PROLOGUE

THE CHALLENGE *TO* SCIENCE, 1866; THE CHALLENGE *OF* SCIENCE, 1966*

A. P. Elkin

PART I

THE CHALLENGE *TO* SCIENCE, 1866

The Vision of Solomon's House

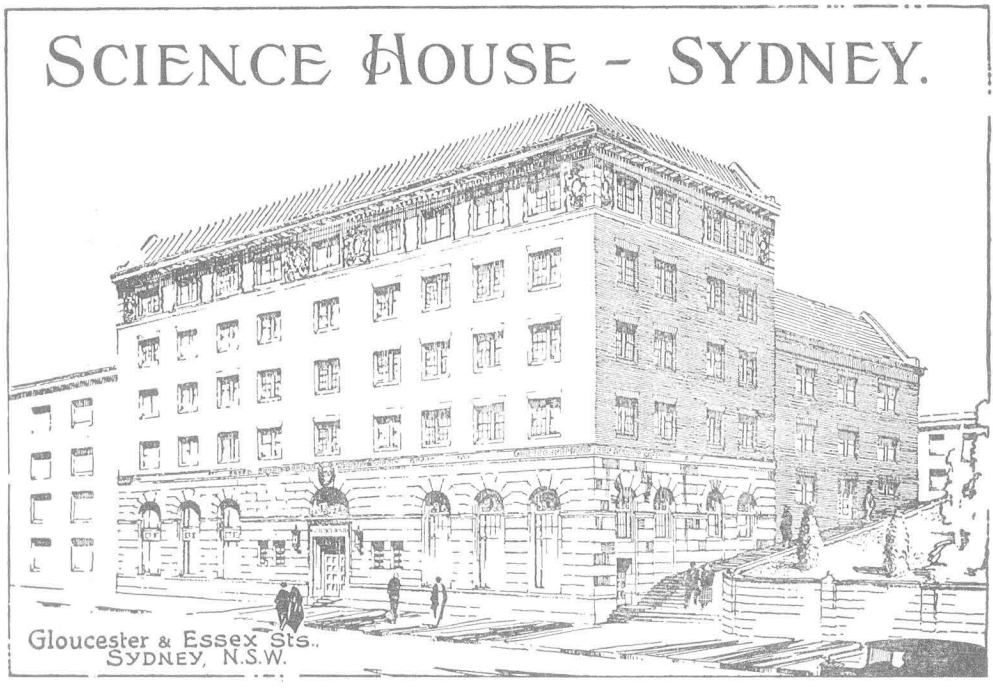
The philosopher-scientist Francis Bacon near the end of his life had a vision. It was of a kingdom, the New Atlantis. In it the King instituted an order or society, called Solomon's House, "the noblest foundation, as we think, that ever was upon the earth, and the lanthorn" of the Kingdom. Its object was to reveal "the true nature of all things"—to come to a knowledge of their causes and secret motions, and so to increase the use of all things possible for the good of men. As a means to this end, two ships were to be sent every twelve years "to several voyages", with three of the fellows or brethren of Solomon's House in each ship. Their mission was to obtain knowledge "especially of the sciences, arts, manufactures and inventions of all the world".

Little did Bacon dream that such a ship would be sent about 150 years later from the kind of society he envisaged to bring back knowledge, not only of the "secret motions" of heavenly bodies, but also of the sure existence of a new continent, Australia.

He died in 1626. His emphasis on observation, induction and experiment, and his vision of scientific expeditions may have seemed to fade away with him under the political cloud which enveloped the one-time Lord Chancellor of England. But this was not so. The tumults, wars and proscriptions of the second third of the 17th century had, in Macaulay's words, "stimulated the faculties of the educated classes, and had called forth a restless activity and an insatiable curiosity such as had not before been known among us". Many busied themselves with framing constitutions for a republican era, but a few, withdrawing from the distractions and wasteful futilities of civil strife, devoted themselves to scientific inquiry. Amongst them were Boyle and Harvey.

* The Centenary Oration, delivered to the Royal Society of New South Wales, in the Hall of Science House on Friday, October 28, 1966, by Emeritus Professor A. P. Elkin, C.M.G.

Napier and Newton, a quartette surely constituting "the noblest lanthorn in the Kingdom". No wonder that from the meetings of such men in the Bull's Head Tavern the Royal Society of London came into being—a veritable Solomon's House. It was royally founded when it received its charter in 1662 from the new monarch, Charles II. Its objective was the promotion of the experimental method of natural science as distinguished from supernatural arts, e.g., witchcraft and divination.



Science House — the home of the Royal Society of New South Wales since 1931. The building won the Sulman Award for Architecture in 1932.

The times were propitious. With the collapse of the Cromwellian Commonwealth, the revolutionary spirit of that period ceased to operate in politics and began to exert itself with unprecedented vigour and hardihood in natural science. In Macaulay's phrase, divines, jurists, statesmen, princes and even the King himself "swelled the triumph of the Baconian philosophy". Poets sang of the approach of a new golden age. Dryden foretold things which, in the opinion of that same historian, neither he nor anyone else understood. The Royal Society, Dryden predicted in his *Annus Mirabilis,* would soon lead us to the last verge of the globe and

> "From thence our rolling neighbours we shall know,
> And on the lunar world securely pry."

We of these latter days admit that the poet's imaginative flight was not altogether astray, but without at once making a soft landing on the moon, we record that the Royal Society of London, just over a century after its foundation, induced the King and the Admiralty to send a ship from Solomon's House, as Bacon would have said, in search of knowledge to the "globe's last verge". The primary destination was Tahiti, an island set in a vast ocean, little known to the Western world. And the purpose! The observation of the transit of Venus in June, 1769, "as the foundation for calculations which would determine the distance of the earth from the sun".

The Royal Society commissioned James Cook, with the co-operation of the Admiralty, to undertake the project. He had shown, in a report on an eclipse of the sun in 1766 observed in New Foundland waters, that he "was a good mathematician and very expert in his business". In addition, the Admiralty gave him instructions, marked secret, that having finished the astronomical task, he was to sail south and west to discover in the south seas a "Continent of Land of great extent" which there was "reason to imagine" did exist. If he found it, he was to observe and report on its soil and precious metals, beasts, birds and plants, and on its natives, and to take possession of it. Thus the Admiralty and Cook, probably quite unwittingly, were carrying out Bacon's principle (defined in his *Novum Organum*) that "the true and legitimate goal of the Sciences is none other than this, to endow human life with new discoveries and resources".

