and research reports and producing two issues per year. Our production and circulation pattern is now well established and our financial position is sound. However, we would like to seek new horizons, and thus be in a position to offer a new service to Quaternarists throughout Australia (and perhaps New Zealand). Jim Bowler's proposals as published in this issue provide us with the opportunity of asking you if expansion of the scope of the AQN to include publication of short articles is appropriate at this stage. We have in fact already published some extensive research reports, with references, that were border-line cases; we have also rejected some short papers.

We see the need to provide a quick outlet for at least three types of articles, provision for which is not readily available to many Australian Quaternarists:

1. Records of new localities for Quaternary phenomena. ✓
2. Short descriptive accounts of Quaternary phenomena (e.g. geologic sections, palaeontological and archaeological sites, etc.). ✓
3. Discussion of negative results which would not be accepted by the established journals. ✓

In order to determine if a demand exists for short articles, and to determine if you as a Quaternarist would be interested in contributing papers up to five pages in length to the AQN, we are adding a further question to the questionnaire associated with Jim Bowler's proposals. We hope you will take the time to fill out this questionnaire and return it to us as soon as possible so we can gauge opinion and decide our future policy.

Jeannette Hope
Bruce Thom

AN AUSTRALASIAN QUATERNARY ASSOCIATION

TO BE OR NOT TO BE?

How many people are associated in one way or another with Quaternary research in Australia? Bearing in mind the growing numbers of universities and colleges with related course work, the increased activities of archaeologists, vertebrate stratigraphers, botanists and others, that number is quite substantial.

During the recent Birmingham INQUA Congress the Australians present raised this question amongst themselves. How well are we served by our present organisations? Do any of the existing professional institutions or meetings serve as an adequate focus for Quaternary workers to meet, report, and discuss matters of mutual interest? The general feeling was that there was no such adequate forum.

In response to this situation we agreed to raise this question amongst our colleagues, to sound out the wisdom and feasibility of trying to arrange meetings or field trips orientated specifically towards Quaternary interests. The first step was to air the problem through the columns of this Newsletter.

Let us examine briefly some aspects of such an enterprise and some points that emerged from the Birmingham discussions:

1. No one seemed anxious to form yet another professional association with all the paraphernalia that entails, such as constitutions, office bearers etc. On the other hand, to enable institutions to sponsor attendance and provide funds for the substantial travel that might be involved, some structure would be necessary.

2. Although useful models for associations of Quaternary workers exist in other countries, notably in the USA where the Friends of the Pleistocene and AMQUA (American Quaternary Association) operate in close contact with each other, nevertheless the distribution of workers in Australia at distal points, Perth, Hobart and Townsville etc., require that any plan should be orientated specifically to Australian conditions.

3. We should aim to include New Zealand workers in any such consideration. The Quaternary record of Australia and New Zealand has so much in common yet so much that is complementary. It costs no more to get from Christchurch to Sydney than to go from Sydney to Perth. Furthermore, preliminary discussions with the New Zealanders present assured us of initial interest in any such prospect.

4. The aim of such an exercise would have to be carefully defined. There should be sufficient informality to enable people to meet and present working papers on a wide range of topics. However, to ensure sufficient meat in the enterprise, discussions should have a core or central theme.

Meeting should be associated with a field trip related to this theme under conditions where we could combine work with salubrious informality. Thus, meetings with a coastal flavour might be arranged at Hayman Island; evolution of the arid zone at Arkaroola (northern Flinders Ranges); glacial chronology in the Snowy Mountains or the Tasmanian National Park; Man and environment at Mungo; vegetation history and environmental change at a site on the rainforest-dry sclerophyll contact. There is certainly no shortage of interesting themes and available venues. But is the need sufficient to warrant pursuing the matter? How broadly should we cast the net? Do we aim to include New Zealand now, later, or not at all?

In order to obtain some guidelines we would ask you to fill in the questionnaire attached at the back of this issue and return it to the editors. In the next issue of the Newsletter we will report on the response, try to summarise any consensus and perhaps formulate some recommendations.

BOOK NOTICE

Sunda and Sahul: Prehistoric Studies in Southeast Asia, Melanesia and Australia. Ed. J. Allen, J. Golson and R. Jones. Academic Press, £12.50/$24.50.

This book consists of a series of papers originally presented at the 13th Pan Pacific Science Conference in Vancouver in 1975. These focus on the prehistory of the world's largest archipelago, which extends from the Southeast Asian mainland to New Guinea and Australia. Among the papers of relevance to Quaternarists interested in this region are the following:

Rhys Jones: Sunda and Sahul: an introduction. Joseph H. Birdsell: The recalibration of a paradigm for the first peopling of Greater Australia. W.W. Howells: The sources of human variation in Melanesia and Australia. A.G. Thorne: Separation or reconciliation? Biological clues to the development of Australian society. Sandra Bowdler: The coastal colonisation of Australia. J. Chappell and B.G. Thom: Sea levels and coasts. Jared M. Diamond: Distributional strategies. Rhys Jones: Man as an element of a continental fauna: the case of the sundering of the Bassian bridge. David R. Harris: Subsistence strategies across Torres Strait Betty Meehan: Man does not live by calories alone: the role of shellfish in a coastal cuisine. D.E. Yen: Hoabinhian horticulture? The evidence and the questions from northwest Thailand. Jack Golson: No room at the top: agricultural intensification in the New Guinea highlands.

A REPORT ON INQUA

BIRMINGHAM, AUGUST 1977

Radiocarbon dates to 75,000 BP, glacial age sea surface hot spots east of Australia at 18,000 BP, analysis of a 200 m Quaternary core from Biwa, these and many more results were reported in the 510 papers delivered to delegates attending the Xth INQUA Congress at Birmingham, August 16-22.

The Congress, held on the university campus, provided something for everyone. Large international gatherings of this type may indeed be one man's meat or another's poison. Like any other, the Birmingham Congress offered a very mixed fare. However there were enough very good papers interspersed through a wide range in which more pedestrian or badly presented results occurred too frequently. With up to six sessions running concurrently, there was the usual hassle of trying, often in vain, to dash from one room to another to catch papers of interest.

Perhaps more importantly the accommodation arrangements in university halls of residence were very good. Large number of delegates shared common facilities with dining room and bar attached. This made excellent opportunities available for close contact and extensive discussion outside conference hours.

