THE AUSTRALIAN UNIVERSITIES COMMISSION

THE second report of the Australian Universities Commission* covers the 1961–63 triennium and the Commission's recommendations for the triennium 1964–66, for the first two years of which the rapid growth in numbers of students which marked the 1961–63 triennium is expected to continue. The report covers 10 universities, including the Australian National Institute of Advanced Studies and School of General Studies, both founded in 1946. Total enrolments of students increased from 53,391 in 1960 to 68,949 in 1963 and a total of 94,650 is forecast for 1966; the number of equivalent full-time students is given as 41,164, 52,225, and 73,740 respectively; and of full-time staff, 3,849, 4,748, and 6,704, the two latter figures assuming a student/staff ratio of 11 : 1. Recommended grants for the 1961–63 triennium totalled £124·8 million. During the triennium, establishment of new university colleges at Townsville and Wollongong was supported, as well as a new university institution at Bedford Park, Adelaide (*Nature*, 201, 553; 1964), and a new technological institution at Whyalla. During the 1964–66 triennium, establishment of further university institutions in the Sydney and Melbourne areas is recommended, together with a university college at Newcastle.

Of 51,395 students enrolled for bachelor degrees in 1962, 8,420 were in science, 5,144 in medicine, 6,107 in engineering and 14,979 in arts. About two-thirds of full-time students appear to receive some form of assistance from public funds. There has been a steady increase in postgraduate students since 1957, from 1,357, or 3·69 per cent of the total enrolment to 3,691 or 5·64 per cent, in 1962, and the figure is expected to reach 6,900 in 1966. Sponsored overseas students numbered 1,146 at June 30, 1962, and the total of overseas students in 1962 was 3,895, or 6 per cent of enrolments. Of estimated full-time academic staff in State universities in 1963, 391 were professors, 365 readers, 1,149 senior lecturers, and 1,529 lecturers. The ratio of academic staff to students varies widely for faculties, and the report indicates that recruitment of high-calibre staff presents the same problem as in the United Kingdom.

As in the preceding triennium, a notable feature of the 1961–63 triennium was the growth of the research programmes and postgraduate schools of the Australian universities. Enrolments for Masters' degrees increased from 2,048 in 1961 to 2,493 in 1962 and 3,040 in 1963, and are expected to reach 4,283 in 1966; for Ph.D. degrees, the corresponding figures are 1,092, 1,341, 1,620 and 2,572. Expenditure on research in Australian universities rose from £3,048,617 in 1959 to £3,610,564 in 1960 and £5,204,831 in 1961. Of the last-mentioned total, 38·8 per cent was in biological (including medical and dental) sciences, 40·4 per cent in physical sciences, 5·6 per cent in technology and applied science, and 12·3 per cent in social sciences. Of the 1961 total £2,041,915 was from external sources.

A separate chapter in the report describes the spectacular advance in the development of electronic data processing equipment for scientific purposes. Two committees were appointed to deal with this field in 1960; one was a policy committee to co-ordinate the installation of computers for Commonwealth of Australia organizations and universities; the other was an expert inter-departmental committee to co-ordinate computing activities in Government departments and agencies. For the 1961–63 triennium, the Australian University Commission offered grants up to £30,000 to universities without computers for installing modest facilities out of an approved capital research equipment grant of £1 million; and for the 1964–66 triennium, grants totalling £948,000 have been recommended. Including a Commonwealth grant of £1 million, it is estimated that more than £2·8 million was spent in 1961–63 on affiliated residential colleges and about £1·5 million on halls of residence, and at the end of the triennium 14·3 per cent of the students were in residence. For the 1964–66 period, grants totalling £1·2 million for affiliated residential colleges and £3,463,000 for halls of residence are recommended, and at the end of the triennium the proportion of students in residence is expected to rise to 16–17 per cent. For the 1964–66 period, grants totalling £172 million are recommended, of which £81·4 million is from the Commonwealth and £90·6 million from the States. Of the total, £123 million is in recurrent grants and £39 million in capital grants. The report gives considerably greater detail of recommended grants for each university institution than is customary in the quinquennial reports of the University Grants Committee in Britain. There are also illustrations, and among several appendixes are the report of the Committee on University Salaries, a note on the computer network for the Commonwealth of Australia and some designs for halls of residence, in which the cost of new places is estimated at £2,000 per place.

