

# Neville Hewlett White 1906–1991: Prophet, philosopher and teacher of plant pathology

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## The enthusiastic individualist

Neville White was his own man. While having a great knowledge of and respect for the pioneers of science, he was not shackled to the past. He was imaginative and excited by new ideas. He never feared looking into other disciplines to find what might be useful, was liberal in his scientific views and versatile in his thinking. His many students believed him to be an outstanding teacher, largely because of his contagious enthusiasm for his subject and for the encouragement he gave to the exploration, debate and development of ideas. He loved the stimulus and challenge of new ideas and was clever at promoting their discussion. He readily led proposers of faulty ideas into analyses that showed up where they had gone wrong. It was not his nature to pour cold water on any idea, rather he fostered and nurtured the spark of discovery into a flame of self-confidence.

Neville developed completely new approaches to, and structures for, teaching plant pathology when others around the world were still following courses based on the taxonomic groupings of pathogens. He used hypotheses in ecology, physiology and pathosystems, epiphytology (not epiphytology!) etc. to great advantage in his teaching. He thrived from teaching and made a point of presenting exciting ideas from the world's most innovative biologists. He responded with enthusiasm to ideas and hypotheses advanced by his colleagues as well as his students and would ensure that they and he derived the utmost pleasure from any further exploration.

Within his profession he was an individual and a loner. His ideas were mainly appreciated by his own students. With some notable exceptions, outside his family of pupils, they were ignored. Yet not uncommonly, 30 to 40 years later, as new discoveries about the mysteries of pathogen behaviour and pathogenesis are published, these same pupils are assailed by feelings of *deja vu*. His approach to new ideas, his personal knowledge and broad way of thinking as well as deep insights into biological phenomena endowed him with an element of prophecy! Over time his novel approach has been vindicated and has begun to be measured as a far-reaching contribution to this discipline.

## Getting started

**Path to a science career** Neville White was born at Bexley on 15 March, 1906. Two years later the

family moved to Beecroft-Pennant Hills where he remained until after he retired in 1971. At the age of about four, Neville remembered finding the moss *Funaria*, and asking if it was a plant like others growing in the garden. The delicate structure so intrigued him that he sought mosses wherever he went. In 1915, the children at Beecroft Primary School, including Neville White, Lilian (later Dr) Fraser and my mother, were taught by Miss Margaret Reid. On his ninth birthday, Miss Reid gave Neville a book entitled, 'Nature's Little Ways' (published by John Shaw of London, author unknown). He always kept this beautifully illustrated book which simply and accurately describes the world of plants. He read it so often he was able to quote passages from it verbatim. From this time on he became conscious of the possibility of learning formally about botany. In fourth, fifth and sixth classes he won the Annual Robert Vicar Prize for the best project based on an observation of nature. Later while on a Scout excursion he discovered a pink flower which he identified from a copy of Florence Sulman's (1914) 'A Popular Guide to Wild Flowers in NSW' as *Lambertia formosa*, the 'prickly honey flower bush'. Thus, he began to learn about Latin binomials, common names and classification.

**The educational base** After Primary School he went to Sydney Technical High School. University education being outside family experience, he was directed towards a trade and in spite of his success at the Leaving examination no thought was given to his matriculating. The post war economy was booming in 1924 when his father arranged his entry into the optical trade. By December 1929 the depression was strangling commerce and he was retrenched. Although a shock at the time, he later considered it opened the way to a more fulfilling career.

When he began work, his botanical hobby led him to evening courses in botany and physiology at Sydney Technical College. He had completed three years of physiology and one of botany when Prof. F.S. Cotton, Sydney University, who taught physiology, suggested Neville consider a University course. His father agreed to provide board and lodging and in February 1931 he enrolled in Science at the University of Sydney as an unmatriculated student.

His family, while physically supportive, did not believe a degree was attainable with his background. He financed himself from his savings. He

coached medical and pharmacy undergraduates in botany at coaching colleges, and demonstrated botany at University.