On the debit side there were many papers of a routine nature telling us more and more about less and less. Contributions from Europe and North America continue to concentrate on glacial environments, often covering old ground or sharpening a chronologic sequence perhaps of considerable local interest but of little value in the broader perspective. By comparison, papers dealing with low latitudes, with deserts and with tropical environments were under-represented.

We were left in no doubt of the real interest in the Australian region. This was particularly apparent in the genuine and widespread attention given to virtually all contributions by Australian delegates. Such contributions came from Bob Galloway, Edmund Gill, David Hopley, John Ogden, Ian McDougall, Jon Firman, Eric Colhoun, Gus van de Geer, Bernie Joyce and myself. The Australian delegation was represented at meetings of the International body by Professor E.S. Hills.

Let me summarise briefly some impressions and some highlights of trends or fashions, new and old.

1. The study of Quaternary sequences in many localities is now leading to a new understanding, not only of <u>what</u> changes took place but perhaps more importantly of the <u>rates</u> at which climatic variations occurred. Russell Coope's work on beetles and quantitative estimates of pollen influx rates demonstrate unexpectedly fast changes of temperature following the retreat of European ice sheets. Similarly with the availability of higher resolution O^{18} curves the record is much more 'spikey' than earlier evidence would indicate, with steep falls and rises reflecting rapid changes in ice volumes.

2. In terms of new chronologic techniques, radiocarbon enrichment discussed by Stuiver of Seattle offers the possibility of extending the dateable range beyond 70,000 years. However problems of large sample size, contamination, and long counting time involve a

situation of diminishing returns. Few C^{14} laboratories are likely to be attracted into the business. The fascinating possibilities of C^{14} analysis by mass spectrometry or in the cyclotron remain amongst the more promising although yet unevaluated techniques.

3. On short and long sequences: One of the fashionable and, indeed very worthy aspects to emerge, is a growing interest of continental workers in extending their sequences well back into the Pleistocene. Thus there is now a concentration on long cores, data from which may hopefully match the excellent records available from the oceans. Whilst this enterprise is important to us all, it led to some rather dubious evaluations which one sometimes felt were based more on length of the core than on the quality of data obtained from it.

The record is currently held by the Japanese Lake Biwa group with cores to 200 and 1000 m from that lake. Curiously, the preoccupation of many with long sequences is not matched by a corresponding concern to develop much more discriminating techniques for understanding short ones. To reconstruct Quaternary climates reliably we need to know not only whether conditions were wetter or drier, hotter or colder, but we should seek to provide climatologists with estimates of seasonal temperature and precipitation variations. Some indeed are attempting to do just this. Tom Brown from Rhode Island, influenced by the success of the CLIMAP/ group transfer function analysis is attempting to match the oceanic reconstructions using the pollen record from North America and the UK. In Africa, Dan Livingstone is attempting a much finer identification of grass pollen from equatorial lakes using SEM identification of cutical, phytoliths and other remains.

4. Tree ring analysis continues to open up new and, for the southern hemisphere at least, as yet largely unexplored capabilities for providing extremely sensitive records of Holocene climates. John Ogden and Val LaMarche's work in southern Australia and Tasmania provided excellent examples.

5. The expanded glacial chronology and environmental construction of Eric Colhoun and his colleagues from Hobart is helping provide a much needed picture of the cold climate chronology from Tasmania.

6. The prize for sheer interest and volume of new and fascinating data must go to the CLIMAP group. Jim Hayes and Lloyd Burckle told us of the 18,000 BP variations in Antarctic sea ice and the polar convergence; Andy McIntyre presented a new and final version of the 18,000 BP map of the oceans, just one week old, hot off the production line with the 60 odd collaborators 'still nursing their bruises'. Larry Gates modelled the map to produce a global temperature reconstruction. All of this was presented with that enthusiasm and flair that has characterised the CLIMAP enterprise (though it too has it critics, 'too many Chiefs and not enough Indians' as one North American palynologist complained). Fascinating though it is, it serves to return the point of interest to the continents. It is here on land that climate is measured and observed. The modellers and oceanographers, no matter how good their methods, now depend on more tightly and reliably reconstructed land-based sequences to complete the work of global reconstruction they have begun.

We in Australia are uniquely situated to provide data for a wide range of environments from tropics, deserts to Tasmanian glacial sequences, data that in a special way will be representative of the

southern hemisphere. Just in case any of us needed to be reminded, the INQUA Congress served to drive home that point.

On matters administrative, we must congratulate Jane Soons of Christchurch, newly elected President of INQUA. Jane defeated M. Nikiforova in a closely contested ballot. Jane will have the task of presiding over the next Congress in Moscow in 1982.

Three final comments. The place of Man in Quaternary sequences received little attention, probably a reflection of the lack of dialogue between archaeologists and Quaternary scientists in the United Kingdom. Secondly, there was no sign of delegates from the Peoples Republic of China. With the next INQUA to be held in Moscow, unless there is a dramatic thaw in Sino-Soviet relations, we can hardly expect to see an immediate response from the Chinese. Finally Australia's ties with the working commissions will be strengthened in the fields of aeolian sediments (through membership of the Loess Commission) and by close contacts with a newly formed Palaeoclimatology Commission.

The interest in research in the Australasian region and the enthusiasm with which such work is now being pursued both in Australia and New Zealand ensures an exciting decade for students of the Quaternary in this part of the southern hemisphere.

Jim Bowler
Biogeography & Geomorphology
ANU

AMERICAN QUATERNARY ASSOCIATION

The Fifth Bienniel gathering of AMQUA (American Quaternary Association) will be held at The Edmonton Plaza Hotel, Edmonton, Alberta, September 2-4, 1978. It will be preceded by a 2-day field trip in the Medicine Hat area and followed by a 2 ½-day field trip in the Rocky Mountains. The central theme for the meeting is 'The Ice-Free Corridor and Peopling the New World'.

The following topics will be covered in 8 sessions each with an invited chairman, speaker and discussants:

1. The geology of the Ice-Free Corridor.
2. Paleoecology of the Ice-Free Corridor.
3. Faunal exchanges between Siberia and North America.
4. Bison and man in North America.
5. Elephant and man in North America.
6. Perspectives on early man.
7. Clovis culture.
8. Holocene peopling of the new world.