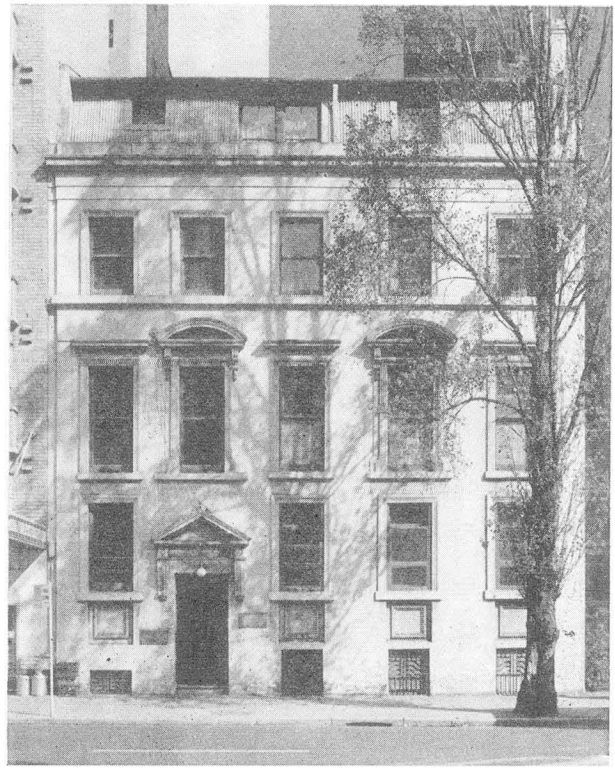
So James Cook, whose accustomed business was in the great waters, and whose eyes were ever scanning the heavens, sailed by way of the Antarctic to Tahiti, New Zealand and then westward until the eastern coast of Australia arose before European eyes.

Cook's mission was scientific—to make contributions to astronomy, geographical discovery and natural history. He had with him an experienced astronomer and also as "paying guests" Joseph Banks and his suite. Banks was wealthy and young, a Fellow of the Royal Society and a keen botanist. His suite included the "ablest botanist in England", Dr. D. C. Solander, F.R.S. Wherever the *Endeavour* touched land, these two went into "the woods botanizing as usual", nowhere with greater success than at Botany Bay.

Nine years later Banks recommended Botany Bay to a committee of the House of Commons as a satisfactory site for a penal colony. His opinion was weighty, for in addition to having been in New Holland, he was now (since 1778) President of the Royal Society.

The First Fleet arrived there in 1788, but thanks to the wise judgment of Captain Phillip moved on to Port Jackson. The small

settlement soon augmented by further shiploads of men and some women, mostly convicts, experienced short rations and other stresses and strains during its first twenty years. Supplies from England, over four months away, were neither regular nor sufficient. So search had to be made for farming and grazing land, and a watchful eye kept for minerals that might be a source of revenue. That is, the very existence



Elizabeth House, 5 Elizabeth Street, Sydney—the home of the Royal Society of New South Wales from 1875-1927.

of the settlement put out a challenge to natural history; it depended on the results of exploration, on gaining a knowledge of the environment, of its soils, waters, climate, plants and animals. This implied observation and collecting, and in this the spirit of Banks overshadowed the Colony. His collecting urge was infectious. Every vessel from New South Wales took to him botanical, zoological, geological and anthropological specimens. Governors assisted, White and Considin, surgeons with the First Fleet, and Robert Brown and George Caley in the first decade of the 19th century were amongst those who collected for him. Allan Cunningham did likewise in the 1820's for Kew Gardens. In

addition, three French expeditions, each with its team of naturalists, visited the Colony between 1802 and 1829. And all were rewarded; for though the regions traversed did not flow with milk and honey, but rather challenged the stamina and versatility of man, it was very rich in rewards for the student of the natural sciences. New varieties and species of trees and plants, of birds and insects, of marsupials and reptiles awaited him. And the heavens were new, too, dazzling in their brightness, ready to be mapped. As Dante had dreamed

> ". . . I turned, and fixed my mind
> On the other pole attentive, where I saw
> Four stars ne'er seen before save by the ken
> Of our first parents. Heaven of their rays
> Seemed joyous . . ."
>
> (*Purgatory,* Canto I.)

The Philosophical Society of Australasia, 1821

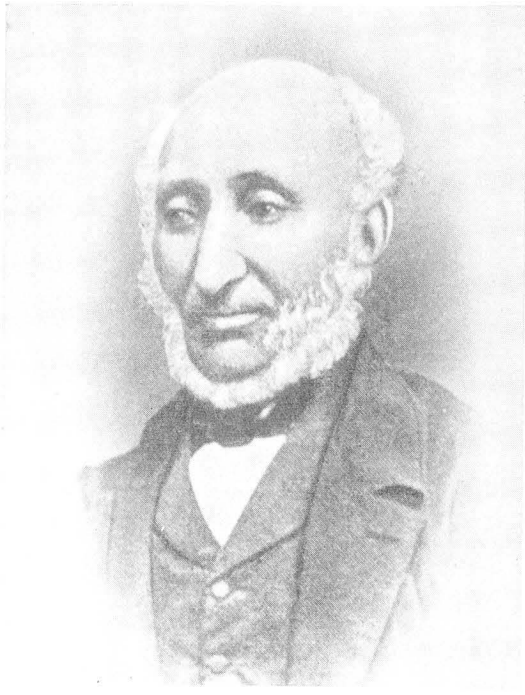
The sixth Governor of New South Wales, Sir Thomas Brisbane, was intent on watching the southern sky, and brought with him in 1821 equipment and a first-class astronomer, Dr. Charles Stargard Rumker. Moreover, with the Governor's encouragement, the Philosophical Society of Australasia* was formed in that same year "with a view to inquiring into the various branches of physical science of this vast continent and its adjacent regions".