At that time, entrance to the University was based on passing matriculation in January. Because he was unmatriculated, his course took seven years instead of the normal four. Being an adult with honours in Leaving Certificate chemistry and english, he was admitted as an advanced student into science. As such, in addition to the full science curriculum of four first-year, (1931), three second-year (1932) and two third-year courses (1933) he was expected to proceed to a fourth honours year in 1934, which he did, passing satisfactorily in biochemistry and qualifying for an honours degree. Although he was debarred from graduating because he had not matriculated, it was possible for him to pursue a two-year research program and gain a B.Sc. (Research) degree. His undergraduate course and honours year had provided a solid base for research on nitrogen metabolism in germinating wheat. He achieved distinctions and a high distinction in botany but did not continue with his research program in 1936, being persuaded by Prof. W.L. Waterhouse to suspend his course for 12 months to work on physiological disorders of apples with

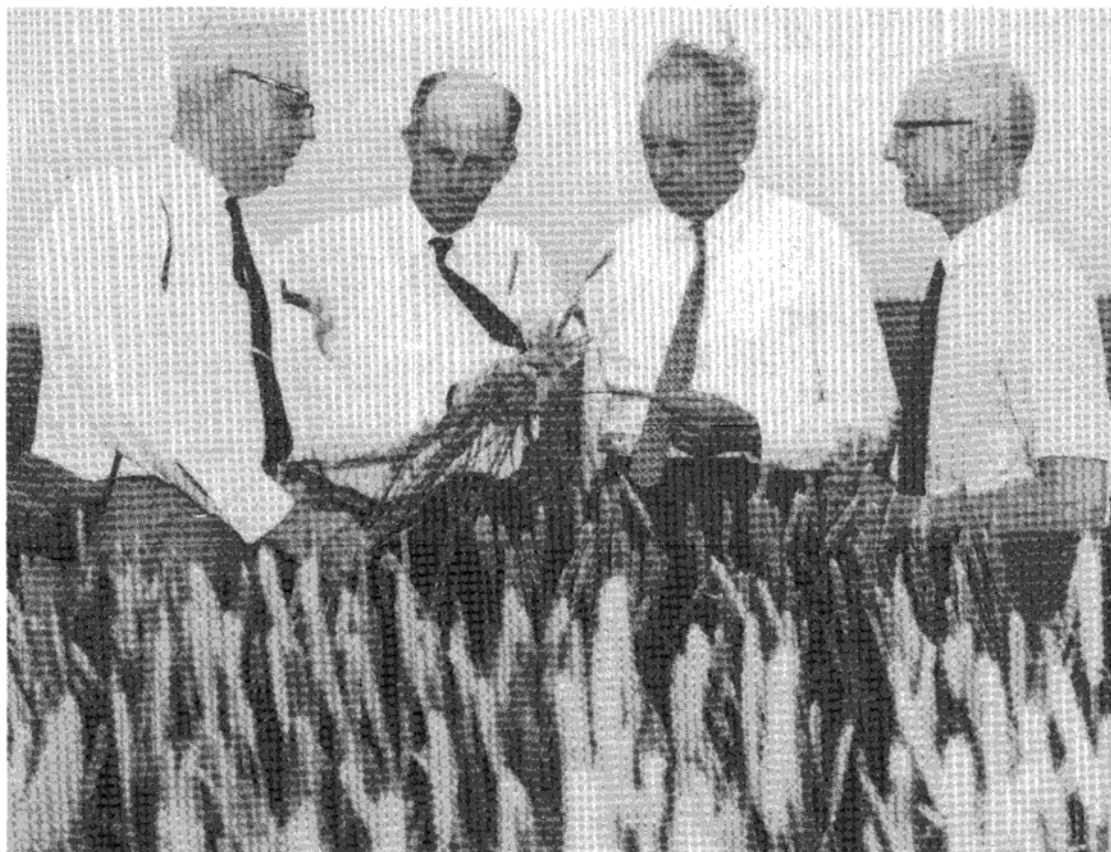
D. Martin at CSIR, Tasmania, while W.M. Carne was overseas. In 1937, he presented a thesis entitled, 'Changes in Nitrogen Compounds During Germination of Two Wheat Varieties', and was awarded a B.Sc. (Res.) degree in March 1938. This work was not published but copies are housed in the Fisher Library of the University of Sydney.

### **Mycology and plant pathology**

His interest in mycology was awakened partly by the third year botany course and partly by Alan Burges, then a post graduate in the Botany School. In 1935, he studied four subjects in the Faculty of Agriculture. W.L. Waterhouse taught plant pathology, agricultural botany, genetics, and plant breeding, and Gilbert Wright took agricultural bacteriology. Waterhouse's presentation of plant pathology attracted Neville's interest.