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A SYMPOSIUM ON BIOLOGICAL PROBLEMS IN THE RECONSTRUCTION OF QUATERNARY TERRESTRIAL ENVIRONMENTS

Australian Academy of Sciences, Canberra, 21-22 February 1978

The Quaternary Period began about 1.8 million years ago and continues today. It has witnessed the total cultural evolution of man. The characteristics of its environments and the fluctuations of some aspects of them (e.g. climate, vegetation, sea level) are our best guides to the living conditions which we shall have to face in the future. Moreover, because its deposits are relatively accessible and its organisms and geographical situations comparable with some existing today, Quaternary studies throw valuable light on geologically more general phenomena.

The reconstruction of Quaternary environments relies heavily on fossils, the recovery and analysis of which, from pollen grains to human skulls, are now well-developed. During the past 20 years there has been a growing gap between the experimental scientists' knowledge of the processes which relate organisms to their environment and the application of this knowledge to the reconstruction of Quaternary environments. The techniques of Quaternary research produce ever more sophisticated data which are not being used as profitably as they might be.

The Symposium is intended to help bridge this gap. It will bring together leaders in several fields of Quaternary research and of the experimental sciences which should provide the basis for Quaternary environmental interpretations. It is hoped that it will lead to more sophisticated reconstruction of Quaternary events throughout the world and an improvement in our understanding of palaeoecology generally.

The Symposium has been organised by a committee chaired by Professor D. Walker under the auspices of the Academy's National Committee for Quaternary Research.

A volume of proceedings containing the contributed papers edited by the authors after the Symposium will be published by the Australian Academy of Science. The price for orders received and paid for before 22 February 1978 will be $A12.00.

All correspondence relating to the Symposium should be addressed to:

The Secretary
Australian Academy of Science
PO Box 783
Canberra City ACT 2601

Program:

Tuesday 21 February 1978: *The Problems*

Dr J. Chappell	Chronological methods and ranges and rates of Quaternary physical changes
Professor M.B. Davis	Interpretation of pollen analytical data
Professor W.A. Watts	Interpretation of organic stratigraphy and macroscopic plant remains
Dr R. Wells	Interpretation of mammalian remains

Dr T.L. Crisman	Interpretation of lacustrine animal remains
Dr A.G. Thorne	Special problems in the interpretation of human remains

Wednesday 22 February 1978: *The Responses*

Dr I.R. Franklin	Rates of microevolution and population genetics
Dr J.M.B. Smith	Dispersal and establishment of plants
Dr J.H. Calaby	Dispersal and establishment of animals
Professor A.R. Main	Ecophysiology of Australian mammals
Dr N.M. Wace	Human modification of the natural ranges of plant and animals
Mr H.A. Nix	Determinants of environmental tolerance limits in plants
Professor W.V. Macfarlane	Determinants of tolerance limits in animals, including human adaptability

ABSTRACTS

Three papers have appeared in recent years which provide considerable information on the Quaternary geology of particular regions. We feel that it may be useful to readers to reproduce the authors' abstracts.

Quaternary evolution, morphology, and sediment distribution, Westernport Bay, Victoria. M.A.H. Marsden and C.W. Mallett. *Proc. R. Soc. Vict.* 87:107-38. 1975.

The complexity of Westernport Bay springs from its overall morphology which is controlled mainly by bedrock distribution, the relative lack of freshwater and sediment input from the hinterland, the dominance of tide-driven sediment movement patterns, and long-term net landward transport and deposition of sediment with the concentration of the main tidal flats in the head of the Bay. Westernport is strictly an embayment, not an estuary, and differs markedly from neighbouring Port Phillip and many embayments elsewhere.

Three lines of evidence portray the physical and sedimentological variability of Westernport Bay, namely:

(a) its Quaternary evolution in which four phases are recognised, showing an interplay between tectonics, erosion, deposition and sea level changes, including evidence for higher Holocene sea level than at present;

(b) the morphology of the present Bay, with the recognition of rapid variation between morphological units within eight major morphological systems, shown at a scale of 1:50,000, and including: 1. Beaches, Rock platforms, 2. Salt Marsh Zone, 3. Mangrove Zone, 4. Inshore Marginal

Sandy Zone, 5. Intertidal Flats and Banks, 6. Offshore Banks and Shoals, 7. Embayment Plains, 8. Tidal Channel Systems;

(c) the distribution of bottom sediment types, shown at a scale of 1:125,000. An overall inward-fining sediment gradient is consistent with net landward re-working of relic sediment, with only minor contributions from the hinterland prior to artificial drainage.

Both morphology and sediment distribution indicate specific bedload transport paths for ebb-flow and flood-flow, particularly along the channels. Landward transport also of suspended sediment is thought to have been responsible for the accretion of the very extensive intertidal sedimentation zones which occupy about 35% of the area of the Bay.

New Late Cainozoic rock units and depositional environments, Lake Frome area, South Australia. R.A. Callen and R.H. Tedford. *Trans. R. Soc. S. Aust.* 100:125-68.

Five new rock units are defined for the Lake Frome area of South Australia.

The Namba Formation of Miocene age constitutes fine grained immature muddy sediments laid down in a low-energy fluviatile and lacustrine environment, possibly partly estuarine or lagoonal. Climate was subtropical or warm temperate with high rainfall, but seasonal aridity. Aphanitic oolitic lacustrine dolomite and palygorskite are included in this sequence. The Flinders Ranges had very low relief. The overlying and intertonguing Willawortina Formation represents alluvial fan deposits with minor lacustrine phases, recording the beginning of the late Cainozoic uplift of the Flinders Ranges, during which the Miocene lake was greatly reduced in area.

The Millyera Formation, constituting laminated ostracode bearing clay, fine sand, and charophyte limestone, records lacustrine deposition during the Pleistocene. This took place in an enlarged ancestral Lake Frome. The essentially fluviatile and aeolian deposits of the Eurinilla Formation and Coonarbine Formation were deposited during the Late Pleistocene and early Recent. Arid and pluvial climates alternate in the late Tertiary and Quaternary. Drainage trends and the predecessor of Lake Frome were established, closely approximating present day geography. During deposition of the Coonarbine Formation the seif dunes of the southern Strzelecki Desert formed.