* Commonwealth of Australia. *Australian Universities, 1961–1966*: Second Report of the Australian Universities Commission. Pp. ix + 124 + 71 photographs. (Melbourne: Australian Universities Commission, 1963.)

PHYSIOLOGY, ECOLOGY AND BIOCHEMISTRY OF GERMINATION

AN international symposium on "Physiology, Ecology and Biochemistry of Germination", organized by Prof. H. Borriss to mark the two-hundredth anniversary of the Botanic Gardens of the Ernst-Moritz-Arndt-University at Greifswald, Germany, in September 1963, was a memorable occasion. Contributions were received from all continents, although those attending the meeting came only from European countries. Among the 100 papers in the programme, the chief and most-discussed topics were the induction and the breaking of dormancy; the roles of light (mainly effects on the phytochrome system), temperature, atmospheric gases and seed coats; of chemical inhibitors and promoters, foremost among them were the gibberellins; metabolic changes connected with water uptake before and during germination; and the many and intricate interactions between these factors.

The symposium gained much from the wide interpretation of its subject, which included the breaking of the dormancy of vegetative as well as generative organs, and also of bacterial and thallophyte spores.

A paper by Haber (United States) showed that mitosis and photosynthesis can proceed within dormant lettuce seeds, and that dormancy proper is due to a 'block' which specifically prevents elongation of the embryonic axis. Black (Great Britain) discussed the role of the period of unbroken darkness in relation to the dormancy of seeds of two species, *Nemophila insignis*, a low-temperature or alternatively a 'short-day' seed, and *Betula pubescens*, a high-temperature or alternatively a 'long-day' seed. In both cases the photoperiodic sensitivity only becomes apparent over a narrow range of temperature and only so long as the seed coat is intact. In *B. pubescens* the

causes of dormancy are probably the slow decay of light-produced promotive agents during long dark periods, as well as the presence of germination inhibitors in the seed coat and restricted oxygen supply to the embryo. In *Nemophila*, long dark periods are required, probably for the far-red (or blue ?) absorbing form of phytochrome to be effective and cause germination.

Mohr (West Germany) discussed the diversity of responses to light in thallophytes. Thus the mechanism of spores of the liverwort, *Sphaerocarpus donnellii*, is extraordinarily complex: they do not germinate in darkness; they are day-neutral in far-red light but require short days in white light owing to the effect of its red component on their endogenous diurnal rhythm. Borriss (East Germany) showed that the application of inhibitors increases the light sensitivity of seeds, whether they be dark- or light-requiring; this decrease in their readiness to germinate is probably due to a process which is not directly connected with the primary photo-reaction; neither inhibitors such as *p*-chloromercuribenzoate nor stimulants such as potassium cyanide are likely to operate through an effect on respiration, since the oxygen consumption of imbibed seeds varies very little, irrespective of whether they are inhibited or promoted. On the other hand, Nyman (Sweden) considered that the photo-reaction of phytochrome in *Pinus silvestris* seeds (where even light given to unimbibed seeds promotes germination) chiefly affects germination by means of the mechanism of anaerobic respiration.

