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Marine and estuarine studies in South Africa: an historical perspective

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In summary, we in South Africa are fortunate to have access to some of the best data in the world on the biodiversity of the biotas of our rocky shores, coastal waters and estuaries. We also have large, well-curated collections of most of the taxa. Of course the reason that we have such a wealth of data is that we have been fortunate to have had dedicated biologists who recognised the value of detailed, quantitative and systematic information on our aquatic ecosystems.

INTRODUCTION

South Africa is exceptionally fortunate – perhaps more so than any country outside northern Europe – in having a long-standing tradition of studies in marine biology. The background information available to us about the marine and estuarine biotas of South Africa, and the ecosystems in which they live, is an invaluable resource for present-day biologists, particularly those investigating the extent of human-induced changes in threatened systems such as the Knysna Estuary. In this paper, I pay tribute to the biologists who had the enthusiasm and foresight to lay the foundations of marine and estuarine biology in South Africa. In preparing the paper I have relied heavily on the accounts of the history of marine biology in South Africa by Day (1977); on the books on the history of the South African Museum by Ray Summers (Summers, 1975) and of other scientific institutions by Brown (1977), Naude & Brown (1977), and on unpublished notes and numerous anecdotes related by my late husband, John Day.

THE EARLY DAYS

Situated as it is at the southern tip of Africa, on the sea route from Europe to the rich trading grounds in the east, South Africa was visited by traders and naturalists from Europe virtually from the moment that the sea route became known. The naturalists in particular were fascinated by the unknown and often bizarre plants and animals emanating from this and other far-flung regions of the Earth. For more than 300 years after the sea route was established, though, few naturalists travelled out here to collect material in person and, with the exception of the odd botanist, virtually none stayed for more than a year or two. Most merely inveigled crew members of passing ships to snatch a few oddities, which were examined with interest back in Europe and often displayed in museums. Gradually museums became centres not only for the display of curiosities but also for their identification and study. So it is that even today, museums are the primary employers of systematists. The South African Museum in Cape Town was the first museum established in South Africa, and still has the finest collection of marine organisms in the country, so it is worth mentioning something about the history of this august institution.

THE SOUTH AFRICAN MUSEUM

The fashion for displaying interesting and spectacular animals led Willem van der Stel to start a small zoological museum in

the Gardens in Cape Town at the beginning of the 18th century. This seems to have been no more than a display of curiosities, however, and lasted for a relatively short time. Nonetheless, interest in the local fauna had begun and the South African Museum – one of the first public museum to be established outside of Europe – was founded by Lord Charles Somerset in 1825. The unpaid post of “Superintendent” was filled by Andrew Smith, a medical doctor in the British Army. Smith took his duties seriously and built up a collection of local organisms for study and display. Some of this material he collected during expeditions as far afield as Zululand, Namaqualand and the Transvaal. He was probably the first naturalist to publish local descriptions of South African organisms. Although these days it may strike us as odd that he should use the local newspaper to publish descriptions of fish and crabs, it was not uncommon in those days to use newspapers as a medium for the publication of taxonomic descriptions.

Because he was not paid for his work at the Museum, Smith took his collections with him when he was transferred back to England. Nobody was appointed in his place and so the condition of the remaining material deteriorated. Apparently a few of the specimens were used for teaching (and we all know what students can do to preserved animals) but the rest disappeared.

In 1854 things began to look up. Edgar Layard was appointed to the Colonial Secretary's office and was expected to run the Museum as well as holding down his regular full-time job. Fortunately for the Secretary, Layard seems to have been unperturbed at having to do two jobs. The post was still unpaid and so Layard would go to the Museum early in the mornings before starting his regular job and return there in the evenings, sometimes working late into the night. Roland Trimen, an entomologist, took over from Layard in 1872. As well as running the Museum (the post was still unpaid), Trimen designed a new building to house the collections. The building was first occupied in 1895 and still stands as the focal point of the present South African Museum at the top of the Gardens in Cape Town. The first paid Director of the Museum, William Sclater, was appointed on the retirement of Trimen in 1896. Sclater's greatest contribution seems to have been the design of the cataloguing system, which is still largely in use today, albeit mostly in electronic format.