Geomorphology and soils of the Stratford-Bairnsdale area, East Gippsland, Victoria. W.T. Ward. *CSIRO Soils and Land Use Series* 57. 1977.

The soils of the Stratford-Bairnsdale area are varied, although there are few differences in the kinds of sediment from which they are formed and differences in relief are small. In some of the soils there are features that formed when the ground water occupied higher levels than now, and other soils have relict horizons produced by weathering many thousands of years ago. A knowledge of the past history of the soils is needed to understand soil development and help with classification, and the results of field investigations with this purpose are described here. Soil genesis is shown to be closely related to landscape history.

Many of the present-day soils are developed on prior soils that are now partly eroded or partly buried. The prior soils were made relict

not by these events in most places, however, but by new conditions of weathering produced by a climatic change that is estimated to have occurred 300,000 to 400,000 years ago. This change was possibly associated with the growth in the northern hemisphere of continental ice sheets. Soils formed since then show a progressive sequence of weathering stages, according to age of soil formation. With passing time they have become more differentiated, especially with respect to texture. Topsoils have been leached of clay and of weatherable minerals, and colloidal weathering products have accumulated in the subsoils. This has occurred in all soils except those formed on modern flood-plains and young aeolian sands. On the lowlands near the coast formed in the last 4000 years soil development is slight and is complicated by recent changes of ground-water level.

Differences in age of land surface and differences in texture of the parent material account for the greater part of the differences shown by the soils.

Weathering has resulted in the development of texturally ?? differentiated (duplex) profiles, with clay subsoil textures beneath porous sandy topsoils. This change in the soil interferes with drainage and occurs at various depths. Its position is possibly related to ground-water flow-lines in the soil. Water moves laterally above subsoil clays for long distances, in wet seasons, before soil drainage can occur.

The 20 soil associations shown on the accompanying map are closely related to a series of 14 marine terraces and a less complete sequence of matching alluvial terraces bordering the major rivers. Soil ages are estimated by correlation with former shorelines. Sedimentation during periods of high sea level produced the greater part of the marine and alluvial plains of the Stratford-Bairnsdale area and at these times conditions would have been like those prevailing now. By contrast, the extensive and fertile East Sale plain and its equivalents elsewhere were formed in cold and arid glacial times.

S.A. TERTIARY QUATERNARY DISCUSSION GROUP

This group has been active during 1977; but unfortunately we received the year's program too late to include it in the last issue of the Newsletter. Talks have been given on a variety of topics, including the use of aquatic invertebrates and foraminifera as indicators of past climates, Tertiary palynology, and fossil frogs in Australia and New Guinea.

The next meeting will be:

Rod Wells Biological Sciences Flinders University	The fossils and sediment of Victoria Cave, Naracoorte and their relationship to climatic variations in Southern Australia.

8 pm, Nov.22nd, Room 029, School of Biological Sciences, Flinders University.

QUATERNARY SHORELINES REPORT

1976-77 Research on Quaternary Shorelines in Australia and New Zealand - a summary report of the ANZAAS Quaternary Shorelines Committee

Introduction

Although much detail has yet to be provided, the general outline of the maximum of the Holocene and last interglacial (Eem - Sangamon) transgressions is known around much of the Australasian continent. Greatest gaps in our knowledge occur in the patterns of sea level change during low stands of the Upper Pleistocene, and during the Lower and Middle Pleistocene generally. It is encouraging therefore to be able to report that coring on the mainland and reefs and islands of the continental shelves, and extensions of marine geology programs are now providing new insight into the area of late Pleistocene low stands. Similarly, on the coasts of southern and western Australia especially where older shoreline features are stabilised as cemented calcarenites, there is an increasing amount of research on the older sea levels of the Quaternary (see for example Cook *et al.* 1977, *BMR Journal of Australian Geology and Geophysics* 2, 81-8). New Guinea, New Zealand and Australia may continue to provide data on Quaternary sea levels of world wide significance.

David Hopley
Honorary Secretary

NEW SOUTH WALES

Ongoing research

Two research projects examining aspects of Holocene sedimentation are being undertaken in the Illawarra Region by members of the Geology and Geography departments of the University of Wollongong. The first, at Bulli Beach, is substantially complete and the results are being prepared for publication. Fieldwork has recently started on the second project, at Killalea Lagoon, on the southern shore of Bass Point.

A good sequence of Holocene sediments on Bulli Beach is periodically exposed after storms. Outcrops have been measured and sampled, and a drilling program across the area has been completed. The results indicate that an initial period of sand deposition adjacent to outcrops of Permian Illawarra Coal Measure strata was followed by an extensive period of soil formation. The soil is very clay-rich and the upper horizons are oxidised and contain abundant iron nodules. The topography at this period consisted of a shallow valley cutting E-W across the present beach. The valley later became filled with estuarine sediments from which C^{14} dates have been obtained. Finally, the estuarine sediments were overlain by beach rock and small sand hills which form the present back-beach area.

B.G. Jones
R.W. Young
I.G. Eliot

Killalea Lagoon is a site where the stratigraphic record is likely to offer insight into the chronology of nearshore deposition along the Illawarra Coast. The lagoon embayment is exposed only to winds and waves from the southeast sector; the dominant wind and wave direction for South Coast, NSW. Cursory inspection of the site suggests that it may be possible to determine a chronology of major storm phases occurring at this site during the Holocene. The lagoon is a small, brackish water swamp contained in a steep-sided depression. It is impounded by a sandy barrier that is periodically breached when fresh flood water discharges seaward, or when high seas overtop low lying sections. Both breaching events have catastrophic effects on sedge communities within the lagoon. Sea water incursions, in particular, cause extensive die-back of the fresh-brackish water flora and its replacement by more salt-tolerant species. At intervening, more arid times, the barrier dunes are mobilised and transgress into the swampland. Layers of wind blown sand interdigitate with the muddy lagoon deposits, including the organic material deposited in vegetation die-back phases, on the inner margin of the barrier.

A preliminary survey is to assess the potential of the site for more detailed investigation. The first phase of the survey, a percussion seismic survey, to determine the depth of the bedrock embayment containing the lagoon and barrier, is substantially complete. The second phase, drilling of the barrier deposits, will commence in the near future.