Göring (East Germany) demonstrated that when respiratory intensity (measured as uptake of oxygen) is plotted against total dry weight, no significant difference is generally apparent between inbred and hybrid maize; however, cell size in hybrid is smaller than in inbred seeds and therefore the respiration per cell in hybrids is more economical and, *in toto*, more productive. Arndt (East Germany) found in her work with non-after-ripened *Agrostemma githago* seeds that the temperature ceiling for their germination is raised from 10° C to 20° C by an increase in the carbon dioxide content of the atmosphere: even a large number of seeds in an incubator is sufficient to initiate this effect. Analogous observations were made by Heydecker (Great Britain) on lettuce seeds, where increasing atmospheric carbon dioxide contents resulted in increasing germination percentages at the 'ceiling' temperature of 25° C. Similarly, a paper by Ballard (Australia) showed that after a few days' cold-treatment or removal of the seed coat—neither effective in itself—brief exposure to an atmosphere high in carbon dioxide completely breaks the deep dormancy encountered in certain batches of *Trifolium subterraneum* seeds. Using $^{14}CO_2$, he demonstrated that dormant seeds accumulate the isotope four times more intensively than non-dormant ones; he considered that carbon dioxide probably acts non-specifically, by setting in motion the normal citric acid cycle.

Isotopes were also used by Borriss and Engelbrecht, who showed that phosphorus from $Na_2H^{32}PO_4$ can be accumulated by *Agrostemma* seeds and incorporated into various fractions of organic compounds of the embryo before there is any sign of radicle emergence. Significantly, seeds blocked by high-temperature treatment (30° C) incorporate much less phosphorus-32 than ungerminated seeds which have been activated by lower temperature (10° C). On the other hand, no such temperature relation was found by Pilgrim and Borriss for the dark-fixation of carbon dioxide by imbibed *Agrostemma* seeds.

Agrostemma seeds were also the object of an investigation by Borris and Hempel into the role of native growth substances, and they concluded that germination is probably often regulated by a complex interaction of gibberellins and auxins. Mohr (West Germany), in one of the discussions on gibberellins, produced evidence to show that seeds do not necessarily possess gibberellin-controlled germination mechanisms simply because gibberellins can stimulate their germination. This property of gibberellins is nevertheless often very pronounced indeed. Thus Borriss found that seeds of *Honkenya peploides* are particularly sensitive to gibberellic acid (GA_3) and respond to concentrations of less than 0·01 p.p.m. (10^{-3} γ per seed); furthermore, effects of gibberellin 'GD', a mixture of 80 per cent GA_4 and 20 per cent GA_7, can be 5–1,000 times as strong as those of GA_3; but even effects of definite gibberellins on definite kinds of seed are not constant; they are most pronounced in an acid medium (optimal *p*H 3·6), buffered preferably with a citrate rather than a phosphate buffer and, as with other germination promoters, many species-specific differences exist concerning the degree of importance of the contributing factors; in general, effects are most marked when seeds are in a 'labile', that is, still partly dormant, condition. A paper by Mohill (Israel) and Paleg (Australia) presented evidence that sugars added to the germination medium do not enhance, and often even counteract, the stimulating effect of GA_3 on dormant lettuce seed. Nikolayeva (U.S.S.R.) reported on differences in the effect of GA_3 on germination, depending on the kind of seed and the GA_3 concentration. Thus seeds of a number of annuals, including *Sinapis alba* and *S. juncea*, are inhibited by 0·05 per cent GA_3; at 0·005 per cent, the former still remain inhibited, but germination of the latter is stimulated. Gibberellic acid also can stimulate germination of 'weakly dormant' seeds which normally respond to exposure to light or to dry storage or a short cold period. On the other hand, the 'deep' dormancy of certain kinds of seed is, according to Nikolayeva, due to an interacting dual mechanism, involving the prevention by the seed coat of gas exchange and the production of an inhibitor by the embryo. Such seeds require a long period of moist-chilling ('stratification'), which cannot be replaced by light or dry storage; and they respond to gibberellins only under specific conditions; for example, with seeds which normally require alternating temperatures during stratification, such as *Euonymus europaeus*, imbibition periods in gibberellic acid can replace the warm periods. Also, excised embryos of deeply dormant seeds, which ordinarily produce 'dwarfs' if not stratified, can be promoted into normal growth by gibberellins. The mechanism responsible is not known but, like many processes promoted by gibberellins, is thought to be non-specific. A paper by Villiers, Frankland and Wareing (Great Britain) suggested that where the inhibitor in the embryo (for example, of *Fraxinus excelsior*) remains fully active even during germination, the breaking of dormancy may be due to the production of gibberellin-like endogenous promoters under specific conditions. Concerning desirable conditions during stratification, Suszka (Poland) found that the dormancy of seeds of most *Prunoideae* is much more effectively broken by a warm–cold sequence than by a straight cold treatment. Two weeks at 20° C followed by a prolonged period at 1°–3° C appeared optimal in Poland, but there was evidence that the best 'cold' temperature may vary with the provenance of the seed and may be higher (up to 8° C) when the seeds are produced in a less extreme climate. Ludwig and Junges (East Germany) showed that the factors influencing the degree of dormancy of seeds of *Impatiens balsamina* (a short-day plant), which are often dormant up to five months after maturation, and of grains of malting barley (a long-day plant) are very similar. In both cases low temperatures, scarcity of sunshine, and much rain while the seeds are maturing induce dormancy, although the effect of high rainfall is counteracted by high nitrogen supply (certainly in balsam, probably also in barley). Dormancy is also more pronounced in samples with a higher than with a lower 1,000-grain mass. Other important effects of provenance were found by Galatschalova and Marussina (U.S.S.R.), who showed that wheat grains grown in southern Siberia have a higher dry matter and protein–nitrogen content than those grown in northern Siberia; the southern grain