It was actually a small scientific club consisting of ten members besides Brisbane. Meeting in turn in their houses, lending books to one another, reading and discussing papers, they encouraged one another in the pursuit, usually part-time, of their scientific interests. These little gatherings held out hopes of being oases of refreshment in what must have seemed a cultural desert: of the Colony's total population of 30,296 in 1829, only 2,097 had arrived free or were born in the Colony. Here was an expression of that deep-seated urge to which T. H. Huxley referred in his Anniversary Address to the Royal Society of London over sixty years later. Wherever English-speaking communities have been planted and have had time to develop, "the instinct which led our forefathers to come together for the promotion of natural knowledge has worked in them and produced most notable results".

This would be the outcome also in New South Wales, but only after early disappointments. Towards the end of 1822, the little Society

* Barron Field, in his introduction to *Geographical Memoirs of New South Wales,* refers to the Philosophical Society of Australia. W. B. Clarke, in the Inaugural Address to the Royal Society of N.S.W., uses both "Australia" and "Australasia". The latter was used by the Society on the tablet placed to mark the place at Botany Bay where Cook and Banks first landed in 1770.

"expired in the baneful atmosphere of distracted politics", as one of its members, Judge Barron Field, wrote. More precisely, as the Reverend W. B. Clarke said in his Inaugural Address to our own Royal Society in 1867, "the fictitious, variable value assigned to the dollar, the coin then prevalent [in 1822], was the cause of the breaking up of the little band who cultivated science for the love of it".



Dr. Henry Grattan Douglas, M.D. (1791-1865). Foundation Secretary of the Philosophical Society of Australasia (1821-1822), of the Australian Philosophical Society (1850-1855) and of The Philosophical Society of New South Wales (1855-1866). The latter body became the Royal Society of New South Wales in 1866.
"His connection with scientific effort in Australia was very important"—(Obituary).

One of this band was Henry Grattan Douglass, M.D., who, arriving in the Colony in 1821, took a keen interest in the social and intellectual welfare of the community. In 1848 he returned from a visit to England fired with the idea of establishing a University in Sydney. He persuaded F. L. S. Merewether and then W. C. Wentworth to take the necessary steps with the result that the University Act of Incorporation received the Royal Assent on October 1, 1850, and the

first Senate was appointed two months later. Douglass was a member, and when the Great Hall was built, his coat of arms was one of the ten carved at the eastern end.

The Australian Philosophical Society, 1850

But what about the former Philosophical Society which Judge Field hoped in 1825 was not extinct, but only in a "state of suspended animation"? Perhaps Dr. Douglass could revive it. According to Mr. Clarke, the chief credit for its revival in 1850 belonged to Douglass, its Honorary Secretary then as in 1821–2. We may accept this opinion, for getting the Society going again was complementary to making a university a reality. Certainly, in his person and in that of Alexander Berry, the Society of Brisbane's day was carried forward into the Australian Philosophical Society of 1850, the object of which was "the encouragement of Arts, Sciences, Commerce and Agriculture in Australia". Indeed, until the end of the century the Anniversary Addresses were numbered from 1821. Thus, J. H. Maiden's Address as President, given in May, 1897, was on the seventy-sixth anniversary of our Society.

In the intervening years, 1823 to 1850, the future pattern of eastern Australia was set. Exploration by Mitchell, Sturt, Hume, Leichhardt and others revealed the variable moods of our country, while natural history was pursued by Cunningham, Strzelecki and W. B. Clarke. Settlement had spread and the population of New South Wales in 1851 was 187,243 and the new colony of Victoria 78,260, about an eightfold increase since 1821. Sydney itself had now a population of 44,240. The convict system was gone. The economic depression of the 1840's had been endured, and by an Act of the British Parliament in August, 1850, the Australian Colonies were endowed with self-government. Thus, stability and progress were to depend on the determination, wisdom and knowledge of the colonists. This was a situation demanding advance in education, in professional training and in scientific research—the very context for universities and scientific societies. Appropriately, Sir Charles FitzRoy, the Governor, was Visitor of the University of Sydney and Patron of the Philosophical Society, while Sir Charles Nicholson was Vice-President of the latter and Vice-Provost of the former.

The Philosophical Society of New South Wales, 1855

The revived Society was very active for a while, but amid the excitement of the first gold rush it ceased to function—but not to exist—and a meeting in 1855 made a territorial change in its title, substituting New South Wales for Australia. This was very fitting,

because the several Colonies were drawing up their own constitutions, and in November, 1855, a new one was adopted for New South Wales. The first Parliament elected under it met first on May 22, 1856. This was thirteen days after the renamed Philosophical Society held *its* first meeting in the School of Arts. Thus do the political, economic and scientific aspects of society interact with each other.

Prof. Archibald Liversidge, F.R.S., F.C.S., F.G.S. (1847-1927). Hon. Secretary of the Royal Society of New South Wales for 13 years, 1874-1884 and 1886-1888. He served three terms as President, 1885, 1889, 1900.
"We never got a move on till Liversidge came."
(Obituary)

During the next eleven years, seven or eight meetings were held each year, and a total of 100 papers was given by 42 contributors. Membership rose to a peak of 186 in 1858 and then fell to little over 100 in 1866. Looking back from our vantage point eighty years later, we may well regard this as very creditable. For we are aware of the many problems which confronted the Colony in the aftermath of the goldrush: the rapid and somewhat turbulent increase in population, the inadequacy of education, especially of what we define as secondary, and the correspondingly small contribution the University

could make to the pursuit of science and its application. Even twenty years later Professor Liversidge described the University as financially very poor. The Reverend W. B. Clarke, however, who was Vice-President of the Society for most of the 1856–67 period and its acknowledged leader, was very perturbed. He seems to have hoped for a worthwhile membership drawn from the general community, but now admitted that such support would not come "from persons whose leisure is generally given to the frivolities of ephemeral excitement, or whose mental occupation is only exercised by sensational novels or a railway literature". That was 1867. Thirty-four years later, Professor Liversidge was to hold the railways and tramways responsible in another way for a corresponding drop in the Society's membership. As a result of the opening of suburban tram lines and of additional railways, miles of new suburbs had grown up; streets near the Society's House which had been residential were now lined by professional offices and business premises. Consequently, large numbers of people, particularly of those who would be interested in science and culture, now lived in the suburbs and found difficulty in attending night meetings. In those years membership had fallen from 494 in 1884 and 1885 to 368 in 1901. But even in 1885 only 35 of the 494 members had contributed papers, and indeed most of these were given by seven or eight persons. This brought the comment from Professor Liversidge: "There are few men of leisure in the Colonies, and still fewer of learned leisure."

