Thorne, having submitted his Ph.D. thesis to the University of Sydney on his Kow Swamp and Lake Mungo human material, spent the year tidying up odd ends and thinking further about the implications of the Australian hominid material to the broader question of the emergence of modern *sapiens* man. He visited new sites in western New South Wales, and continued working with A. Carstairs on a bibliography of Australian Aboriginal palaeopathology. The West Point Tasmanian cremated human material, originally excavated in 1965 by Jones, and analysed in 1967 by Thorne, was sent to its final resting place in the Tasmanian Museum and Art Gallery, having been photographed and catalogued by Markovic and Carstairs.

Rhys Jones
(with help from
departmental members)

ANU RADIOCARBON DATING LABORATORY

GENERAL PROJECTS

The laboratory is playing an important role in a number of research projects. Indeed, there is a continuing and increasing need for laboratory generated research involving improvements in dating techniques, analysis, interpretation and reporting of results; parameters fundamental to the validity of dating such as environmental contamination and selection of applicable dating standards. Equally important is participation on a cooperative basis in research generated by other departments and institutions, often involving field work.

Low-level Liquid Scintillation Counting Parameters
(H.A. Polach, G.E. Calf, I. Fraser, J.D. Gower)

Commercially available liquid scintillation counting equipment is capable of establishing natural C^{14} concentrations within the age range of ca. 1000 to 25,000 years before present (BP). We have shown that significant improvements are possible if modification to equipment are carried out involving operations at reduced high voltage associated with masking of the photo-multiplier tubes, and careful selection of other operating parameters such as gain and % efficiency settings.

Improved glass counting vial design (to reduce background) and sample carbon to benzene (the liquid scintillation counting medium) synthesis together with better purification procedures have in our case led to increased precision of C^{14} activity

measurements within the range of 100 to 42,000 BP. The use of "Teflon" (poly-tetra-fluroethylene) counting vials further reduces the background count significantly. When these vials are used with an optimised liquid scintillation spectrometer and most pure benzene is counted, the relative factor of merit equals the best gas-proportional C^{14} detection equipment and procedures. Potentially such application would extend our dating range from "contemporary" to ca. 50,000 years BP. The precision of age determinations becomes such that limitations are no longer imposed by detection and measurement of residual C^{14} activity of the sample, but by other parameters such as sample size, sample chemistry, post depositional contamination and collection techniques.

Computerisation of Data Handling and Age Reporting
(H.A. Polach, M.W. Ray, Anne Sandilands)

In 1967 we established our first data handling computer programmes. These were basically output data statistical analysis (CSIRO) and age calculations (ANU). Over the years improved and extended versions of these have been written. However, modification and updating of both Computer Centre facilities and an ever increasing demand for C^{14} age determinations necessitated a systems analysis. This showed that our first need (both for efficiency and economy) was to handle all our data analysis at the ANU Computer Centre. Our second immediate need was to establish a computerised primary data storage and retrieval system together with statistical date analysis, short term equipment performance analysis and a preliminary age calculation programme. Thirdly, there is need to establish data sorting programmes to enable monitoring of the long term equipment stability and reproducibility and based on these, to produce a final age report. Fourthly, "on-line" data handling should be evaluated.

The first two steps have now been completed. This well documented (but as yet unpublished) programme has already been requested by five radiocarbon dating laboratories throughout the world. To complete the third and fourth stages of programme development, a programmer has been appointed to work with us for six months next year.

Selection of Modern Reference Standards
(H.A. Polach)

Two problems have been recognised. One is to provide a readily available and reproducible radiocarbon dating standard for all dating laboratories. The other concerns divergencies of C^{14} activity from this reference standard of modern samples in different environments.

The study correlating the activity of the ANU Sucrose secondary C^{14} dating standard (introduced in 1972) to that of the NBS Oxalic Acid primary dating standard has almost been completed. International cooperation has been excellent and almost all the laboratories invited by us to participate in this cross checking programme have supplied preliminary or final results. These show that the proposed ANU Sucrose secondary

dating standard will have its desired effect in bringing all C^{14} concentrations (ages) reported relative to the primary standard into line. Indications are that the inter-laboratory variation of ±2%, associated with usage of NBS Oxalic, will be reduced to less than ±0.5%.

The problem of assigning absolute C^{14} ages to any sample, using the radiocarbon dating standard, stems from the now widely recognised variations of C^{14} concentrations in nature. C^{14} levels in many environments - notably the ocean - differ from local or global atmospheric means, necessitating the establishment of local standards for particular sites and sample types. Many of the projects in which we are involved require this fundamental referencing and we continue to provide this basic research.

The Greater Barrier Reef Geochronology and Geomorphology
(D. Hopley, R.F. McLean, H.A. Polach, T. Scoffin, D.R. Stoddart, B.G. Thom)

Three main dating programmes are related to the Royal Society Coral Reef Exploration project. Drill cores, surficial reef geology and selection of modern reference standards.

Drill Cores: The Pleistocene-Holocene boundary was recognised in the Bewick Island core. Five C^{14} age determinations have been completed and no further dating of this core is expected. Three further samples from the Stapleton Island core have yet to be dated.

Surficial reef geology: The reef islands comprise a complex set of geomorphological units, from which all surficial samples dated as Holocene in age. Our concern is to establish the chronology of rapid c hanges in island structure, their evolutionary pattern and relation to sea level changes. Results indicate that the sea reached approximately its present level by 6000 years BP.

Modern reference standards: Some seventeen samples of living coral and marine plants were collected to evaluate C^{14} concentration variations in this oceanic environment. When completed, this study will allow the proper relationship between the primary (and secondary) radiocarbon dating standards and reef material to be established.

Quaternary Sea Level Changes
(J. Chappell, P.J. Cook, M.J. Head, T. Langford-Smith, H.A. Polach, B.G. Thom, C. von der Borch)

Conflicting radiometric data (C^{14} and Th^{230}/U^{234}) from Quaternary shorelines have been difficult to reconcile. We have demonstrated that some of the errors are due to indiscriminate sample collection and other errors are due to post depositional changes (contamination) in the samples.

In corals and shells contamination by infill and by boring during early diagenesis is followed by progressive recrystallisation, with accompanying sample to environment chemical exchange. Cross-checking of C^{14} and Th^{230}/U^{234} of samples from excellent exposure indicates that C^{14} dating of corals becomes increasingly unreliable beyond 20,000 years BP, while within the Holocene Period C^{14} chronologies for corals appear more consistent than Th^{230}/U^{234}. Discrepancies between the methods for Recent corals warrant further investigations.

C^{14} dating of coastal feature by incorporated fossil wood, peat and other organic matter produces two other sources of error: misassociation of sample and event (largely a field problem) and post-depositional contamination of samples by organic matter of different origin and age (largely a laboratory problem). In addition to selected field consultations, we continue to chemically and physically fractionate samples where contamination is suspected. This enables us to evaluate the total site history.

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