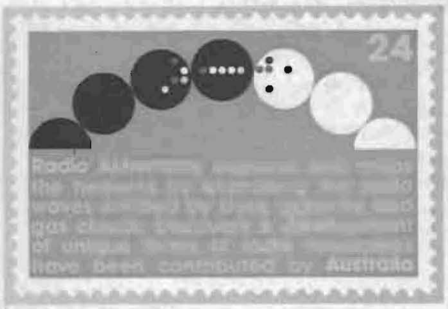
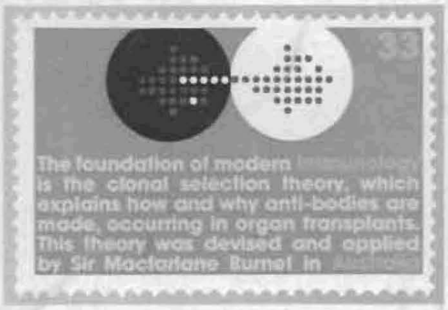
See page 68

PHILATELIC BULLETIN

Australian Post Office June 1975





Dr. Alan Walsh operating an early Australian-produced atomic absorption spectrophotometer.

Scientific Development

Australian scientific developments are the subjects of a series of definitive stamps issued by the Australian Post Office on 14th May, 1975. The series comprises 11c Atomic Absorption Spectrophotometry, 24c Radio Astronomy, 33c Immunology, and 48c Oceanography. These four denominations are the rates for the several weight steps for non-standard articles posted by surface mail within Australia.

The four designs show graphic illustrations which are symbolic of each subject, together with an explanatory caption of the subject matter; they are the work of Weatherhead and Stitt, Melbourne.

The stamps were printed by multicolour photogravure in sheets of 100 on the Chambon machine at the Note Printing Branch of the Reserve Bank of Australia, Melbourne, on KP5D Shoalhaven unwatermarked coated stamp paper containing helecon. Five cylinders were used for printing each of the four stamps. Colours, in printing order, are: 11c – greenish yellow, orange yellow, bright reddish violet, orange red, black; 24c – chrome yellow, bright reddish violet, pale blue, rosine, black; 33c – olive yellow, mauve, rosine, chestnut, black; 48c – greenish yellow, greenish blue, brown-ochre, bright lilac, black. Each stamp measures 37.5 mm x 25 mm, including perforations.

The subjects depicted on the stamps are four important fields of science in which outstanding contributions have been made by Australian scientists. Atomic absorption spectrophotometry, an analytical technique, was devised and developed by Australian scientists; the Commowealth Scientific Industrial Research Organisation's Division of Radiophysics was a pioneer in the development of radio astronomy; and significant contributions in the fields of oceanography and immunology have also been made in Australia.

Atomic Absorption Spectrophotometry

Research by scientists in the C.S.I.R.O. Division of Chemical Physics on the absorption of light by atoms in a flame led to the development, some years ago, of atomic absorption spectrophotometry.

The instrument, an atomic absorption spectrophotometer, can identify and measure minute amounts of particular elements, in a wide variety of liquids and solids.

Acclaimed as "the most significant advance in chemical analysis of this century", it has been an increasingly useful tool in research in many fields, bringing tremendous benefits to agriculture and industry and to medical research.

For instance, when a badly-burnt child in Sydney Hospital failed to respond to treatment, doctors began a series of tests using an atomic absorption spectrophotometer. The results showed a severe loss of magnesium as a result of the burns. This was replaced and the child, then very close to death, recovered. The measurement of magnesium in blood samples had rarely been attempted before because it was too difficult by previous methods.

In agriculture atomic absorption spectrophotometry has helped scientists investigate the role of various metallic elements in plant and animal nutrition by speeding up and simplifying the analysis of soils, and plant and animal tissues.

The spectrophotometer has also had a revolutionary impact in the field of mineral exploration where ore samples have to be analysed for metals such as copper, zinc, nickel and lead. Hundreds of thousands of such samples are now analysed annually in Australia.

Atomic absorption spectrophotometry is extensively used in the Australian Post Office Research Laboratories for the determination of trace elements in telecommunication equipment; e.g. the technique is applied to the analysis of steels, ferrous alloys and magnetic materials used for relays and switching devices, antenna and microwave structures, and automotive and stationary generating plants.