### **Professional biologist**

In 1938, jobs were hard to find, but one day in February the mail contained two offers of employment. One, with an annual salary of £550, was for a bac-



(Left to right) Professor J.R.A. MacMillan, Professor I.A. Watson, The Vice-Chancellor of Sydney University and Professor N.H. White at a University field day in 1962.

terio­logist to the Queensland Hospital Board, while the other, at a lower salary of £312 per annum, was for an assistant research officer at the Division of Plant Industry, CSIR, Canberra. He accepted the latter, judging it to offer the best long-term prospects. In 1939, he qualified for candidature for a M.Sc. degree at Sydney, awarded in 1940 for a thesis entitled, 'The Nutritional Requirements of Root Infecting Fungi' (White 1940).

As World War II got underway, vegetable production increased in Tasmania, where, following the resignation of Dowson in 1932, there was no plant pathologist. In 1943, Neville was seconded to the Tasmanian Department of Agriculture. During the following three years, in addition to working closely with the vegetable industry (White 1945a, e, f, g; 1946c), he made a survey of plant diseases in Tasmania (White 1946a). He also consolidated his work on take-all into a thesis entitled, 'The Biology and Etiology of Take-All of Wheat', and submitted it to the University of Tasmania for a D.Sc. (White 1946b). His examiners were: Prof. F.T. Brooks, Cambridge University, Dr S.D. Garrett, then Chief Mycologist at Rothamsted Research Station, and Prof. W. Brown, London University. Each strongly recommended the award of the degree.

## Research and philosophy

**Take-all of wheat** From 1939 to 1943, while with CSIR, Canberra, he investigated take-all disease in wheat and virus diseases in potatoes. Dr S.D. Garrett had researched take-all at the Waite Agricultural Research Institute from 1929 to 1933 and in 1939 Neville began corresponding with him. He claimed later (personal communication) that he was greatly influenced by Garrett from 1939 onwards, through correspondence on take-all disease of wheat and through following the development of his hypotheses on the biology of root-infecting fungi. In 1952, during a visit to Cambridge, Neville was invited to give a series of lectures on his work on take-all which had earned him great credit and is still quoted as fundamental work (White 1939; 1941; 1942; 1943; 1945b, c; 1946b; 1947a, b).

**Virology** While with Plant Industry, he also became interested in virology, studying mixtures of strains of Potato virus 'X' in potatoes with J.G. Bald (Bald and White 1941b). He later studied the infectivity of Tobacco mosaic virus from the local lesion host, *Datura stramonium* (White 1954c) and the cause of mosaic or 'black streak disease' in *Cymbidium* and other orchids (White and Goodchild 1955).

His scientific philosophy emerged from ideas he formed about relationships between pathogens, including viruses, and their hosts, and those he expressed in papers on antibiosis (White 1956a) and host pathogen relations (White 1957; 1958) including resistance to systemic spread (White 1968). His

final paper on viruses was a consideration of reasons for an apparent lack of indigenous viruses in Australia (White 1973). By the end of 1965 he had prepared the manuscript for a textbook on 'The Principles of Virology'. Unfortunately, because another text by Corbett and Sisler became available at the same time, the publishers did not proceed.

**Pathosystems** Central to Neville's success as a teacher were his insatiable curiosity about plant parasite interactions, his capacity to see them through the eyes of a trained physiologist and biochemist, his strong interest in the evolution of pathogens, and his great capacity to anticipate where answers lay. Through his book, *Principles of Plant Infection*, Gäumann (1950) demonstrated the need to view plant disease as physiological reactions in plants to the actions of invading organisms. In discussing how pathogens colonise their hosts, Gäumann (1950) stated, "Thus they feed on the living substance of the host, that is, they are *biotrophs*", and, "These pathogens feed on the dead substance of the host, therefore, they are *necrotrophs*". These concepts attracted Neville who went back to papers by Münch (1929), and Link and Eggers (1933) to discover more about them. This strengthened his view that the terms, 'obligate parasite', 'facultative saprophyte', etc. while valuable in ecology, were not helpful in physiological considerations. In the early 1950s, he began using the terms *biotroph* and *necrotroph*. Information from his own observations and other pertinent literature was sifted through with regard to these concepts in an attempt to understand the needs and actions of parasites, and the reactions and disease responses in their hosts. By the late 1950s, he was confident enough to publish his theories (White 1956a; 1957). Brierley's translation of Gaumann (1950) was his main text for teaching host parasite relations in the mid 1950s. To his great credit, he developed and taught these concepts and incorporated them into a theory on host parasite relations 20 years before they were espoused in America (Luttrell 1972) or the United Kingdom (Lewis 1974) and almost 30 years before they were more widely used elsewhere (Heitfuss and Williams 1976; Ingram 1978). They were, however, used in Australia well before then (White 1957; Parbery 1963; Thrower 1965).