germinates better and produces more vigorous plants. Schubert (East Germany), working with seeds of *Robina pseudacacia* on the thorny problem of seed quality evaluation, found that dehydrogenase activity, indicated by the change of colourless triphenyl tetrazolium chloride into bright red formazan, is indeed a reliable index of the viability and vitality of seeds, provided pre-soaking and treatment are effectively standardized and the results receive expert interpretation. To verify his conclusions from the tetrazolium (TTC) test, Schubert has developed a non-lethal TTC treatment (0·01 per cent for 24 h), which permits normal germination and seedling growth. One disadvantage of TTC is its failure to record heat damage to tissues. Lindner (East Germany) demonstrated a similar inability of TTC to differentiate between normal seeds and those which have been damaged by excessive levels of mercury fungicides. In an attempt to forecast the performance of seeds in the field (their 'vigour') Lindner had found that with many farm and garden seeds, notably cereals, the upright-rolled-paper (*Keimrollen*) test provides much more information than other tests about the quality of consignments of seeds, since seeds which germinate but weakly can be clearly observed.

A number of speakers dealt with the modification of plant performance through the manipulation of germinating seeds. Krekule (Czechoslovakia) pointed out the importance of standardizing both the stage of germination reached and the water content of the seed at the time when vernalization is applied: a close correlation between the growth made before, and the result achieved by, vernalization exists only within narrow limits, outside which the results may be erratic. In a fascinating review, Henkel (U.S.S.R.) dealt with the utilization of what he called the 'plasticity' of plant material: for example, re-imposition of drought on imbibed seeds of many species increases the viscosity and elasticity of their protoplasm, enabling the resulting plants to withstand drought or heat later in life better than would unprepared plants.

Several papers dealt with the germination of bacterial spores. Lund and Norris (Great Britain) investigated the enzyme and antigen changes during germination of *B. cereus* spores using starch-gel and immuno-electrophoresis. A paper by Vinter (Czechoslovakia) dealt with the characterization of the individual steps of the development of spores into vegetative structures, and Mach (East Germany) reported on the ultra-structure of germinating *Streptomyces* spores.