The technique behind the application appears at first sight to be simple enough. If, for example, the amount of nickel in an ore sample is to be measured, the sample is first dissolved and vaporised in a flame. A beam of light from a specially-designed lamp, which emits light at a wavelength characteristic of nickel, is then passed through the flame. Some of this light is absorbed by the atoms of nickel in the flame. Measurement of the amount of light absorbed in the flame gives a precise determination of the amount of nickel in the sample.

The simplicity of the operation gives little indication, however, of the painstaking research that went into making the instrument a practical reality.

The world's first atomic absorption spectrophotometer was produced by C.S.I.R.O. It was originated in 1953 by Dr A. Walsh in the C.S.I.R.O. Division of Chemical Physics, Clayton, Victoria. After about 30 Australian laboratories had been equipped with instru-

An experimental multichannel atomic absorption spectrophotometer for the simultaneous determination of six elements.

ments whose manufacture in Australia had been arranged by the Division, commercial firms were permitted to manufacture them under licence to C.S.I.R.O.

Radio Astronomy

The stars we see at night are much the same as our own sun. Although they are far apart, in terms of very much vaster distances of the universe, they are clustered together in what we call a galaxy.

Outside our galaxy, and at staggeringly great distances, lie thousands of millions of other galaxies which make up the rest of the universe. Just as the optical astronomer studies the stars and the galaxies by observing the light waves which reach him across enormous distances of the universe, so the radio astronomer studies them by observing the radio waves which reach him from outer space.

The radio astronomer uses radio telescopes – elaborate aerials and receivers which can pick up and magnify the feeble radio signals from distant space which tell him so much about the structure and origin of the universe.

The story of radio astronomy began in 1932 when a young engineer working in the Bell Telephone Laboratories in America discovered that radio waves were reaching the earth from outer space. At least some of them seemed to be coming from our own galaxy.

This discovery aroused little interest and radio astronomy may have lapsed into oblivion for a decade except for the initiative of one man, Grote Reber, a radio engineer in Illinois, U.S.A. In his backyard, he built the first radio telescope, and surveyed the Milky Way. It is of interest that Reber is now an Honorary Research Fellow of the Radiophysics Division of the C.S.I.R.O. and still works on radio astronomy in Tasmania.

Then in 1942, when British radar observers were searching the sky for enemy aircraft, they sighted mysterious "blips" on their radar screens; it was realised later that the mysterious signals appeared only when the radar aerials were scanning across the sun, and that there had been large groups of sun spots at the time.

However, it was not until 1946 that the C.S.I.R.O. Division of Radiophysics, with radar equipment developed during the war, showed beyond all doubt that the unusually strong signals from the sun came from active sunspots.

In the same year the Division made another exciting discovery. It identified the Crab Nebula as a direct source of radio emission; this was the first so-called "radio star". Since then many thousands of radio sources have been found by radio astronomers in Australia and overseas.

The Division also found that its radar equipment could be used to study cloud and rain formation, and so a cloud physics group was set up. This group has since become a separate C.S.I.R.O. Division (Cloud Physics).

In the last 25 years the Division of Radiophysics has developed some remarkable radio telescopes.

The most famous of these is the 64-metre telescope at Parkes, New South Wales, which was completed in 1961.

It is still effectively one of the most powerful and sensitive instruments of its kind in the world and can receive radio waves from 15,000 million light years away (a light year is nearly 6,000,000,000,000 miles). It has been used to study radio emissions from the sun, the moon and the planets, to map our own galaxy, and to observe the myriad galaxies beyond.

After only a few years of operation, this telescope has helped to revolutionize our understanding of the universe.

One of the most exciting moments came in November 1962, when the Division pinpointed a radio source known

I am becoming a patriarch! G.R. 24/7/75

as 3C273, by tracking it as it was eclipsed by the moon. Its position was established with such accuracy that optical astronomers in California were able to train the famous 200-inch Mount Palomar telescope on to this spot where they found a faint star-like object quite different from anything they had ever seen.