The Royal Society of New South Wales, 1866

To return to the comparative doldrums of the 1860's: Mr. Clarke sensed an explanation in the very ascription in the title of the Society, namely, the term Philosophical. Likely members might be frightened off by the thought of abstruse papers, although the discussion and advancement of philosophy as such had never been a concern of the Society. Moreover, as far as Clarke was concerned, to do so would be useless, for in the words of S. H. Lewes, the empiricist: "Philosophy is a Desert, whose only semblance of vegetation is a mirage—the Desert without fruit, without flower, without habitation and without horizon: arid, trackless, silent but vast, awful and fascinating." For the "founding father" of our Royal Society, the grand questions beyond that horizon would never be answered by any human process. Whence came the world? Why is the universe formed as it is? What is the nature of God and of the human mind? As a man of religion, Mr. Clarke had a faith grounded in those "records in which Antiquity found its consolation and hope". But for the rest, he was an empiricist. The former systems of philosophy had passed away. Intellectual inquiry no longer aimed at finding out by the "processes of logic those invisible

things which are beyond the attainment of reason". It was rather trying "to make discoveries *in* things visible, hoping thus to obtain an insight into that which mere Philosophy can never reach".

In true Baconian spirit he steered the Society along that path in which it would be able to take up the challenge of the country and the nation *to* science. "We ought to be labouring", he proclaimed, "for

Rev. William Branwhite Clarke, M.A., F.G.S. (1798-1878). "The pioneer geologist of Australia." Foundation Vice-President of the Philosophical Society of New South Wales and of the Royal Society of New South Wales till 1878. He was effectively President—the Governor of the State actually occupied this position.

"Our true position is that of pioneers, sowers, foundation layers . . ." (Anniversary Address, 1876).

the development of the physical character of the country we live in", and to reveal its natural history and productions, "since this appears to be now admitted as the especial object of our researches".

So after due steps had been taken the offending word "Philosophical" was deleted from the Society's title, and thanks to the good offices of the Society's President, His Excellency the Right Honourable

Sir John Young, the Queen's sanction and authority were obtained "for us to carry out our future labours under the Royal Patronage". The letter from Downing Street conveying this information was dated September 24, 1866. It was received at a meeting of the Philosophical Society of New South Wales on December 12, 1866, which, at the conclusion of business, adjourned as the Royal Society of New South Wales. Moreover, its Fundamental Rules made its objective quite clear: "to receive at its stated meetings original papers on subjects of Science, Art, Literature and Philosophy", as in the Rules of the Philosophical Society, but with the following addition: "and especially on such subjects as tend to develop the resources of Australia, and to illustrate its Natural History and Productions".

Drawing attention to the amended objective, Mr. Clarke concluded his Inaugural Address to the first meeting of the Society under its Royal title, on July 9, 1867, with a charter of research. "We have in this Colony a vast region, much of which is still untrodden ground. We have, as it were, a new heaven for astronomy and a new earth for geology. We have climatical conditions of the atmosphere, which are not to be viewed by us merely as phenomena interesting to the meteorologist. We have facts to accumulate relating to Droughts and Floods which have a deep financial and social importance. We have a superficial area which may engage the attention of Surveyors, Agriculturalists, and Engineers for years to come. We have unrevealed magazines of mineral wealth in which Chemists and Miners may find employment for ages after we shall have mingled with our parent earth."

There indeed was the challenge *to* science, as the leaders of our Society saw it a century ago. To repeat, the spirit of Francis Bacon was there with his dictum: "the true and legitimate goal of the Sciences is none other than this, to endow human life with new discoveries and resources." This may not seem to us to be the whole duty of scientists, but it is a duty, and in a new country it loomed large.

Actually, there were two trends. On the one hand, workers carried out their observations and studies in the fields of natural history, palaeontology, astronomy and mathematics (including geometry and statistics) for the sole purpose of adding to our knowledge and understanding of phenomena, whether or not their results had any bearing on the development of Australia's resources. Indeed, the first paper given to our Society after being designated Royal was entitled "Non-Linear Coresolvents". The writer was the Chief Justice of Queensland, an F.R.S. Papers on the anthropology and languages of the native peoples of Australia and the Pacific were also accepted.

On the other hand, many papers and anniversary addresses for thirty years and more after the revival of the Philosophical Society

in 1850 were concerned with matters on which the development of the Colony did depend: particularly, on storing and reticulating adequate water; on geological surveys indicating or confirming the presence of valuable metals, minerals and coal; on improved and increased means of transport and communications; and on safeguarding public health. Only a few references, including one in 1888 to Farrer's work, were made to agriculture and animal husbandry. Research in these fields and indeed in many others would follow the establishment of relevant University Departments.

Water, metals, transport and health: these four: but the greatest was water. Back in 1825 Barron Field of the first Philosophical Society ended the Preface to his *Geographical Memoirs of New South Wales* with a graphic text:

"Thou hast given me a south land; give me also springs of water."

And for such springs we have been searching ever since. Much of the story of that search, especially in relation to Sydney's water supply, is recorded in the Journals of our Society. The core of the problem was put very succinctly by Professor John Smith just 98 years ago. "Sydney is not favourably situated for an abundant water supply, and it cannot be procured without enormous outlay." Hence arose inevitable arguments about sites for dams and reservoirs, with consequent delays and hesitation to implement reports (especially if rain followed their presentation, as Professor Smith noted in 1871). Delays were followed by water shortages and restrictions, but the population continued to increase and crises were never far away. So it was one hundred years ago, and fifty years ago; yes, and one year ago. Australia has not changed, and the challenge still goes forth to science to solve our water problem! to cause the clouds to release rain, which the Society's President in 1882, astronomer Russell, thought improbable; and the salty waters to be so treated chemically and economically that they can be used to refresh the land where and when it is dry.