Earlier in his career he saw that, in spite of the value of knowing about life cycles of pathogens, the understanding of disease cycles was fundamental to disease control. Here again, he developed a body of practical theory, about disease cycles with continuous infection chains, opposed to disease cycles with discontinuous infection chains.

## Field pathologist to teacher

In Tasmania, he established a sub-department of plant pathology and completed a plant disease sur-

vey. In 1946, he was appointed lecturer in agricultural botany in the Faculty of Agriculture at the University of Sydney, in Prof. Waterhouse's department. In 1949, he was promoted to Senior Lecturer in Plant Pathology, in 1955 to Associate Professor and from 1966, until he retired in 1971, he held the newly created Chair of Plant Pathology. Prof. Waterhouse retired in 1952, and in 1953 Neville was put in charge of the new sub-department of Plant Pathology. Throughout his career he was recognised as an innovative and inspirational teacher. The first decade of his working life provided an appropriate base for the excellent coursework and the imaginative, high quality teaching which were his hallmark.

From 1955 until his retirement in 1971, 97 final-year students majored in plant pathology, making it the third most popular of the ten final-year major electives. A high proportion of these have remained in plant pathology and further evidence of White's success was that, in 1972, six of the ten Australian universities at which plant pathology was taught, all employed prior students of his in teaching posts. They were: J.F. Brown, New England; W.A. Shipton, James Cook; L.W. Burgess, Sydney; G.A. Chilvers, ANU; D.G. Parbery, Melbourne; and J.M. Fisher, Waite Institute. In addition, K.J. Scott, Professor of Biochemistry at the University of Queensland, acknowledges that his research interest in the biochemistry of host defence was stimulated by Neville White's enthusiasm. Prof. C.D. Blake, now Vice-Chancellor of Charles Sturt University, was his student and later a member of his staff, teaching nematology at Sydney in the 1960s. Many plant pathologists employed in other fields, throughout Australia, were also trained at Sydney University during this period.

### Philosophy on host-parasite relations

Neville White signalled his interest in the biochemistry and physiology of plant responses to disease in 1945 (White 1945d). By the mid 1950s he was proposing that in many cases, considerations of the mechanisms of resistance to disease were limited because the nature of the pathogen, its requirements of its host and the mechanisms likely to work against it were unknown. He considered that unless plants were immune to infection, actions by different types of pathogens were likely to induce different types of reactions in their hosts. Accordingly, depending on the fundamental nature of a pathogen and its requirements of its host, a host reaction favouring one pathogen may just as well disadvantage another. For example, since necrogenesis alone would favour necrotrophic pathogens, so-called hypersensitive reactions limiting necrotrophic pathogens might be expected to involve more than merely necrotic tissue. White recognised that host-cell death was not always the cause but often the result of events underlying the hypersensitive response. His insight into the nature of this response

preceded other research (Ingram 1978) by several years. He was a pioneer of the modern approach to physiological plant pathology (White 1945e; 1954a; 1957; Baker and White 1954; Scott *et al.* 1957; Brown *et al.* 1964a, b; 1965; 1967). His initial study of differences in the reactions of barley cultivars susceptible and resistant to powdery mildew (White 1954a; Baker and White 1954) was followed up by Millerd and Scott (1955) and led on to other significant work (Millerd and Scott 1956; 1962; Scott *et al.* 1957). This work and studies undertaken with his students J.F. Brown and W.A. Shipton, provided an understanding of hypersensitivity.

He was interested in knowing if the host-parasite relations of plants and viruses matched those of plants with bacteria, fungi and nematodes. He was particularly interested in the significance of local lesion reactions in plants to virus infection because of its similarity to the hypersensitive response (White 1954c; 1968). He was also interested in the evolution and general biology of viruses (White and Goodchild 1955; White 1958; 1973).

His ideas on the evolution of parasitism coincided with those of D.B.O. Savile (1955) and provided interesting Friday morning class discussions in addition to those arising from Beveridges' (1957) portrayal of the art of scientific investigation and other such exercises, which fostered student confidence in the use of concepts and language. His ideas (White 1956b; 1957; 1964; 1971; 1992) were basic to his teaching and research.