Since then a number of similar objects, called "quasars", have been found. So far, radio astronomers have been unable to explain them, but they believe that quasars may hold the key to the origin of the universe.

While this constant prying and probing at the very edge of the universe goes on, radio astronomers have not forgotten our own star, the sun. At Culgoora, near Narrabri, in New South Wales, the Division has another giant radio telescope for taking moving "radio pictures" of the sun. This unique instrument, called a radioheliograph, was conceived, designed and constructed by the Division of Radiophysics. It consists of 96 dish-shaped aerials each 13.7 m across, spaced in a circle with a diameter of 3 km.

Each dish is automatically steered to follow the sun. Radio signals from the sun are picked up by the aerials, amplified, and then carried along overhead transmission lines which – like a giant spider web – converge on the central observatory. Here the signals are fed into a complex of electronic circuits and computers and finally displayed as a picture on a T.V. tube at the rate of one a second.

The radioheliograph thus gives a detailed second by second picture of the sun in the light of the radio waves emitted by the sun at frequencies of 43, 80 and 160 MHz. These pictures are the sort of thing we might see if our eyes were sensitive to radio waves of this frequency. Before the radioheliograph came into operation in 1967 the fastest radio picture of the sun took about 45 minutes to compile.

Near the centre of the giant ring of aerials, the C.S.I.R.O. Division of Physics has set up optical telescopes to study the sun. The combination of optical and radio astronomy facilities has enabled C.S.I.R.O.'s observatory at Culgoora to take its place as one of the world's leading centres for solar research.

Since World War II the C.S.I.R.O. Division of Radiophysics has established an international reputation in the field of radio astronomy.

CSIRAC, the first electronic computer to operate in Australia and one of the first of its kind in the world, was built in the Radiophysics Laboratory, and some navigational aids for aircraft were invented. One of them, D.M.E. (Distance Measuring Equipment), tells a pilot how far away he is from reference points on the ground. This discovery placed Australia years ahead of any other country in aircraft navigation.

D.M.E. is now a compulsory aid on all passenger aircraft in Australia and it has contributed to the excellent safety record of our airlines.

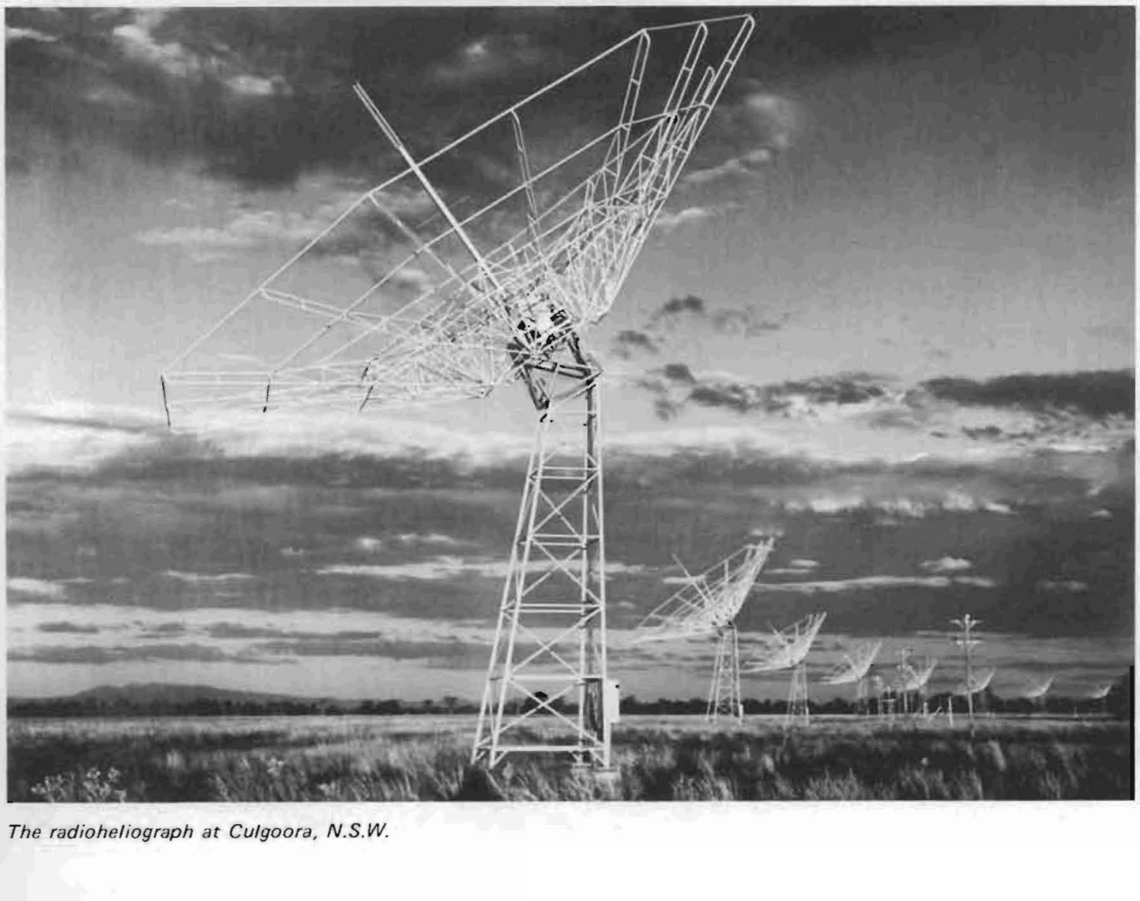
Recently the laboratory has returned to radio navigation problems and has invented a landing system called Interscan. It is based on concepts derived from radio astronomical experience. The system has won the approval of the U.S. Federal Aviation Administration and may possibly be adopted by the International Civil Aviation Organization for world-wide use in the 1980s.