The Pioneering Role of the Society

The contributions of the Clarke period—the 1850's to 1870's—were of observed phenomena, rather than of scientific analysis or theory. Such was the goal set by Clarke. "We do not boast at present", he said in his 1876 Anniversary Address, "of taking a lead in Science or Literature. Our true position is that of pioneers, sowers, foundation-layers, and in that respect we have assuredly an honourable occupation." Or, as Mr. C. Rolleston, Auditor-General, put it in the anniversary address of the following year, when ill-health prevented Mr. Clarke from being present: "In a new country we may not perhaps look for

great original thinkers or investigators of the calibre of Darwin, Tyndall or Huxley"; rather "the laborious collection of facts must always hold first place amongst us", and foremost in that work was Mr. Clarke. The Royal Society of London thought likewise and made that one of its reasons for electing him to Fellowship on June 1, 1876; but it also cited his part in re-founding the Philosophical and Royal Society of New South Wales, and in promoting scientific knowledge in the Colony.

Pioneers must serve their generation in the context of their day, and the members of the Philosophical and the Royal Society of New South Wales laid foundations on which in the next phase (the Liversidge phase, as I would call it) a lasting scientific structure would be built.

Engraved in the outside wall of the Chapel of St. Paul's College in the University of Sydney, a College of which W. B. Clarke was an original Fellow, is part of a striking passage in the Sixth Book of Vergil's *Aeneid,* which we may apply to ourselves in this our House:

> "Hic . . . dum vita manebat,
> Inventas aut qui vitam excoluere per artes
> Quique sui memores alios fecere merendo"

which being interpreted reads:

> "Here we remember those who in their day have civilized life by the sciences they have discovered, and who by their merit have established a memorial among their fellows."*

For W. B. Clarke, the greatest memorial was the Royal Society itself. *Esto perpetua,* he challenged, and "with somewhat of parental pride" sought ways to increase its effectiveness and to ensure its right to the liberal support of future generations. We must have a home, he said—a home for meetings and for the library, and not be "like dwellers in the desert living in tents, without a spot of earth to call our own". In the year of his death, 1878, the Society was able to buy its own home, and no longer be nomadic.

He wished, too, that the Society be incorporated with a Charter, so that its members "should not be simply annual subscribers for the purpose of an evening's amusement, but be men who have nobler objects and a more resolute will to be of use to others". The Act of Incorporation was passed on December 16, 1881.

* The reference to St. Paul's College is appropriate, for the third Warden of the College, the Reverend William Scott, M.A. (1865-1877), was a member of our Society from 1865 until his death. He was a student of astronomy, gave eight papers to the Society, served on its Council, and was Honorary Secretary for eight years.

Further, in his last Anniversary Address, May 17, 1876, he suggested the formation of Sections or Committees so as to get more individuals contributing to the advance of knowledge. There "may be thousands of facts of apparently little importance at the moment"; nevertheless they may be worth recording "as either bearing on some past discussion or leading to some future application". Small committees could garner such material and preserve it in the Society's *Proceedings*.* So Clarke spoke, and Sections began to appear in that same year: Astronomy and Physics; Chemistry and Mineralogy; Geology and Palaeontology; Zoology and Ethnology; Literature and Fine Arts, including Architecture; Medical Science; Social Science and Statistics. Engineering and Economics, Agriculture and Industry came later. Amongst the most active were the Medical and Engineering Sections, providing much needed meeting grounds for the keener members of those professions. Speaking generally of the Sections, however, there were periods of activity and of inactivity; there were appearances, disappearances, and reappearances, and in time dissolutions. Only Geology is with us today. But the Section scheme played a significant role in developing the disciplines which they fostered. Australian science owed much to the Royal Society of New South Wales for giving rise from 1876 onwards to many of the important scientific and scientifically-based professional institutions of the present day: biological, physical, social and medical. The trend was seen as early as 1880 for Sections to become self-contained; they met, not just for informal discussion of matters of common interest as had been envisaged, but formally, to read papers and even to have Section-Presidential Addresses. Thus, the hiving-off of Sections into separate societies was to be inevitable, especially when University Departments were established to further their specialized disciplines. Indeed, the Royal Society itself was to the fore in pressing for such Departments.

The Liversidge Phase

The provision of organizational aids to meeting Australia's challenge *to* science was a feature of the thirty years or so following Mr. W. B. Clarke's death. He was himself the symbol and leader of the movement to lay a sure foundation for the structure of "Solomon's House", that is, of science, in New South Wales, just as for the earlier period, 1821-51, Dr. H. G. Douglass focused the urge of scholarly men in a far-off land to find a setting for that foundation. So, too, because of his scientific prestige, administrative skill and wide vision, Professor Liversidge became the symbol of, and main influence in, the thirty-year phase of our scientific history from the late 1870's onward.

* The *Journal and Proceedings* had been published annually from 1868.

Largely through his efforts, our Society obtained its first home and its Act of Incorporation and, more importantly, grew in scientific stature. On a wider scale, he repeated in 1886 an idea he had put forward tentatively seven years earlier. This was the establishment of a sort of federation or association of the 38 scientific bodies which then existed in Australasia. He suggested ways in which the Royal Society of New South Wales might bring this about. He was hopeful. For such an inter-Colonial outlook in science would be in keeping with the movement towards political federation in Australia. In addition, in Liversidge's view "progress in material affairs would not be made unless a corresponding advance were first made in science". He suggested the formation of an Australasian Association for the Advancement of Science, possibly to become a reality in 1888. It did. Following the initiative taken by our Society in 1886, the first General Meeting of the new body was held in Sydney in 1888 with Professor Liversidge as Honorary Secretary and Mr. H. C. C. Russell, F.R.S., a past President of our Society, as President. And so began the long and fruitful history of the A.A.A.S., or A.N.Z.A.A.S., (Australian and New Zealand Association for the Advancement of Science), as it has been called since 1930.

Science in Australia Comes of Age

The successful foundation and functioning of this scientific association with its regular congresses was an essential step for the well-being of science in our region. Moreover, it was the background for a very significant event which followed in due time almost as a logical corollary. This was a meeting in Australia, in 1914, of the British Association for the Advancement of Science. The Premier of Victoria had proposed such a meeting as far back as 1885, but Professor Liversidge pronounced the proposal as premature. Now, however, retired in England since the end of 1910, he used his influence to bring it about.