The directorship of the Museum must have been good for the health, the average period in office of Directors having been pretty close to 20 years. After Sclater came Péringuey, an entomologist (1906–1924), followed by Leonard Gill, a palaeontologist (1925–1942) and Keppel Barnard (1942–1956).

Keppel H. Barnard was a shy, retiring “naturalist polymath”, who studied botany, zoology and geology, and later also developed an interest in anthropology, (exploring numerous “strand-lopers” caves) and ethnology, as well as being fluent in German, competent at the law, and loving mountain climbing. In 1907, Barnard came from the Plymouth Marine Laboratory to work at the South African Museum. He mounted several expeditions by oxwagon to the Cunene River and Mozambique, as well as cataloguing most of the *Pieter Faure* collections and writing monographs on three entirely different taxa: the marine fish, the marine molluscs, and the decapods. In all, he produced more than 200 papers covering topics as varied as freshwater insects and primitive crustaceans, and both freshwater and marine amphipods and isopods. He was appointed Assistant Director of the South African Museum in 1920 and Director in 1942. According to John Day, when he retired Barnard was in the midst of a quarrel with someone at the museum – probably the Editor of the *Annals*, because the editor insisted that Barnard provide a reference list, and Barnard was used to citing his references merely as footnotes. The outcome was that Barnard removed all of his reprints and so on from the Museum and donated them to Day, who worked in the Zoology Department at the University of Cape Town. (In contrast, Dr Nellie Paterson, who taught in the same Zoology Department for many years, was upset when a junior applicant was appointed to a post that she thought should have been hers. She left the University in dudgeon, taking her books and papers with her and bequeathing them to the South African Museum, where she worked until the end of her biological career.)

Although the three Directors since Barnard have been palaeontologists, the Department of Marine Biology has continued to flourish and excellent work on the systematics and ecology of the South African marine and estuarine fauna is published regularly in the *Annals of the South African Museum*, as well as in the international literature. There is no doubt that the South African Museum continues to house the largest and most valuable collection of South African marine and estuarine organisms. It is worth noting that all the material collected by the marine and estuarine surveys of the Zoology Department at the University of Cape Town (see below) is now housed at the SA Museum.

COLLECTING MANIA: THE GREAT MARITIME EXPEDITIONS

The earliest naturalists were mostly collectors of curiosities, although a few made systematic collections of particular kinds of plants or animals. Thunberg, for instance, spent much of the period 1772–1775 in the Cape Colony collecting seaweeds for the University of Lund in Sweden. (This material would not be identified and described until almost 200 years later when, in the 1940s, they were examined by “Ferdie” Papenfuss of the University of Cape Town.) All in all, though, between the work of Andrew Smith in the 1820s and of Keppel Barnard in the 1920s, advances by local marine biologists were sporadic. Most of the senior staff of the Museum were more interested in terrestrial than in marine biology, while shore-based collectors, who ventured as far as Mozambique, usually collected for overseas institutions.

A remarkable phenomenon of 19th century Europe touched our shores on many occasions, though. The fashion grew for western governments to mount great expeditions to explore various aspects of the open seas and far-off lands and many called at Cape Town. The ships bore romantic and evocative names such as the USS *Blake* and the Swedish *Eugenies*. The British *Challenger* (which called in 1857 but did not collect

specimens in the Cape because it was their habit not to collect from areas that were already well known biologically – Linklater, 1972), and the German *Valdivia*, concentrated on investigating the deep seas, while *Discovery II* (British) and *Sudpolar* (German) collected in the Antarctic. More specific tasks were set for the British *William Scoresby*, whose crew was charged with examining the biology of whales in the Southern Ocean, and the German *Meteor*, whose task was to investigate the feasibility of extracting gold from the water of the open oceans. (Although they found traces of gold in the water, they could find no way of extracting it in economic quantities – a situation that still pertains.)