Immunology

Since the turn of the century the attention of medical researchers has been increasingly directed towards the workings of the immunity system. The discovery that patients who recover from a bacterial infection were often protected from subsequent disease by that particular infection led logically to attempts to prevent infectious disease by immunization. This kind of immunity is known as passive immunity.

Spectacular successes were achieved for tetanus, diphtheria and smallpox and it became clear that the harnessing of the immune response was a major priority.

The amazing specifity of the immune response, such



The radioheliograph at Culgoora, N.S.W.

that an attack of flu would protect a patient from the strain of flu virus responsible, but leave him susceptible to attack by a very closely related virus, had to be determined, as did the function of the system in tissue transplantation rejection.

A skin graft transferred from any individual to another is promptly rejected. Only tissue transplantation between identical twins results in a permanent "take" of the graft tissue.

Thus there must exist inherited difference between individuals, expressed in tissue cells and capable of recognition as "not self" by the immune system of the new host.

In the 1950s, an eminent Australian scientist, Sir Frank McFarlane Burnet, then Director of the Walter and Eliza Hall Institute of the Royal Melbourne Hospital, Victoria, presented the concept of clonal selection.

The theory, which was termed the clonal selection theory of antibody formation, is the basis of modern immunology. It predicted that the body contained a preformed, large library of lymphocyte specifities capable of recognizing "attack" by a particular antigen (foreign organism). In essence, the theory stated that the immune response system is man's means of identifying and resisting any foreign organism (bacteria, virus) that "attacked" the body. The main agents of the system are white blood cells called lymphocytes, each lymphocyte having a different receptor pattern on the surface. When a foreign organism enters the body it has no effect on the majority of lymphocytes but only on those which carry on their surface a receptor for that of the "attacking" antigen. These selected lymphocytes, which are already manufacturing, at a low rate, an antibody that corresponds to the infecting organism, immediately begin to multiply rapidly as a result of the antigenic stimulus. The name for a series of cells reproduced from a single ancestral cell is clone and thus the name clonal selection.

Since it takes several days to form antibodies in sufficient quantity to destroy the foreign organism the infection is well-established by the time the antibodies come into action. But once the antibodies have formed in sufficient numbers they will "attack" and destroy the foreign organism. This is known as active immunity. A second infection from the same antigen can be counteracted at once, before it establishes a hold. However, not all infectious diseases give lasting immunity, but most epidemic diseases do so.

Oceanography

Oceanography is the study of currents, tides, the movement of oceanic water masses, and the identification of their chemical and biological properties.