B.G. Jones
R.A. Facer
I.G. Eliot

Quaternary shorelines research by Dr Peter Roy of the NSW Geological Survey has focused on two areas over the past year. In Newcastle Bight, studies have been made of the stratigraphy and sedimentary environments of Fullarton Cove, a large lagoon bordering the Hunter River and trapped between the Inner and Outer Barriers. Dr Roy has also substantially added to the knowledge of sedimentary environments in the offshore zone. The view that a longshore decrease in sand grain size observed on the present beach and dunes away from the Hunter River mouth is related to relic patterns of sediment on the inner shelf, and not to contemporary river sediment supply is supported by this study. The second area of research is in the Kurnell area near Sydney. Here Dr Roy is developing a complex model to explain estuarine, littoral and aeolian sediment patterns bordering Bate Bay and Botany Bay. Roy and Crawford (1977, *Proceedings Third Australian Coastal and Ocean Engineering Conference*, Melbourne, p.177-84) convincingly demonstrate that central and northern NSW rivers are not significant contributors to sediment budgets of coastal compartments.

At the Coastal Studies Unit, Geography Department, Sydney University, morpho-stratigraphic studies of the Shoalhaven delta are being continued by Ian Wearne under the supervision of Don Wright and Bruce Thom. A deep core from the estuarine portion of the delta has been sampled in detail for various chemical, mineralogic and sedimentalogic analyses. Abundant organic detritus and *in situ* shell, especially *Notospisula*, are available for C^{14} dating.

NSW beach-ridge plains are still being subjected to detailed geomorphic and pedalogic research. The problem is whether continuous accretion has taken place at a declining rate, or whether accretion has been episodic. A report in preparation by Thom, Polach and Bowman fails to resolve this problem. An ARGC grant has been awarded to the Sydney University Radiocarbon Laboratory to continue this study with Thom. Closely spaced sampling and dating of the upper shell horizon across extensive beach-ridge plains will be undertaken in the next 12 months at various localities in eastern Australia. Greg Bowman is continuing his investigation of podsol pedogenesis in relation to sand barrier development in eastern Australia. He is using C^{14} to determine the ages of soil profiles and is monitoring podzolisation by means of chemical, minerological and SEM - microprobe techniques.

B.G. Thom

NEW ZEALAND

Coastal sedimentation

Detailed descriptions are given by Dingwall (7) in his description of Bay-head Sand Beaches of Banks Peninsula. He concludes that 'the fine sand beaches are rather stable, but medium sand beaches are dynamic'; and that 'the magnitude of change...is greater than would be expected on beaches located deep within a land mass and...results from the unusual nature of the coastal sea floor, whose planar surfaces cause a concentration of wave energy in the bay head'. He also concludes that there is 'an influx of longshore-drifted sand from the continental shelf' but 'elucidation of the relative importance of loess and alluvial shelf sediments as sources of beach sand is a matter awaiting further research'.

Schofield (24, 27) argues that so-called drowned beaches and sand spits off the east coast of Otago are in reality being formed under present hydraulic conditions i.e. 'the continental shelf should not be thought of as a little-modified, drowned landscape, but as a seascape in equilibrium, or approaching equilibrium, with present sea level'. Dissenting views are expressed by Andrews (1) and Cullen (6). An instrument package to monitor sediment-water interaction on the continental shelf is described by Carter *et al.* (5).

Shallow sea-floor, and Holocene sub-surface sea-floor sediments are described by Lewis and Carter (18) in the descriptions of Evans and Lyall Bays, Wellington.

Pain (21) describes a number of Late Quaternary period of dune formation but is at a loss to find a cause for the Paparoa dunes, declaring that 'increasing sediment supply because of falling sea level cannot be used to explain' their initiation. He neglects that very real possibility of Late Holocene sea level fluctuations and it could well be that both his Pararoa and Nukumiti Sands Members could have been initiated by periods of regression (23).

General descriptions

Coastal Quaternary sequences are briefly described in a number of publications (8, 17, 20, 21, 29). There are also a number of publications describing nearshore currents (2, 4, 9-16, 19, 28).

Late Holocene sea levels

Six, late Holocene, second-order, transgressions, with an average periodicity of 660 radiocarbon years, have been recognised in the Gilbert and Ellice Islands (25). They correlate in time with second-order transgression, recognised in northern New Zealand, but differ in magnitude. The highest reached a level between +2.1 to +2.4 m, 2760 years BP and represents the local maximum for the first-order Flandrian Transgression and differs from the Flandrian maximum of +2.1 m, for northern New Zealand, 4015 years BP. This delay of 1250 radiocarbon years in the timing of the Flandrian maximum is in line with predictions previously made that delays in oceanic mixing of low-saline, melt water with higher-saline, sea water would cause such equatorial delays (22).

Atolls

Bullivant *et al.* (3) include a brief coastal description of Manihiki Atoll. Reef zonation is attributed (27) to Late Holocene sea level fluctuations, whereas the formation of reef islets is almost certainly due to a net fall in sea level during the last 3000± years, the bulk of the islet material being obtained from the lagoonal shallows as a result of this fall (27).

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J.C. Schofield

QUEENSLAND

Work in Queensland continues to be concentrated in three areas of the state, the southeast, the Gulf of Carpentaria and the Great Barrier Reef, although the numbers engaged in research are increasing. Further, the scope of this research is being widened beyond the study of the last interglacial and latter part of the Holocene transgression.

In the Gulf of Carpentaria the Bureau of Mineral Resources has largely completed its field program and results are now being published (20). Auger drilling and levelling of beach ridge complexes by J. Smart in western Cape York Peninsula with C^{14} dating show that an older group, of late Pleistocene age and a younger group of Holocene age are present. The Pleistocene ridges probably originated as barrier-island complexes, as did the first set of Holocene ridges. The remaining Holocene ridges formed as cheniers. An age of about 120,000 years seems probable for the Pleistocene ridges, and the Holocene ridges range from over 6000 years BP to the present day. Holocene coastal sediments between Burketown and Karumba in the southern Gulf were investigated in the field between 1975 and 1976 by Mr E.G. Rhodes (Department of Biogeography and Geomorphology, Research School of Pacific Studies, The Australian National University). A stratigraphy has been established by the drilling of more than 45 auger holes through the Quaternary sequence. C^{14} dating of relict landforms (cheniers and multiple beach ridges) has confirmed a periodicity of coastal progradation during the Holocene. Extensive sampling of off-shore and onshore modern environments is providing correlation with drill hole data.