THE FISHERIES CONNECTION

It was clear by the end of the nineteenth century that the seas around the Cape supported exploitable quantities of fish. So it was that in 1895 John D. Gilchrist, a young man from England, was appointed as Government Fisheries Biologist. In 1897 the Cape Government imported from Scotland a small ship, the SS *Pieter Faure*, to allow Gilchrist to explore the fish stocks around the coast of the Cape Colony, especially on the Agulhas Bank. Gilchrist dutifully found hake (stockfish) and soling grounds. Luckily for marine biology in this country, though, he was really a naturalist at heart, and did not allow the incidental material collected on these trips to go to waste. He collected numerous samples of the invertebrates inhabiting the coastal waters around the Cape coast from about Port Elizabeth to the mouth of the Berg River, and ensured that they were all sent away to expert systematists for identification and, where necessary, for taxonomic description. Oddly, the Department of Agriculture seems to have fought with the South African Museum for ownership of the non-fishy material collected by the *Pieter Faure*. Fortunately the Museum seems to have won, for it is unlikely that a thoroughly terrestrial organisation such as the Department of Agriculture would have been the safest home for marine specimens.

Because of his interest in marine organisms in general, Gilchrist was made an honorary Curator of the South African Museum by Sclater. The Government of the Cape Colony also built an aquarium at St James, on the False Bay coast, to allow Gilchrist to study living marine organisms, especially fish. Much later, in 1924, the now-elderly SS *Pieter Faure* was replaced by SS *Pickle*, forerunner of the *Africana* and *Africana II*. The result of these collaborations was a series of papers collectively entitled “Marine Investigations in South Africa” (see Stephenson (1947) for a complete list of the 50-odd papers published under this title in various journals). These papers included the description and naming of many common local species by overseas experts. A further 220 or so publications were issued under the general title of the “South African Fisheries and Marine Biological Survey”.

THE UNIVERSITY OF CAPE TOWN

The history of marine biology in South Africa in the early 20th century is intimately bound up with the history of the University of Cape Town (UCT). UCT began in 1828 as the South African College, instituted to provide academic support for young South African men about to go overseas to university. (Of course at that stage there were no universities in this country.) The first biology to be taught at the College was botany which, from the 1850s, was taught by the Government Botanist until the post was disestablished in 1866. The teaching of any form of biology seems to have lapsed for many years until the South African College established separate Departments of

Botany and Zoology in 1903. Gilchrist was appointed "Supervisor of Marine Studies" in the new Department of Zoology and in 1907 was offered the Chair of Zoology, at which time he was required to relinquish his formal connection with the South African Museum. By Act of Parliament in 1916 the South African College became the University of Cape Town, and Gilchrist held the Chair of Zoology until his death in 1926.

When Gilchrist died, the Chair was taken over by Lancelot Hogben, a controversial physiologist from Canada. Numerous stories, mostly defamatory, were told about Hogben, who seems to have been thoroughly disliked by most of the people associated with the Zoology Department. There must have been at least some substance to the stories, for he is said to have thrown away all of Gilchrist's specimens that had not been moved to the South African Museum! The post of Government Marine Biologist, which had been held by Gilchrist until he died, was taken over by Cecil von Bonde, who filled the newly created post of Director of Sea Fisheries.