The history of the study of the sea first began in any detail in the late fifteenth and the sixteenth centuries when many great voyages of discovery were undertaken by European navigators, culminating in the circumnavigation of the earth by Ferdinand Magellan in 1519-22.

Initially these early navigators set out to explore the surface of the earth in order to discover new lands for trade. In the course of exploration they discovered not only new land masses but new oceans. From their discoveries rough charts of the world were compiled showing the distribution of land and water. The discoveries made by Cook and other eighteenth century navigators added more and detailed scientific information about the oceans to the charts.

In 1853 the first international oceanographic conference was held in Brussels where it was agreed to make uniform the methods of making nautical and meteorological observations. During this period many important aspects of oceanography were being investigated by scientists, including the chemistry of sea water, deep soundings and the presence of marine life in the depths of the ocean.

It was not until 1872, however, that the first great oceanographic expedition was undertaken. In December of that year the "Challenger" set out from England, returning in May, 1876, after traversing the Atlantic, Pacific and Southern oceans and collecting the first comprehensive data about the ocean.

Since the "Challenger" expedition there have been many subsequent expeditions concentrating on a variety of aspects of marine science; some of them were of major importance.

At the beginning of this century extensive marine biological expeditions were carried out in the world's oceans, notably by the Dutch, the Germans and the Russians. Then came a period in which there was increasing concentration on physical and chemical oceanography. In the early 1920s the German research vessel "Meteor" worked in the north and south Atlantic. In the next 15 years there were a number of global oceanographic expeditions by the Swedish research vessel "Albatross", the Danish vessel "Dana" and the Dutch vessel "Snellius".

From the early 1930s to the beginning of World War II the United Kingdom research vessel "Discovery" undertook a systematic study of the oceanography of the Antarctic seas.

After the war oceanography came of age as a science with the development of sophisticated instrumentation. The United Kingdom, Germany, U.S.S.R., U.S.A., and Japan engaged in intensive investigations involving accurate measurements of ocean currents, water properties, biological features and the geology and geophysics of the sea bed, the latter leading to the theory of continental drift.

In Australia, C.S.I.R.O.'s Division of Fisheries and Oceanography became committed to this type of oceanography in the early 1950s, culminating in its extensive participation in the Indian Ocean Expedition, (1959-1965) a co-operative investigation of the Indian Ocean involving the ships of thirteen nations. This expedition set a new pattern in oceanographic investigation with the concentration of resources in terms of many ships and scientists on a single area.

Most Australian oceanography is now carried out by the Division of Fisheries and Oceanography.

The chemistry section of the Division is concerned with two distinct areas of interest, the coastal shelf waters and the deep sea ocean waters. In the study of coastal waters, projects include regular monitoring of the characteristics and the variability of the sea. Special attention has been given to the effects of the Snowy Mountain Hydro-Electric Scheme which diverted rivers formerly flowing east to the coast, over to the western side of the Great Dividing Range.

Chemical work beyond the coastal fringe, which is dependent on the use of Navy ships and chartered vessels, concerns the identification of water masses and the determination of their structure; their analysis can point to large-scale water movements in the deep ocean involving very long time periods; for instance, North Atlantic water has been detected in deep waters to the south of the Great Australian Bight.

A drift card programme is currently in operation to study surface currents and their seasonal variations. The programme utilizes red plastic cards, about five inches long and shaped like a fish to attract attention when they are washed ashore or caught in fishermen's nets; a "please return" message is stamped on the cards which are released each week offshore from Port Hacking, N.S.W., and Rottnest Island, W.A., and each fortnight from Laurietown and Eden, N.S.W.

Charts of the salinity and temperature conditions of the Tasman and Coral Seas are being prepared each month from data collected by twenty merchant ships, which carry thermographs; these continually measure the temperature of sea water, taken from about ten feet below the surface, and brought in to cool the engines. Samples of the water are collected at regular intervals for later analysis. This information is an aid in predicting movements of the surface waters of the Tasman and Coral Seas, fish distribution and weather phenomena.

In a study of the effect of the East Australian Current on sea level at the coast, sea level is measured by tide gauges at many points along the coast. For the measurement of the current, the variation of passage time of merchant ships is used to calculate its speed and direction.