THE SIR WILLIAM MACLEAY MEMORIAL LECTURE 1978

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The Sir William Macleay Memorial Lecture is an occasion on which to honour the memory and legacy of one of the most important pioneers of scientific endeavour in the State of New South Wales and in Australia generally. Prime architect and benefactor of the Linnean Society of New South Wales, Sir William Macleay was foremost a naturalist, at a time when that term was a respectable admission both for a gentleman and for a man of science.

Arriving in New South Wales from England in 1839 at the age of 19, he had already spent some time as a medical student, but opportunities and family associations were to divert him wholly from this course (Walkom, 1942). He became quickly involved in the management of property on the Murrumbidgee near Wagga, where he lived almost permanently for 15 years. It was from this formative period of direct and intimate contact with the flora and fauna of the Australian bush, that William Macleay developed a devotion and a commitment to the study of nature that was to dominate the rest of his life. He returned to residence in Sydney in 1857, and to comfortable circumstances which allowed him in 1862, at the age of 42, to make the decision to give his whole attention to Natural History. Out of this decision arose many investigations, expeditions and benefactions in the study of the biological sciences generally in Australia, all of which retain their importance even after the passage of nearly 120 years. Among them was the formation of the Linnean Society of New South Wales, in 1874. In initiating this move, in association with a number of other zoologists, botanists and geologists of the day, Macleay called for the formation of "A Society of Natural History". Ten years later, in a Presidential Address to the then well established Society (Fletcher, 1893), he included the following comment: "Our rules state that the Society is for the promotion of the study of Natural History in all its branches". In the course of time the objectives of the Society were redefined as the promotion of the study of Natural Science, but the practice of the Society has been to retain the spirit of Sir William's major intention, in fostering the development of research and scholarship in Zoology, Botany and Geology. During the twentieth century, with the increasing penetration of science into more and more esoteric concepts and technologies, these disciplines have broadened and become cross-linked, and the Society has now come to embrace the Biological Sciences and Earth Sciences as its domain — a move which Sir William would have thoroughly approved.

I feel, however, that because Sir William came to be a scientist and a promoter of scientific endeavour through his observation and appreciation of nature, and not through any formal early training, he might also have been concerned to see that the focal point of his view of Natural History, namely the continued comprehension of the faunal, floral and geological diversity of the earth, was not lost to sight in the search for ever more powerful theoretical abstractions.

For example, with his interest in bacteriology (commemorated, for instance, in the

Linnean Macleay Lectureship in Microbiology at the University of Sydney), Sir William would no doubt have been delighted with the discoveries of modern microbial genetics; but would also have seen, I think, that these do not assist our ability to conceptualize the diversity and biology of, say, the marsupials. To do this properly one needs, among other things, a vast array of comparative descriptive and experimental data — on the animals themselves, their habits, their reproduction, their interactions with other animals and with many species of plants, their distribution, their fossil history, and the relationship of this history with the geological history of the earth in the Mesozoic and Tertiary. The same argument applies to any other group of animals or to any group of plants, with varying degrees of difficulty depending on the group. This kind of science, which focuses on the systematization of diversity, was what people meant in the nineteenth century when they talked about Natural History. Its importance was obvious at that time, because of the need to try to systematize and manage the flood of information on diversity being gathered from all parts of the world. Gradually everything fell into place with the acceptance of the idea of Evolution, which provided a means of dealing with diversity in a unified way. But from this in turn has stemmed in the present century an array of astonishing achievements in experimental biology, which has brought us to the brink of control over the fundamental processes of life, and to the powerful theoretical constructs of molecular biology and population biology.

What possible significance, then, can Natural History continue to have today? Can it continue to contribute significantly to understanding, or is it a Dodo, a relic from the past that has now been knocked on the head and made extinct as a profitable, professional scientific discipline.

Modern dictionary definitions of Natural History are not encouraging. Natural History, says the Shorter Oxford Dictionary (1959 edition), is the systematic study of all natural objects, animal, vegetable and mineral — so far, so good — but, *now* restricted to the study of animal life, usually in a popular manner. Example, another incident in natural history is, "Toads eat larks".

Websters Dictionary (1926 edition) is even more interestingly denigrating. Natural History, it says, was formerly the study, description and classification of animals, plants, minerals and other natural objects, thus including the sciences of zoology, botany, mineralogy, etc. in so far as they existed at that time (the time is not specified, but the implication is that of Aristotle and Pliny), but *now* commonly restricted to a study of these subjects in a more or less superficial way, at least without making use of modern anatomical and analytical methods.

A DODO INDEED!

In fact, a more constructive definition of scientific Natural History can be developed by contemplating the thoughts and work of some of its founders as contributing scientists. I present two examples, both Englishmen, Gilbert White in the eighteenth century and Charles Darwin in the nineteenth century.