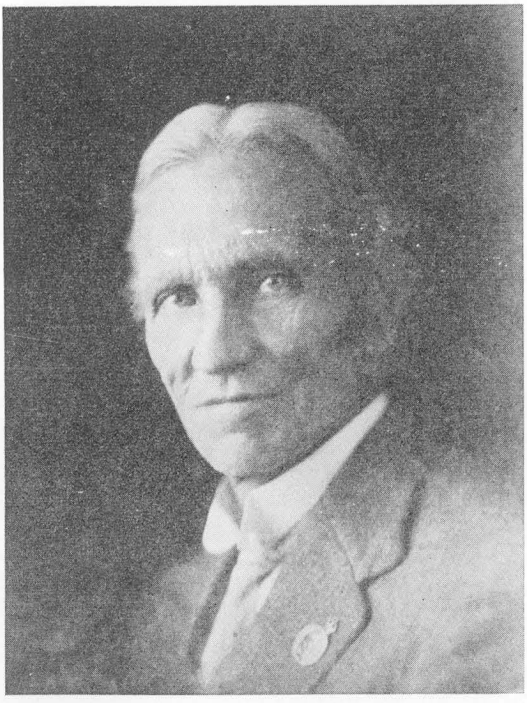
Science in Australia had come of age. The coming of the office-bearers and members of the British association, including leading scientists, to our southern land in days of relatively slow sea travel to hold their eighty-fourth meeting was a very generous undertaking on their part. For our scientists it was a significant and stimulating experience. It was a peak in a zestful upward curve of scientific venture and achievement in the Australian region, a trend which was not deflected by the outbreak of World War I during the congress. This period of optimistic, purposeful and even enthusiastic progress in science is best symbolized in the person of Professor Edgeworth David. In him the challenge *to* science was met with eagerness and on

occasions with oratory. Determining our coal resources; probing tropical coral formations in search of their history; exploring the icy wastes of Antarctica until the magnetic south pole was located; or devoting his special knowledge in the battlefields of the First World War to keep western Europe and Australia free from domination: in these and other undertakings he conveyed a zest for science to those associated with him in the Society, in the university, in expeditions, in congresses and in institutions in which he played any part.

C.S.I.R. and A.N.R.C.

Two such institutions were the C.S.I.R. (Council for Scientific and Industrial Research), and the Australian National Research Council, both of which grew in soil at least partly prepared by the Royal Society of New South Wales. As far back as 1868, Mr. G. R. Smalley, Vice-President, in the Anniversary Address, claimed that the Society could be useful to the Government by acting as a board of reference to discuss and report upon questions of practical importance. He listed several which might have been so referred with advantage: Sydney's water supply; the best means of ensuring health in this populous but badly drained city; the preservation of the harbour by preventing it from being silted in; disease in fruit trees; and a compilation of a history of the Aborigines of New South Wales before they became extinct. As the years passed by, several Presidents lamented the lack of appreciation by Government and people of the practical importance of men of science. One of them, Mr. C. O. Burge, urged in 1904 that we should emulate Germany in promoting science and technical education, and then in prophetic words he posed two alternatives: either we get a proper appreciation of these urgent matters, or we may be "rudely awakened from self complacency by some crushing loss in trading or in war". And war came in 1914. Then as the President in 1916, Dr. R. Grieg-Smith, pointed out, we realized how dependent we had been on Germany for certain fundamental materials, though now, rather late in the day, we recognized how much a nation depends for its existence on scientific research. For Australia was at last considering the establishment of a Commonwealth Institute of Science and Industry to promote the investigation of matters of importance to primary and secondary industries. In time, in 1920, this Institute (later the C.S.I.R.) was established. It has made an immeasurable contribution to scientific research as well as to the development of Australia's resources—thus meeting the challenge *to* science in a way that W. B. Clarke and his keenest contemporaries could hardly have dreamt of.

Even more imaginative, however, was the vision of Professor Liversidge which he outlined in the Anniversary Address of 1901. By then the Australian colonies were united as States in a Federation, and appropriately, the many scientific societies were associated in the A.A.A.S., so that scientists could share their discoveries and thoughts with each other. But something more was needed: a scientific élite to which scientists would aspire, and from which governments would



Prof. Tannatt William Edgeworth David, K.B.E., C.M.G., D.S.O., M.A., D.Sc., Sc.D., F.R.S. (1858-1934). Geologist. Served many terms on the Council of the Royal Society of New South Wales, as President in 1895-1910.

"Science was to him the eager quest for truth, a joyous adventure in which fresh wonders and delights were ever appearing to reward the diligent searcher . . ." (Obituary).

seek and accept advice. Professor Liversidge proposed an organization, resembling the Continental Academies, but under rules more like those of the Royal Society of London, with elective membership based on proven scientific contributions of an original nature. The seat of such Academy, Liversidge took for granted, would be in the Federal Capital when built, where a suitable site should be reserved for the

Academy's House, as well as for museums, libraries, art galleries, and for other educational and scientific institutions, including a Federal university. That was 1901. Canberra had not yet been selected as the site of the Federal Capital, but there today Liversidge's vision has been expressed in buildings and equipment and in men and women.*

The Academy did not appear suddenly. There was an intermediate phase in the inauguration of which our Society acted. Towards the end of World War I an International Research Council was formed, and early in 1919 the Royal Society of London, a foundation member of that Council, invited Australia to join the latter. It asked our Society, as the senior scientific institution in Australia, to take the necessary steps towards forming an organization to act as a National Research Council and to be the Australian member of the international body. The object of this new Council would be to promote scientific and industrial research in its various branches, including those of national defence. Our Society acted, and at a conference on August 21, 1919, the Australian National Research Council was formed on a provisional basis until a more widely based meeting could be held during the Congress of the Australasian Association for the Advancement of Science in January, 1921. Professor David was its first President (1919–1922) and a member of the Executive Committee until his death (1934). The Council, with a limited and elected membership, acted as an Academy; it encouraged research and also advised the Commonwealth Government on scientific matters. But when by 1955 the number of scientists in Australia, being Fellows of the Royal Society of London or recognized by them as of high calibre, had increased sufficiently to justify the step, the Council gave way to the Australian Academy of Science. A Social Sciences Research Committee which had been established under its auspices became the Social Science Research Council of Australia.