Offshore work dominates the research reported from southern Queensland by the Department of Geology, University of Queensland. Mr A. Stephens reports that he is mapping ancient stranded and submarine tidal delta deposits and submarine erosional features in the Moreton Island to Caloundra area as part of his PhD project on sediment dynamics in coastal inlets. Mr N. McIntyre is studying sedimentary processes in the southern part of the Great Sandy Strait and Fraser Island as a MSc project and Mr M. Friederick has submitted a MSc thesis on the marine geology of an area near Peel Island, Moreton Bay. Similar work is being continued on the inner shelf near Townsville by Mr A. Belperio (Department of Geology, James Cook University of North Queensland) who is continuing his work on sediment transport processes, transport dynamics and mass transport rates, including coastal accretion rates (1, 2).

On the mainland of southeast Queensland, and adjacent sand islands, Dr W.T. Ward (CSIRO Division of Soils, Brisbane) is indicating a long history of accumulation for the major dune sequences. With workers quoted above he has shown that nine dune sand and nine beach sand units can be distinguished. Bribie Island, for example, is formed largely of beach ridges developed in successive interglacial ages. The sea has occupied six distinct levels in the course of its formation, all of which are within ± 1 m of present level (21, 22, 23, 24).

Further extensions of the research carried out on the 1973 Royal Society-Universities of Queensland Expedition to the Great Barrier Reef (the reports of which are to be published later in 1977 in the Philosophical Transactions of the Royal Society, London) are reported from both the southern and northern Great Barrier Reef. Dr G.R. Orme and Mr P.G. Flood (Department of Geology, University of Queensland) and colleagues are continuing their study of the sedimentology of the Capricorn-Bunker Group and of materials collected in the 1973 Expedition (8, 9, 10, 11, 12, 13, 17, 18, 19). Dr P. Davies (Bureau of Mineral Resources, Canberra) and co-workers have been investigating the nature and influences of the antecedent karst surface beneath the modern reefs of the Capricorn-Bunker Group. They have also been examining modern morphology and present-day carbonate production as an aid to interpreting evolution (3, 4, 5, 6, 7).

A similar program is being continued on the northern Great Barrier Reef by Mr N. Harvey (Department of Geography, James Cook University of North Queensland). Seismic results have indicated the Pleistocene-Holocene disconformity at depths between 9 and 20 m on the reefs between Cairns and Lizard Island (14). A related program of Associate Professor D. Hopley has investigated the variation of sea levels over the continental shelf of North Queensland by C^{14} dating of shallow cores from the reefs. Dating of the outermost ribbon reefs near Lizard Island show present sea level obtained by 5800 years BP, not much different from the 6300 years age for inner shelf reefs. This is possibly less than expected from the hydro-isostatic predictions of Bloom, Walcott and Chappell, though the outer reefs show no signs of the c. 1 m emergence of mid-Holocene age shown by the inner reefs (15). The programs of both Harvey and Hopley are being extended to the contrasting wider shelf of the south central Great Barrier Reef out to the Pompey complex in 1977. Hopley and Isdale (16) have indicated some dangers of misinterpretation of sea levels from coral micro-atolls and corrected published information on an erroneously interpreted raised reef on Holbourne Island near Bowen.

Also in North Queensland, Dr J. Bunt (Australian Institute of Marine Science) is planning an extensive drilling program of the mangrove swamps on the northern end of Hinchinbrook Island during the next 12 months.

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D. Hopley

VICTORIA

Part 1: published work

Douglas and Ferguson (1976) edited the *Geology of Victoria* in which there are numerous references to Quaternary sea levels. Much of the information is by way of review, but there is also new information. P.R. Kenley (pp 290-8) covers southwestern Victoria, describing the formations of the Portland district, and discussing late Quaternary higher sea levels of 0.8 - 1.8, 4.6 - 6.1, 12 - 15 and 27 - 30 m. The best recorded is the Last Interglacial which at Port Fairy is dated 125,000 yr, and its maximum height can be measured as 7 m above MSL. E.D. Gill (pp 299-304) updates his account of the Warrnambool-Port Fairy district, where self-cementing calcarenite records a standard sequence of sea levels at 1-2 (Holocene), 4, 7, c.12, 21 (Last Interglacial), 36 (Penultimate Interglacial) and 50+ m (Antepenultimate Interglacial). The level of the sea that deposited an earlier cycle still is not yet known. The 1.9 m.y. Yangery Basalt behind the sequence shows it to be within the Quaternary. Calcarenite sand blocked the mouth of the River Hopkins so that during the Last Glacial it debouched at Sandy Bay about 20 km from Allansford (at the edge of the basalt plain) where the two courses diverge.

In the *Geology of Victoria* also, J.J. Jenkin (pp 305-9) gives a general account of the coastal areas of Port Phillip Bay, while J.L. Neilson (pp 309-15) described the Yarra Delta at the head of the bay. Interleaved within Quaternary formations is a basalt 0.81 m.y. old. Jenkin (pp 315-25) also covers the Gippsland coast, recording sea levels up to 3.3 m in the Holocene, and in the Pleistocene levels of 2-3, 6-7.6, 12-13.5, 27-30 and 33-36 m. Lower sea levels to -110 m are recorded. New information is provided by R.L. McLennan (pp 325-7) on the Snowy River Delta, proving downcutting during low sea levels, and some evidence of higher sea levels. 'Lake Curlip has a bench shoreline 2.4-3.7 m high on its east side'.

A physiographic atlas of the coast of Victoria has been published (Edgell and Robinson, 1975). Gill has published papers on the quantitative approach to the study of sediments (1976a), large waves at Lorne (1977b), channels in shore platforms (1976c), the migration of *Anadard* to SE Australia (1977a), and a landslip on the coastal slope at Lorne (1977b).

Part 2: new research

(a) University of Melbourne A study of the evolution of cliffs and bluffs on the Victorian coast (Bird 1977) has indicated that some of the bluffs are degraded Pleistocene cliffs which escaped marine rejuvenation during the Holocene marine transgression, while others are Holocene cliffs that have become bluffs as a sequel to a fall in sea level.