Gilbert White, although he wrote only one book in his entire life (White, 1788), is one of the most interesting characters in the history of Zoology. He was born in 1720. His father was a barrister and his mother was the daughter of the then vicar of Selborne, a small village in rural Hampshire in southern England. Gilbert himself, after pursuing a liberal education and taking an M.A. at Oxford in 1746 at the age of 26, entered the church. For some 15 years he moved among different parishes in England, to become eventually in 1761, at the age of 40, a curate in the village of his birth, Selborne. Here he remained until his death at 72. The Selborne Parish Register records that the Reverend Mr White officiated on June 10th, 1793, at the burial of one

of his parishioners, a 16-year-old girl. During this sad duty, White caught a cold, to which he succumbed before the end of the month.

In the 32 years of his settled curacy at Selborne, Gilbert White became, like many educated men of his time, an ardent naturalist. His uniqueness in this pursuit lies in the manner of his investigations and in the book that he wrote on his observations, "The Natural History of Selborne". White spent more time on Natural History than he did on the business of his parish. He identified and described many species hitherto unrecognized, thus contributing directly to the major academic activity of the zoology of the day, dominated by none other than Linnaeus himself. But he also, and this is the crucial point, observed, recorded and interpreted the daily lives and activities of these species. White's are among the first accurate and constructive observations on such matters as — the species specificity of bird songs and their use in distinguishing closely related species; the functional significance of animal colouration; the phenomenon of territoriality in birds; the phenomenon of bird migrations; the occurrence of pseudo-copulation of frogs; and the nocturnal activities of bats, large and small. Never formally trained in zoology, he set in motion an emphasis on field studies and the observation of living animals, of which James Fisher, in his introduction to the 1947 edition of *The Natural History of Selborne* (Fisher, 1947), had this to say: "The theory of organic evolution could never have been propounded, as it was, in the middle of the nineteenth century, without two centuries or more of serious classification, and fifty years or more of serious field observation. It was useless to know how animals were built without knowing the quality of their lives". Gilbert White investigated the quality of their lives. He wrote, for example, of the night-jar *Caprimulgus* feeding on chafers at an oak tree, that "I saw it distinctly, more than once, put out its short leg while on the wing, and, by a bend of the head, deliver somewhat into its mouth. If it takes any part of its prey with its foot, as I have now the greatest reason to suppose it does these chafers, I no longer wonder at the use of its middle toe, which is curiously furnished with a serrated claw". The approach is modern — field observation, cautious interpretation, emphasis on living function. In fact, the claw now appears to be more important in preening — but at least White based his remarks on an observation of nature and not on an imaginative interpretation of dead specimens. Not that he was loath to investigate a dead specimen in connection with his studies if necessary. Take, for example, these comments on a species of large bat. "This summer through I have seen but two of that large species —— ; I procured one of them and found it to be a male; and made no doubt, as they accompanied together, that the other was a female; but happening in an evening or two to procure the other likewise, I was somewhat disappointed when it appeared to be of the same sex — amply furnished with the parts of generation, much resembling those of a boar." Here is evidence of detailed anatomical as well as field observation.

White was, in fact, the epitome of the well rounded, eighteenth century clerical gentleman. He even adhered to the tradition of the day by writing poetry, though alas without the perceptiveness and discrimination that he applied to his observations of Nature:

> "Is this the scene that late with rapture rang,
> Where Delphy danced, and gentle Anna sang;
> With fairy step, where Harriet tripped so late,
> And on her stump reclined the musing Kitty sate?"

The curate's calling is more evident here, in a portion of an ode on a visit by three eligible sisters to his bachelor field haunts. It is perhaps no wonder that Gilbert remained a bachelor. Nevertheless, he understood the meaning and purpose of Natural History in a remarkable way.

The inspiration engendered by the observational techniques of the Reverend Gilbert White soon encouraged a deeper investigation of animals in the field rather than in museums. From about 1820, one begins to see a vast increase in interest in Natural History as recorded from field observations, in a period that was to last through much of the century and was to see the birth of the Theory of Evolution as a consequence. There is no doubt that the unparalleled contributions to Biology made by Charles Darwin had their origin, among other things, in the experiences he gained during his participation in the five years voyage of the Beagle. In the preface to his remarkable account of these experiences, the "Voyage of the Beagle", Darwin (1845) directs attention to the following matters:

1. That the volume contains a history of the voyage and a sketch of those observations in Natural History and Geology which possess some interest to the general reader.
2. That in a larger publication, the Zoology of the Voyage, he had appended to the description of each species (described systematically by various specialists of the day) an account of its habits and range.