ROCKY SHORES

The next era opened when T. Allan Stephenson was appointed to the Chair of Zoology at UCT in 1931. He was an English marine biologist who had spent some years in Australia working on the Great Barrier Reef expedition, where he had conceived a great interest in the structure and distribution of intertidal communities, particularly on rocky shores. Even in those early days he was able to attract research funds from overseas, receiving grants from the Carnegie Foundation for collecting trips around the coast to Port Elizabeth, East London, Durban and Port Nolloth. He later organised a survey of the entire coast of southern Africa, a distance of some 4000 km from Lüderitz to northern Natal, choosing sites about 80 km apart. On this remarkable survey of nearly 50 sites, carried out over several years, Stephenson and his co-workers collected superb data in the form of enumerated samples taken from each level on the shore. Material was returned to the laboratory in Cape Town for confirmatory identification and unnamed specimens were sent off to specialists for description and naming.

Stephenson's assistants included Joyce Eyre, Marjorie Scott (née Bright), Naomi Millard (née Bokenham), Gerry Broekhuysen, C.A. du Toit (later Professor of Zoology at the University of Stellenbosch), Ferdie Papenfuss (who worked on the algae) and, later (about 1938–1940), John Day. Much of the collecting was done by Stephenson and his wife Anne, about whom John Day told the following story with some relish. Apparently Stephenson suffered from severe headaches. On one occasion Stephenson, Anne and John were on a field trip in the Knysna area when Stephenson was struck by a massive headache and had to return to Cape Town, leaving Anne and John – and a single tent. Knysna was as much a hotbed of gossip then as now, and the story went around of "that dreadful Dr Day" having it off with his professor's wife. That "dreadful Dr Day" later worked extensively on the Namaqualand coast (alone) and in Zululand.

The UCT intertidal survey continued from 1931 to 1940 and resulted in a number of papers on specific areas of the coastline, others on intertidal ecology (including Broekhuysen's groundbreaking 1940 paper on ecophysiology of intertidal organisms) and 35 on the systematics of the organisms collected during the survey. (Some of the more important are listed in the Bibliography section of the present paper. A complete list can be found in Stephenson (1947).) Stephenson left UCT at the beginning of the war and took some of the material (and all of the results) to Aberystwyth, where he worked on it for some years, producing the last of the papers mentioned above. Stephenson died in

1961 but Anne finally synthesised the results into a book, *Life between tides on rocky shores*, which was published in 1972.

JOHN DAY AND ESTUARINE RESEARCH

After a childhood in the wilds of Mozambique, John Day completed his schooling at Selborne College in East London and then read chemistry and zoology at Rhodes University. He studied zoology because he had always been a fanatical fisherman and fascinated by the sea. But somehow to study zoology was self-indulgent and so he added chemistry to make him work hard, and probably to give him a better chance of finding a job (not much has changed in the last 70 years, at least as far as jobs are concerned). Having graduated from Rhodes, he went to the University of Liverpool to do his PhD, since this was the only place in the world at the time that offered postgraduate studies in oceanography. He spent the years 1931 to 1937 completing his PhD degree and then working as a lecturer in zoology at the University of Newcastle-Upon-Tyne in Northumberland.

In about 1937 Day returned to South Africa, where he took up a lectureship in zoology at UCT and worked with Stephenson on his rocky shore survey (see above). When war broke out in 1939, John Day was determined to join the Royal Navy. He managed to book a passage to England early in 1940 and, when he arrived, immediately went to the naval recruitment office to join up. To his intense disappointment, the navy was not recruiting at the time. So, he told me many years later, he went around the corner, where the RAF happened to have a recruiting office, and he joined up there. He spent the next five years in Bomber Command of the RAF, winning the DFC and bar, losing a leg in a bombing attack over Norway, being involved in the development of radar and finally running a Pathfinder force using the new navigation devices that he had helped to develop. He was amused at the idea that the RAF considered *any* holder of a PhD to be a "boffin" and thus capable of any kind of scientific endeavour – even physics – required by the Services.