I. Miles, of the Geography Department, has traced the outline of a Holocene freshwater swamp extending beneath the northeastern part of Western Port Bay. Radiocarbon dating has shown that this swamp was forming at 12,505 ± 300 years BP (GX-4156). It has subsequently been transgressed by the sea and overlain by marine sediment.

In Pioneer Bay, to the southeast, eroded freshwater swamp deposits are overlain by marine clay and salt marsh, the swamp deposits yielding a radiocarbon date of 7670 ± 235 years BP (GX-4598) and the immediately overlying clay deposits containing organic material dated at 1550 ± 130 years BP (GX-4599). Further work will document more closely the sequence of Holocene shoreline changes in this part of Westernport Bay.

(b) CSIRO Division of Applied Geomechanics

Lake Pertobe

In 1948 I dug a pit on the west side of Pertobe Road 'one chain north of Price Road' to check the Holocene stratigraphy which was:

0.36 m calcarenite
0.23 m freshwater peat with shells
0.05 m clayey sand
0.51 m calcarenite with marine shell fragments merging into
0.18+m marine shell bed (stillwater facies).

The surface level was then given me as 9.98 ft above LWL but this is now known to be erroneous. Alongside in the Ocean Beach Caravan Park a sewerage trench was recently dug that revealed:

0.28 m fill of peat and calcarenite
0.26 m freshwater peat *in situ*
1.46+m marine shell bed.

The datum nearest the 1948 pit is +1.85 m Australian Height Datum (essentially MSL) and the ground surface at the sewerage trench +1.13 AHD. At 1.3-1.4 m from the surface there is a concentration of shells which grew in the ancestral Lady Bay probably behind a sand ridge. Species include *Mytilus planulatus*, *Homalina deltoidalis*, *Notospisula trigonella*, *Soletellina biradiata*, *Eumarcia fumigata*, *Venerupis crenata*, *Bembicium auratum*, *Parcanassa burchardi*, and *Zeacumantus australis* (det. Suzanne Stevenson, National Museum of Victoria). This band is to be dated by C^{14}. The springs tidal range at present in Lady Bay is 0.91 m; the neaps range is not known, but the range at Portland (where the springs range is the same) is about 0.4 m. The upper part of the shell bed is partly leached, lightly mottled, and cemented, so when the sea withdrew the bed was drained and subaerially weathered. The subsequent deposition of the peat was probably due to another rise in sea level that elevated the water table. The level reached was higher than now, but not high enough to reflood the area.

Re-measurement of Holocene maximum sea level

Beneath this area is the stable Warrnambool Platform on which even the Miocene marine strata are horizontal. As no earth movement can be measured, the tectonic factor can be neglected, especially for so short a period. On the Merri Canal nearby, this shell bed (Pertobe Coquina) was dated by a sample from the west bank account 0.5 m above MSL dated 6500 ± 200 yr (PIC 10). The University of Sydney radiocarbon

laboratory advises (Gillespie pers. comm.) that 450 ± 35 yr should be subtracted from Australian marine shell dates to allow for the age of the coastal waters. Such emerged beds are common along the 800 km of the coast of Victoria (Gill and Hopley 1971), and register the peak of the Flandrian Transgression in SE Australia at about 6000 yr.

When I began work on sea levels (e.g. Gill 1943:149) it was usual to talk about a '15 feet higher' sea level. As research progressed, this proved to be a telescoping of the Last Interglacial and Postglacial sea levels. When these were separated, it became acceptable to talk about a '10 feet postglacial level'. Based on the sewerage survey at Warrnambool, I supported this, but the recent re-survey in connection with fixing the Australian Height Datum showed that this grid was grossly in error with respect to sea level. In a previous paper I spoke of the difference in level between the tide in Warrnambool Harbour and that on the open coast; it is now clear that this difference is merely the error in the sewerage survey grid. For this reason the good exposure of the Pertobe Coquina at the Ocean Beach Caravan Park was surveyed to AHD. Although the top of the shell bed is now emerged, it was below low water when the sea deposited it. The height of sea level when the top of the shell bed was emplaced was 1.58 m (the amount of emergence above LW) plus:

i) the depth of water at low tide above the bed,

ii) the compaction due to draining on emergence (probably not very much),

iii) any reduction of the top of the bed by the sea as it retreated, and

iv) the lowering of the top of the bed due to subaerial weathering on exposure, and following the deposition of peat, the leaching by its acids.

The difference in sea level must therefore be of the order of 2 m, and possibly could be more.

At Warrnambool, calcarenite shore platforms are cut a little above MLW (Gill 1973). They are useful for checking sea level, but they do have a disadvantage. The cliff regression rate at Warrnambool averages 4 cm/yr (op.cit.), so as the width of a platform is something like 10 m, one such can be cut every 250 yr. As the sea retreats, it has time to trim its platform to each new level. Postglacial emerged shore platforms do occur in this area (Gill 1967), but their levels are minimal and not a measure of the peak of the Flandrian Transgression.

Just as at first the Last Interglacial and Postglacial levels were telescoped, so later the Holocene oscillations were telescoped. With increasingly refined study, these are being sorted out. In the Warrnambool District successively lower levels are recorded at approximately 6500, 4500, 2800 and 750 yr (uncorrected for sea water age). Similar oscillations (with others) are recorded now from many parts of the world.

Hopkins River Estuary

Work in connection with a water pipeline across the river showed that its bed consists of about one metre of recent sediment, below which is at least that thickness of shell bed. On the east bank a trench was cut to accommodate the pipe, and this revealed:

1.3 m Tuffaceous soil
1 m Stratifield Tower Hill Tuff (7300 yr)
0.2-0.5 m Terra rossa
6+ m Port Fairy Calcarenite (Last Interglacial marine transgression).

This same formation was revealed also at Dennington on the opposite side of Warrnambool where excavation at the Shell Petrol Depot in Lindsay Street showed it under tuff. However, a difference in facies is present, this deposit consisting of worn open ocean rocky shore shells (such as *Subninella* and *Haliotis*) and pebbles. So at that time, the shore must have been at the edge of the basalt plain just north of Dennington.