There is little doubt that the *Proceedings* of this fertile symposium, to be edited by Prof. Borriss and published by Gustav Fischer, Jena, will be consulted for many years to come. Here are shown not only the complexity and the specificity but also the recurring patterns, which have been uncovered in the processes that occur during the vital transition from dormancy to growth.

It remains to be hoped that the international exchange of ideas which was made possible at Greifswald by personal contact will continue, irrespective of political frontiers.

W. HEYDECKER

PHARMACOLOGY AND THERAPEUTICS IN PAKISTAN

THE Pakistan Society of Pharmacology and Therapeutics, which was formed on July 14, 1962, was officially inaugurated on March 20, 1963, at Lahore by Dr. Salimuzzaman Siddiqui, chairman of the Pakistan Council of Scientific and Industrial Research. The inauguration was held during the fifteenth All-Pakistan Science Conference with the necessary assistance of the Pakistan Association for the Advancement of Science. Dr. S. M. K. Wasti (Lahore), who was appointed as the organizing secretary by the Pakistan Association for the Advancement of Science, acted as a liaison officer between the Society and the Pakistan Association for the Advancement of Science. The help from the Departments of Health of the Government of Pakistan and of the Governments of the East and West Provinces, which enabled all the professors of pharmacology in Pakistan to attend the inauguration, needs a special mention.

The inauguration ceremony opened with a recitation from the Quran. Prof. A. Hameed Khan (Lahore), chairman of the reception committee, welcomed the participants and pointed out that the rapid growth of pharmacology needed a high standard of education and training in that science. He also emphasized the importance of pharmacologists in the drug industry and of the need for a fully equipped and properly staffed laboratory for drug testing, including facilities for the biological standardization of products manufactured in Pakistan. Prof. S. M. A. Zaidi (Hyderabad), general secretary, in his introduction, mentioned the various important objectives of the Society which included an improvement in the teaching of the subject in order to make drug therapy absolutely safe in the hands of medical practitioners. He also referred to the proposed role of the Society in promoting research, specially on the indigenous plants of medicinal value. Prof. Zaidi also outlined the part which the Society could play in the compilation of a *National Pharmacopœia* for Pakistan.

In his presidential address Dr. Siddiqui said that scarcely 2 per cent of the 191,000 species of flowering plants had been examined for alkaloids. He appealed to all the pharmacologists in Pakistan to devote their efforts to the investigation of the medicinal plant wealth of the country, with the view of developing new therapeutic agents for the treatment of human ailments on a scientific basis. Referring to pharmacological research on the medicinal plants, Dr. Siddiqui concluded his address by saying, "It is, indeed, a truly virgin field of scientific and economic endeavour, and it shall be my hope that your Society will in all earnestness accept the challenge and the opportunity it offers".

The inaugural address was followed by the presidential address, which was given by Prof. Nazeeruddin Ahmed (Multan). In his address, Prof. Nazeer criticized the teaching of pharmacology as recommended by the Medical Reforms Commission. He said that "the report of the Medical Reforms Commission has forcibly put the pharmacological cart before the physiological horse. This anomalous situation has added greatly to the burden of the teachers and the taught because the fabric of pharmacology normally rests on the foundation of physiology". Prof. Nazeer mentioned a number of useful purposes which the pharmacologists and the teaching departments of pharmacology in Pakistan could solve, for example, standardization of drugs, training of dispensers, etc. Later, Mr. A. Campbell Benzie (Burroughs Wellcome and Co.) read out the messages of goodwill received from both Pakistan and abroad. Prof. M. Rabbani (Lahore), who is Pakistan's most senior pharmacologist, described the formation of the Society as a great step in the scientific progress of the country and congratulated the pioneers. He thanked the delegates and other participants and the organizers of the inaugural function.

At the symposium on "Pharmacology" which followed, a number of papers on various aspects of the subject were read. The opening paper, "The Scope of Research in Pharmacology in Pakistan", was given by Prof. Mir Mansur Ally (Dacca), who, besides elucidating the importance of the natural drug resources, pointed out the