Day returned to the University of Cape Town in 1945 and was appointed to the Chair of Zoology in 1946, the post he retained until he retired in 1974. Recognising the importance of Stephenson's work on rocky shores, Day wanted to expand the work offshore to the edge of the continental shelf. But then, as now, hiring ships was extremely expensive and trawlermen were not cooperative, so he decided that it would be cheaper and physically easier to work in estuaries. Although these were both perfectly genuine "scientific" reasons for deciding to work in estuaries, some interesting personal reasons were doubtless significant, too. Firstly, he had tried working on rocky shores with his "tin" leg and, although he managed remarkably well, he realised that he could not work as well, physically, as he done before (besides being unable to leap out of the way of freak waves). This was probably a major consideration in his preference for working offshore from the relative stability of a ship. The other personal reason for his decision to work in estuaries was that he met Nancy, his future wife, in Knysna. Here was a chance of working on a supremely interesting ecosystem and having a good excuse to spend time in Knysna.

John eventually got his wish to work offshore. From about 1948 he had reluctantly hired fishing trawlers but, in about 1957, Irving and Johnson offered UCT a small and antiquated trawler, the *Leeukop*. For technical reasons the ship had to be bought by the University, so it changed hands for the grand price of £1. Day and his students worked day and night over weekends to make the little ship seaworthy and were rewarded when she passed her sea trials in 1958 as the RV *John D. Gilchrist*. With her small crew she worked from Mossel Bay to Lüderitz, collect-

ing benthic samples that formed the beginning of a large and valuable collection of the benthos of the continental shelf. The *Gil* was old and soon became unsafe. She was replaced in the mid-1960s by UCT's new vessel, the RV *Thomas B. Davie*, which, together with the CSIR's vessel the RV *Meiring Naude*, completed the coastal survey of South Africa and did some preliminary surveying in Mozambique and Namibia.

During all of this time, Day's interest in estuaries burgeoned. He went on a number of excursions to seek out suitable and interesting systems to work on. In all, he and his staff, students, colleagues and family produced a series of about 13 papers on various South African estuaries between 1951 and 1985 (see reference list). By end of his career, he had developed a good idea of the numbers, densities and species of organisms in the different kinds of estuaries around the coast, and something about the physical and chemical features that determined their biological characteristics. It remained for his successors, such as Brian Allanson and his students, to begin to quantify aspects such as the dynamics and energy flow of our estuaries. Indeed, the mantle settled on Brian Allanson when John Day retired and he carried it with aplomb for another decade or more before he, too, retired. As anyone reading this volume will know, in his retirement Brian has become involved in the management of our aquatic ecosystems and this volume is the result of his efforts to quantify the changes that may have taken place in the Knysna Estuary over the last few decades. Definitive answers would not have been possible had it not been for the invaluable baseline data meticulously recorded by John Day and his colleagues several decades ago.

John Day dominated marine studies in South Africa from the 1950s to the 1970s. His last original work, written in the early 1970s (Day *et al.*, 1971), dealt with computerised numerical analyses of the benthic fauna of False Bay. He had learnt many things from Stephenson: careful attention to detail (such as an excellent system of cataloguing specimens); the value of knowing the distributions of animals both up the shore and along the coast; the value of numerical analyses; and the importance of the correct naming of species. He was immensely excited by the possibility of using computerised numerical methods to analyse ecological data that are impossibly too complex to analyse in any other way and he would have seen at a glance the usefulness of present-day multivariate techniques.

John Day was not interested only in ecological processes. He was one of the world's leading polychaete systematists for much of his life, producing a two-volume monograph (Day, 1967) and an identification guide to South Africa's intertidal and estuarine biotas (Day, 1969). Fittingly in regard to the present volume, his last book was a synthesis of estuarine work (Day, 1981). He considered Knysna to be the richest estuary in South Africa (with approximately 350 species of benthic invertebrates) because of its deep mouth and varied biotopes and would have been an enthusiastic participant in this Knysna Basin Project had he had an opportunity to do so.

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¹ Contains a list of most papers on SA marine biology up to that time.