Edmund Gill

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WESTERN AUSTRALIA

Work on Quaternary shorelines and associated deposits in Western Australia is presently mainly being done by two groups of workers from the Geological Survey of WA and the University of WA.

Phillip E. Playford, W.J. Eric van de Graaff, Peter D. Denman, Anthony E. Cockbain, Roger M. Hocking and B.P. Butcher are working on Quaternary sediments for the Geological Survey of Western Australia.

Survey work to date has concentrated on the southern Perth Basin and the northern and central Carnarvon Basin. In the Cape Range area, Eric van de Graaff, Peter Denman and Roger Hocking established the presence of four distinctly warped Quaternary coastal terraces up to a maximum of 61.6 above sea level. The presence of well-exposed coralgal reefs, coarse-grained clastic beach deposits, and overlying finer grained dune deposits which can be related to sea level stands, permitted accurate measurement of the amount of warping on the four terraces. The significance of this warping is that it proves beyond doubt that significant Quaternary tectonism has occurred along this part of the Western Australian coast.

An important temporary exposure of what is probably a correlative of the Peppermint Grove Formation, existed in the Beenyup sewerage trench (now filled). A richly fossiliferous calcirudite overlying calcreted eolianite with solution pipes, grades up through cross-bedded, sub-littoral calcarenit, evenly laminated shore face deposits into eolianite with numerous root casts. George W. Kendrick from the Western Australian Museum is studying the mollusc faunas from both the Beenyup exposures and the Herschell Limestone.

The second group of workers consists of Brian W. Logan, Raymond G. Brown and their co-workers from the Department of Geology of the University of Western Australia. Their research has been concentrated in the Shark Bay, Lake MacLeod, and Exmouth Gulf areas, and an exhaustive listing of their projects and publications, and of the personnel involved, appeared in the Sedimentological Newsletter No.6 (1975) issued by the Australasian Sedimentologists Group of the Geological Society of Australia. Ongoing research is concentrated on Lake MacLeod, Exmouth Gulf, and the continental shelf in the Perth area.

Since the appearance of the Sedimentological Newsletter, Barry Bolton has started a PhD project on the development of the Lake MacLeod evaporite basin with special emphasis on the Late Quaternary history of this small basin. In 1977 Marina Lewis started a PhD project on the Bejaling beach ridges to the south of Lake MacLeod. The development of these ridges, which is related to growth of the Gascoyne delta, is thought to have played a major role in the development of Lake MacLeod as an evaporite basin.

Karl-Heinz Wyrwoll of the Geography Department of the University of Western Australia has been carrying out detailed mapping and section measuring in the Geraldton area, and the coastal plain west of Cape Rouge. He uses marine transgressive deposits as marker beds in establishing the stratigraphy of Late Quaternary alluvial and associated eolian deposits. In the Geraldton area a C^{14} date of 6025 ± 170 yrs BP has been obtained for the maximum of the Holocene transgression.

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W.J.E. Van de Graaff

SOUTH AUSTRALIA

Ongoing research

During the past year attention has been focused on stratigraphical horizons in ancient barriers, sediment transport, water circulation and variations in mean sea level.

Southeast

Mr D. Schwebel, School of Earth Sciences, The Flinders University of South Australia, is completing his study on Quaternary Shorelines, the main results of which are summarised here. Uranium series analyses of sub-surface aragonitic muds and molluscs from Lake Hawdon Flat have given age estimates of 100,000 ± 30,000 years and 125,000 ± 20,000 years respectively. These indicate that the last episode of deposition along the Woakwine Barrier was during the last interglacial at the '125,000' year + 6 m high stillstand. The pattern of sea level change and associated deposition of the composite Robe Barrier since 125,000 years is consistent with the proposed history of Pleistocene sea level change (i.e. deposition probably occurred at the '105,000' year and '80,000' year high sea levels. By correlating the stratigraphy with the O^{18} variation record from the deep sea, the history of Quaternary sea level change has been extended to approximately 350,000 years, with the major correlations being the Reedy Creek Barrier with Termination III and the West Avenue Barrier with Termination IV. Finally, the approximate 0.10 mm/yr uplift

Horace Lamb Institute of Oceanography

For the past six years Dr R. Radok has been investigating tides, water movement and meteorological phenomena at the mouth of the River Murray, in the Coorong, in the passages leading to Gulf St Vincent and across various sections of Upper Spencer Gulf. The most significant outcome of this work has been the effect of changes in sea level on shoreline equilibrium and the water exchange in the gulfs and bays. Variations in mean sea level are of the same order as the tidal ranges, and sometimes larger, so that an unfavourable combination of fluctuating sea levels and extreme wave conditions can cause severe coastal erosion.

Following this discovery, special attention has been given to the tidal data in the archives of the Institute, and a detailed paper on the subject of mean sea level changes is almost ready for publication. It is demonstrated in the paper that long period, non-astronomical waves, with amplitudes in the order of 50 cm, are superimposed on 5-8 day waves associated with weather systems passing over South Australia. A paper entitled *Air-Sea-River Interactions* published in *Earth Surface Processes*, Vol.1, pp 249-58, 1976, discusses the data collected at the mouth of the River Murray on behalf of the SA Department for the Environment during 1974. Measurements conducted last year, on behalf of the same Department, in Gulf St Vincent and adjacent passages were discussed at the *Third Australian Conference on Coastal and Ocean Engineering*, in Melbourne this year.

Spencer Gulf

Drs J.R. Hails and V.A. Gostin, Centre for Environmental Studies and Department of Geology, The University of Adelaide, are investigating the submarine geology of, and sediment distribution pattern within, Upper Spencer Gulf as part of an interdisciplinary project on sedimentological processes. So far, more than 100 undisturbed vibrocores have been obtained from the seafloor, following sub-bottom profiling in 1976. The project is supported by an ARGC grant and the vibrocoring has been undertaken in collaboration with the BMR/Baas-Becking Group in Canberra. An attempt is being made to relate sediment movement to tidal currents and nearshore wave conditions, whilst the Quaternary history of the Gulf will be partly determined from the results of core analyses. It is anticipated, in the long-term, that an adequate baseline will be established so that future monitoring programs and other studies can also be planned on an interdisciplinary basis.

J.R. Hails

No reports were received at time of distribution from New Guinea, Tasmania and Northern Territory.