* Another example of Professor Liversidge's foresight is given in the same address. After arguing in favour of the metric system of weights and measures, he added that our currency could easily become metric. The half sovereign could be the standard (and called a Victoria), with the shilling being a tenth and the penny, which is only a token, used as a tenth of a shilling. He did not have to consider the cost of converting money-calculating machines, but he pointed out that the change to the metric system for weights and measures would involve a loss (cost) of untold millions both to England and the United States of America, since nearly all the machines in use would have to be altered. Its introduction, however, would save children a year or two of school time which could be spent on modern languages, elementary science and English composition, with the object of teaching them to think and to put their thoughts into clear, intelligible English. Perhaps we should still heed Liversidge's advice.

The idea of decimal currency was not new then. In 1868 Mr. Smalley, our Vice-President, suggested that ladies might attend some general meetings, and not only the Conversaziones, and indeed might have at least elementary training in some scientific subjects, including "the rules of decimals which will enable them to keep the accounts of their houses without difficulty when the decimal coinage becomes law": nearly one hundred years later as it has turned out.

Personal Symbols of Scientific Phases

While sketching the way in which our Society tried to meet Australia's challenge *to* science up to the 1930's, I have selected four persons as symbols of succeeding phases in our Society's history, and indeed in the history of science in New South Wales. These are Douglass, Clarke, Liversidge and David; but these men did not build our scientific edifice alone. They were associated with an increasing band of workers, many of equal or even greater calibre in some aspects, but they became the names to conjure with, and we indeed in several ways, e.g., by lectureships and medals, never cease to pay honour to Clarke, Liversidge and David, as the actual artificers of our Solomon's House. It is the names, the devoted purposefulness and the inspiration of a small series of persons, not just their particular achievements, which symbolize and give life to great movements, be these scientific or other. Those who knew Edgeworth David can readily conjure up the verve with which in his Anniversary Address to the Society on May 20, 1896, he quoted the following panegyric from the *Pall Mall Gazette* following the death of Thomas Huxley (1895): "Four Kings laboured to build a mighty hall, the Hall of a Hundred Columns at Karnak. In a century they built it, and they died; but the Hall remains. Four men (Darwin, Tyndall, Huxley and Spencer) more than all others have raised up within the 19th century an edifice which is the crowning glory of British science, and before the century closes three of them are dead; but the edifice stands and will stand, as a lasting monument to the power of truth and fearless investigation." Douglass, Clarke, Liversidge and David were scientific builders, too, meeting a challenge in another context, in a "new" land—in a new society.

PART II

THE CHALLENGE *OF* SCIENCE, 1966

The Passing of the Former Challenge

As we have seen, when our Society received its Royal Charter in 1866 it openly accepted the challenge of the Australian environment *to* science, by adding to its objects the clause: "to receive papers especially on such subjects as tend to develope the resources of Australia". In working for this objective it prepared the way through its Sections for the rise of specialist, scientific and scientifically based professional institutions, and through the thinking and advocacy of its leading members contributed in no small degree to the setting up of the C.S.I.R. (now C.S.I.R.O.) and the A.N.R.C. and the latter's successors. These various bodies have been meeting that challenge in their several ways, and as a result our Society is not sure of its role. Moreover, specializa-

tion within the sciences has made meaningless the presentation of original contributions to general meetings. Discussion and evaluation must be reserved for specialists within the narrow fields involved—and for the most part this means reference to specialist societies. Moreover, specialist journals now provide for such material so that it will not be "hidden" in general scientific journals, but be readily available to workers in the particular fields. Consequently, the range of material served by the Royal Society's Journal has been limited, and that quite apart from the increased cost of publication.

Consequently, during the past twenty years our Society has been passing through a period of uncertainty.

These changes have affected membership and attendance at meetings, and have given rise to a re-examination of the Society's role in the present phase of science in New South Wales. Is there anything for it to do? One possible service which has been tried was to provide a means of bringing together scientists from their apparently deeply separated fields so that they should become aware of what each was doing, and also realize the extent to which they might be studying different aspects of common problems. So lectures and symposia have been and are arranged. In this effort, however, the Society may be in danger of becoming what W. B. Clarke sought to avoid, namely, a group of persons who subscribe for the purpose of being "entertained" intellectually once a month. This measure, while being logical and useful, is rather stop-gap in character. A more positive role is needed. It is at hand.

The Philosophy of Science

The objects of the Society still include the discussion of original papers on subjects of Science, Art, Literature and Philosophy. We have tended over the century to confine ourselves to the first: only occasional papers or lectures have been given on Art and Literature; while, in line with W. B. Clarke's strictures on Philosophy as he conceived it, that subject has been given scant consideration. I suggest that the Society pay serious attention to the Philosophy, and by implication to the History, of Science, a subject which is now at last being recognized by universities. We are of age and should think seriously on these things. By its theories, accomplishments and discoveries and by what it makes possible, science is a challenge to our thinking and behaviour, and to our social and international order. The very discreteness of present-day science, its almost limitless specialization, and the tremendous range of its revelations, from the apparently boundless to the infinitesimal—these facts constitute a challenge to that sense of unity, which we gain both from our own being and also

from our own common existence in one universe. We may well say with Plato (in the *Republic*) that the true lovers of knowledge—and every member of the Royal Society would claim to be such—"will not rest in the multiplicity of particular things which is an appearance only, but will go on: the keen edge will not be blunted, nor the force of his desire abate until he have attained the knowledge of the true nature of each particular being, and then, and not till then, will he cease from his travail".*

The philosophical problems raised by science, apart from those inherent in the basic concepts we use, such as change, causation, space, time, matter, force, equilibrium, and so on, are moral and social on the one hand, and cosmological on the other—and although the latter is fundamental, we tend to avoid it. The probable reason is that so far we have failed to arrive at a sure and certain theory of the cosmos as a system, let alone at that knowledge of an ultimate reality which would explain that system, its why and whence, as well as its how. We are not satisfied with such classical explanations as are preserved, for example, by Vergil (in the *Aeneid*)

> "In the beginning know that heaven and earth,
> The rivery plains, the glittering orb of the moon,
> And the Titanic stars were animated
> By a Spirit within, and a Mind interfused
> Through every fibre of the Universe
> Gave vital impulse to its mighty form."†

This may be judged anthropomorphic, and yet the tremendous advances made in our grasp of relationships within the world, in space and time—the advances made in arriving at general formulæ under which these relationships can be subsumed and by which events, natural or initiated by man, can be predicted—these advances, I suggest, imply a universe, a system in which what we mean by mind and by logical order is expressed. As Mr. Knibbs, Statist, in the Anniversary Address in 1899, put it, "The world which the mathematician explores, and in which his discoveries are made, is the world of mind; the depths he sounds are the depths of human consciousness; the forms of truth which he perceives are the structures of that imponderable world not seen by the eye, but by the soul, for the relations and laws discovered are conceptual, not physical. The elements of the mathematician's world are those ideas, which it is the high function of intellect to project on to the world of sense in order to render it intelligible."