It was this awareness of habits and range, that is, of observations on the lives of species in their natural habitat, and the relating of these observations to structure and adaptation, which gave all of Darwin's work its modern feel and which led him with great insight to the possibility of a system of generalization through which all such phenomena might be comprehended. He was supremely aware of the diversity, functional interrelatedness and temporal instability of living phenomena, and of the relationships between those endless minutiae of detail concerning animals and plants that can be expressed verbally and graphically, but cannot be reduced to mathematical or chemical formulations. And he could express this awareness with the most penetrating simplicity: "The slimy, disgusting Holothuriae, which the Chinese gourmands are so fond of, also feed largely on corals; and the bony apparatus within their bodies seems well adapted to this end. These Holothuriae, the fish, the numerous burrowing shells, and nereidous worms, which perforate every block of dead coral, must be very efficient agents in producing the fine white mud which lies at the bottom and on the shores of the lagoon" (*Voyage of the Beagle,* p. 463, Keeling Island). And again: "It was most striking to be surrounded by new birds, new reptiles, new shells, new insects, new plants, and yet by innumerable trifling details of structure, and even by the tones of voice and plumage of the birds, to have the temperate plains of Patagonia, or the hot dry deserts of Northern Chile, vividly brought before my eyes. Why, on these small points of land, which within a late geological period must be covered by the ocean, which are formed of basaltic lava, and therefore different in geological character from the American continent, and which are placed under a peculiar climate — why were their aboriginal inhabitants, associated, I may add, in different proportions in both kind and number from those on the continent, and therefore acting on each other in a different manner — why were they created on American types of organization?" (*Voyage of the Beagle*, p. 393, Galapagos Archipelago).

One can perhaps sum up and define Natural History as Darwin understood it in the following way. It is the investigation of:

the diversity of animal and plant life,
the relation of structure to habit and environment,
the perpetuation of diversity through reproduction
and the evolution of diversity through time *and* the distillation from these observations of generalizations which summate this diversity.

Using this definition, we can now address the question, whether Natural History has a role today. In my opinion it has, and for the following reasons:

Our knowledge of diversity has increased enormously in the twentieth century. Vast numbers of new species have been identified and named. The amount of information on the distribution, structure, functional organization, activities, reproduction and life cycles of known species has increased to a torrent. A similar plethora of information has been gathered on fossil species, especially of invertebrates, and new techniques have permitted fossil material to be interpreted in much more detail with respect to modes of life, interrelationships and temporal distribution and spatial distribution. All of this information needs to be incorporated into new generalizations which convey our present level of understanding, and not simply tacked on to generalizations which were propounded in the nineteenth century. Let me trace through an example with which I am familiar, progress in the understandings of barnacles. Darwin's two classic monographs (1851, 1854), systematized all there was to know about barnacles at that time and provided a comprehensive statement about the phylogeny, evolution and biology of this group. Subsequent studies have modified this statement in various directions, concerned with feeding, reproduction, embryonic development, larval development, population biology and fossil history. With the exception of the latter, however, these studies have been conducted in relation to various kinds of experimental conceptualizations in physiology, ecology and developmental biology. Only the palaeontologists have kept in mind that questions about barnacles can be most usefully framed in the context of a comprehensive overview of the group, and have tried to improve on Darwin's overview in the light of new information. This endeavour has now culminated in an extensive revision by Newman and Ross (1976) of the phylogeny and classification of the balanomorph barnacles, based on recent and fossil skeletal structure; but much of the other information gathered on structure, function and reproduction in barnacles during the last 120 years still lies outside this framework. It is easy to see what happens as a result. The natural history of barnacles continues to be expressed in outmoded terms, and erroneous conceptions of our basic knowledge of these animals continue to be incorporated into otherwise sophisticated physiological, developmental and ecological investigations.

Suppose, for example, that one wishes to investigate an ecological problem involving knowledge of the pattern and composition of food intake by a particular species of barnacle. Is the information available? Probably not. In order to obtain it, what does one have to use? The techniques of natural history. In order to apply these successfully, what does one have to know? How to describe and interpret one's observations in the general context of information about feeding mechanisms and their evolution in the Cirripedia. Where can this information be found? In Darwin (1854); and then in a random scatter of observations that have never been correlated one with another or used to modify, as they must, Darwin's initial interpretation.

We could do better. As was so eloquently argued by J. W. Evans (1965), we should do better. We should encourage the improvement of comparative, whole-organism descriptive and experimental biology (Natural History) all the time, by professional biologists for professional biologists, so that we can continue to come to terms with diversity as well as with causality. Both are aspects of the same truth.

In fact, I would be prepared to go one step further and plead the cause of professional scientific Natural History in its contribution to the larger human endeavour. The conflict between exploitation and conservation must be resolved if we are not all to sink into the mire of a murdered world. We, as biologists, have a prime responsibility in promoting the conservation of nature. Part of this responsibility can

be met by professional scientific work leading to suitable management techniques — but this work is often highly mathematical and always too high powered for the average person to grasp. Yet the community at large has to be persuaded, because it eventually has to foot the bill in limiting exploitation and accepting that conservation has advantages. Education in Natural History, which builds on a natural link between man and nature, which presents the familiar, shows it to be complex and worthy of respect, and puts this complexity in visual, verbal, graspable terms, can provide one of the few means of communication that can prevent the community from becoming disenchanted with science.

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