### Overseas experience

The award of a Carnegie Travel Grant in 1953 enabled him to spend 6 months visiting research establishments in North America, the United Kingdom and Europe. In the United Kingdom he visited Cambridge where Garrett invited him to give a series of lectures to his final year students on take-all disease. In Zurich he met the renowned Ernst Gäumann whose ideas had so greatly influenced him.

In 1964, the receipt of a Rockefeller Travel Grant enabled Neville to visit Europe for 6 months. In the United Kingdom he attended the 10th International Botanical Congress in Edinburgh and the 3rd International Cereal Conference in Cambridge, presenting papers on mechanisms of resistance at each (White *et al.* 1964; White 1964).

### Interests by the way

White's interest in botany covered a wide spectrum including straight botany (White 1950); ontogeny of fungi (White 1944; 1954c), truffles (White 1956a), general observations on new or interesting diseases (White and Dickenson 1943; Raphael and White 1944; White 1945a, e, f, g; White *et al.* 1956), anti-

biosis (White 1956a), antibiotics (Chilvers *et al.* 1962; Evans *et al.* 1965; Evans and White 1966), phyto-toxins (Evans *et al.* 1965) and disease measurement (White 1966; Keed and White 1971). Perhaps one of his most novel papers was on the subject of decoy cropping as a means of reducing or eradicating certain soilborne diseases (White 1954b), an idea with considerable potential in the search for methods of biological control.

Of special note was his interest in truffles. While teaching mycology in 1949 he became curious about the lack of records of Australian truffles and almost immediately began hunting for them in his home environment at Pennant Hills. He soon recovered three ascocarps of a new truffle, *Hydnoplicata whitei* Gilkey (Gilkey 1954) which was named after him. Four years later he recovered an ascocarp of *Labrinthomyces steenisii* Boedijn within 50 m of his previous find (White 1956a). His conviction that they are common in bushland soils is now supported by the experience of those who hunt them.

### Witness for the prosecution

In 1960, Neville was drawn into the most bizarre experience of his career when police called him, as a Crown witness, to help establish the time of death of a murdered child whose body was found in the bush in Seaforth. Forensic scientists had found mould and other organic matter on the victim's socks and shoes and which police took to him to see if he could suggest how long the body had been in the bush. Among five species of moulds on the shoes were mature ascocarps of *Aspergillus repens*. The literature supported Neville's observations that in the bush at Seaforth during July and August, the earliest the fungus could produce ascocarps was four weeks. Debris on the socks contained a colony of 59 nematodes all of the same age and species, suggesting they arose from the same batch of eggs. He determined it took 35 to 45 days for the nematodes to reach their stage of development. This indicated the child was murdered at the time of his kidnap some six weeks prior to the discovery of the body. In reporting the case, Archibald (1961) claimed Prof. White's evidence was critical to its successful conclusion.

### The private man

Neville White was never uninteresting. He, like all of our lecturers of the day at the University of Sydney, wore an academic gown in lectures and a white lab coat in practical classes. With them he often wore a bow tie or a woollen tie with a large gold 'W' tie pin, and he smoked a pipe. He was never available to students before 10.00 am, jealously preserving the first hour or so for his own purposes. However, after 10.00 am he gave as much time as

one needed and frequently appeared in the laboratories with undergraduate classes and post graduates to see what progress was being made.

In private life he maintained an extensive garden at Pennant Hills. He was deeply committed to Scouting. From 1950 to 1953 he was District Commissioner of Scouts for North West Sydney and from 1954 to 1958 he was District President. He was also a member of the National Trust and the Australian Historical Society. He was a foundation member of the Australasian Plant Pathology Society, and a member of The American Phytopathological Society, The British Association of Applied Biologists and the British Mycological Society. On his retirement in 1971, he was made an honorary life member of the British Mycological Society.

In 1972, his wife Jean and he moved from Pennant Hills to Bateau Bay where they lived until 1988 when they moved to Redhead, Newcastle, near their daughter. Neville died on 26 May, 1991.

### Acknowledgements

My sincere thanks to Jean and Neville White for providing information and comment on the script. Thanks too to Mrs Vyrna Beilharz, Assoc. Prof. John Brown, Dr Graham Chilvers, and to Assoc. Prof. Lester Burgess for assistance and for providing the photograph.

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