* From *The Works of Plato.* Selected and edited by Irwin Edman. Benjamin Jowett translation. The Modern Library, 1928.

† *The Aeneid,* Book VI, lines 724-727. Patric Dickinson's translation. A Mentor book.

However, we do not imagine that we are thereby changing the fundamental being of the universe from something not capable of being comprehended to a system which can be so grasped. True, what nature is in itself we may not yet know, but only what it seems to be and how it works; and yet it would be presumptuous to add that we will never understand. When we remember the great advances made in knowledge, shall we not ask with Galileo, "Who is willing to set limits to the human intellect?"

Today, however, we seem all too ready to set such limits, to make our intellect a collector and observer of facts—obtained with marvellous technological aids—which are fed into a computer, on the principle that only what can be treated in this statistical fashion can provide reliable information. But we should ask ourselves whether the urge to quantify and to reduce to statistical formulæ aspects of, and factors in, every situation, living and mental as well as physical, does more than keep the machines working. Does it lead to understanding?

Possibly we are less intellectually venturesome than some previous generations, or maybe we are so occupied with the technical demands of industry and defence, with meeting the challenge *to* science, that we are blind to the intellectual challenge *of* science itself. Copernicus not only moved the earth, as it were, from the centre of our universe to a place in the periphery of the solar system; Darwin not only substituted for cataclysms and new creations a theory of the interrelatedness of all forms of life on the earth; but in doing so these great expositors undermined men's cherished beliefs. Their visions, their theories, substantiated in a limited field, affected men's interpretation of the universe. After initial shocks, however, thinkers set out to explore it philosophically in the light of the new "revelations". Eventually these became part of man's intellectual adaptation to the universe, as Milton showed with regard to the Copernican cosmology:

> "What if the sun
> Be centre to the world, and other stars,
> By his attractive virtue and their own
> Incited, dance about him various rounds?
> Their wandering course now high, now low, then hid,
> Progressive, retrograde, or standing still,
> In six thou seest; and what, if seventh to these,
> The planet Earth, so steadfast though she seem,
> Insensibly three different motions move?"
>
> (*Paradise Lost,* Book VIII.)

And what if there be other suns! Man will still pursue his daily tasks and accept its joys.

But Einstein's Relativity theory; the Quantum theory; the space-time concept; the concept of the curvature of space; and even the suggestion that the universe may be tending towards a goal of eternal monotony marked only by "the random motion of minute particles": a Nirvana of individual nothingness! None of these concepts seems to have set us furiously to think. Do we just regard them as mathematical complexities worked up by specialists? Or are we so hypnotized by our apparently boundless technological achievements that we are unaware of the intellectual and metaphysical implications of what is happening?

Perhaps we have become blasé! Exploration of space is just another air journey? We bounce information off man-projected satellites; we relay information back from the moon; and before long we may relay men off the moon to explore other reaches of the solar system, somewhat as Plutarch suggested on "high authority that a good explanation of the moon is its function as a staging area for departed souls before they move out into the cosmos"; though we today expect that those who will launch off the moon will eventually return to earth.

The Moral and Social Challenge of Science

However, we are not quite so indifferent to the moral and social challenge which arises from the use of scientific knowledge. During World War II and in the years immediately following it, we talked much about the social implications of science. Indeed, my own Presidential Address to the Society just twenty-five years ago was on "Science, Society and Everyman". We also became concerned about, and are still concerned about, the requirement of secrecy in competitive industrial research and even more in defence research. This may involve duplication of effort, and barriers between workers in the same fields of fundamental inquiry. Moreover, it is contrary to scientific tradition. And yet we know that in time of stress, such as war, the nation is put before such tradition.

Unfortunately, this same condition of secrecy in prescribed fields of research is required in a fear-of-war phase such as we are now in. We live in the shadow of a great fear, because war could mean total destruction of civilization and/or some unforeseen biological tragedy—a consequence of the use made of the results of research in the study and laboratory. And scientists, being citizens and moral beings, cannot shrug the whole responsibility for this fear on to the shoulders of statesmen, industrialists and soldiers. These difficult questions of moral responsibility for the use made of discoveries and for the effects of secrecy requirements in research are problems for moral philosophy; and scientists, being involved, should not shrink from the challenge.

This great fear is the continuing psychological fall-out from the two atomic bombs which ended the Second World War so dramatically, and from the many, much more powerful, bombs stockpiled by several nations. Peace is being balanced precariously on fear, and none of the nations is prepared singly or collectively to make harmless the immediate cause of that fear, that is, nuclear bombs. If they did, they could work freely together for the solution of the basic economic, historical, social and racial issues behind international tensions. Research has done much to enable us to meet the challenge of these issues, provided that we can first meet the challenge *of* science itself: this is to grasp the nettle of the moral and social problems involved in the use we make of science and of its technological applications, both in and between nations.

We read in Vergil's *Aeneid* that as Aeneas and his Trojan expedition came near the shores of Italy, four white horses were feeding on the meadow grass. On seeing them, his father, Anchises, spoke:

> "Strange land, it is war you offer—it is war
> These horses are equipped for—it is war
> These creatures threaten. But it is also true
> That these four-footed creatures can be trained
> To draw a chariot yoked in harmony
> And happily harnessed—so there is also hope for peace."*

And then (says Aeneas) we offered up our prayers.

Today these horses on the cliffs just ahead of us can be likened to physical, chemical and biological forces of immense potential, which have been revealed through science and made available to man. They can be harnessed for *peace,* for the well-being of man, of all men everywhere—provided that the fourth horse, our moral strength, be great enough.

Therein lies the supreme challenge *of* science, 1966.

Perhaps we should add as Aeneas did:

"Tum numina sancta precamur."

* *The Aeneid,* Book III, lines 537-543. Patric Dickinson's translation. A Mentor book.