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A COLLEGE OF AERONAUTICS

AN Interdepartmental Committee on the Establishment of a School of Aeronautical Science was set up in October 1943, under the chairmanship of Sir A. H. Roy Fedden, who had just returned from a mission to the United States, where he had studied, among other matters, the system of aeronautical education in that country. The members of the committee dealing with the scheme were Sir A. H. Roy Fedden (chairman); Sir Alan Barlow, Treasury; Commdr. M. S. Slattery, Admiralty; Mr. W. P. Hildred, Air Ministry; Air Marshal Sir Ralph Sorley, Ministry of Aircraft Production; Sir John Stephenson, Dominions Office; Dr. W. Abbott, Ministry of Education; Sir Charles Darwin, Department of Scientific and Industrial Research; Sir B. Melvill Jones, Aeronautical Research Committee; and Sir Walter Moberly, University Grants Committee. Detailed memoranda and oral evidence were given by representatives of the various interests concerned, a list of which is added to the report*.

The Committee's report states that the object of the suggested college should be to provide a high-grade engineering, technical and scientific training in aeronautics for selected students to fit them for leadership in the aircraft industry, civil aviation, the Services, and for education and research. Sir Stafford Cripps, Minister of Aircraft Production, has already stated, in the House of Commons, that the Government accepts the report in principle and that the Air Ministry is making temporary accommodation available. It is understood that this is to be at Abingdon Aerodrome, Oxfordshire. The cost of this adaptation is likely to be about £150,000, with an additional £300,000 for equipment. The complete scheme, which it is suggested should be situated at either Aldermaston in Berkshire or Dunsfold in Surrey, will cost £2,610,000, with an annual upkeep of £380,000. About £150,000 would also be needed for removing and adapting apparatus from the temporary to the permanent site, and this must be regarded as an expenditure justified by the urgency of the need for starting the scheme at once.

While the efficient use of any applied science by industry must depend upon a continuous flow of scientifically trained entrants, the aeronautical world makes an even greater demand in that its new men need a more comprehensive training. They must be scientific men first, probably either physicists or engineers, and then be further trained in the technology of the application of their science to aeronautics. This is particularly true of engineering, where many problems arise that are peculiar to aircraft and aero-engine design and construction. Education has its own need as well. Facilities for obtaining the more elementary and technological training need to be much more widely spread over the country than they are at present. Such courses will be able to give the shorter theoretical and more practical training to those needing only this, in their own localities, and

* Ministry of Aircraft Production. A College of Aeronautics: Report of the Interdepartmental Committee on the Establishment of a School of Aeronautical Science. Pp.ii+98. (London: H.M. Stationery Office, 1944.) 2s. net.

will also provide a suitable flow of candidates to the proposed college, as well as to the universities. The Ministry of Education is already preparing plans for such courses in many of the local technical colleges and institutions, under extensions of the National Certificate scheme, and some of the universities are considering the question of undergraduate courses in aeronautics and aeronautical engineering.

Many of the Dominions, India, and the Colonies are moving in this matter, and it would serve a double purpose if they also encouraged their students to attend a central establishment in Britain for the completion of their training. All such schemes will form a reservoir from which the best men can be drawn to proceed to a higher education such as this college will provide.

The report also says: "We believe that progress will now depend less on the genius and resource of individuals and more on the organized investigation and experimentation of trained workers working in teams and using large-scale equipment. If so, then the College is essential to the future of the industry." This postulates a further outlook for such a scheme. It will train research workers and produce results of a kind that will be different from, and will not in any way trespass upon the province of, the accepted type of research establishment.

Another aspect that has never received sufficient attention in the past is the more scientific aspect of flight and flying operations. Such problems have come within the province of the Fighting Forces up to the present, and have presumably been investigated by them within their own organizations. The coming of long-distance transport, with its possibilities of stratosphere operation, bring problems for the physicist, engineer, flying operator and the pilot that can only be properly solved by teams of workers, some of whom are pilots trained in the more scientific aspects of flight, working in an atmosphere of experimentation such as would be found in a college of the kind proposed.

The principal function of this college will be to provide a two-year advanced training in aeronautics for about fifty students. It is suggested that they should be of university graduate standard, with at least one year of works experience, although it is emphasized that the possession of a degree should not be considered to be essential.

Shorter courses of a more specialized nature, either to provide training for administrators who do not require complete technical knowledge, or as refreshers for men already engaged in the profession, are contemplated, up to the numbers of a further two hundred students.

The syllabus will contain five main subjects: aerodynamics; aircraft structures, engineering and design; aircraft equipment; engines and systems of propulsion; production, administration and maintenance. Flight and operations will be included, embracing full-scale experimental work and flight testing.

The teaching and experimental work will be in the hands of a professor with a suitable permanent staff in each of the five branches. Specialist subjects can best be dealt with in short courses by visiting

lecturers, who are engaged on that work professionally, possibly with the assistance of some of the permanent staff from the point of view of the technique of teaching. The short courses will obviously be principally of this class of lecture, while the full two-year course will have more of the fundamental science type of teaching, with a judicious mixture of specialist work. It is hoped to combine some appropriate experience in flying and flight conditions with all the courses. The establishment will naturally be in the hands of a principal with the necessary administrative staff; advised by a governing body representing the aircraft industry, the universities, the Government and Service departments, the Dominions and the Royal Aeronautical Society.

The report suggests that the college should be placed under the Ministry of Education for administration purposes, which would be given a special vote for its expenditures. It is also hoped that a Royal Charter would be granted.

The equipment of such a school will be large and expensive, and will need careful thinking out if it is not to lose its usefulness through obsolescence in a comparatively short time. It will need to be chosen to illustrate basic principles rather than to compete in modernity with the latest equipment of a professional research establishment. For example, wind-tunnels, which would inevitably be the principal equipment of the aerodynamics section, always tend towards greater 'Reynolds' number', which is obtained by a combination of increases in size, wind-speed and internal pressure. All these inevitably add to the complication of the apparatus, the rate at which experiments can be carried out and the cost. It is more than likely that all these points would make a high Reynolds' number tunnel unsuitable for demonstrating the principles of aerodynamics to students. The measurement of a force by the simple counterpoising of it by a weight is so much more obvious than, say, balancing it by an electric solenoid where the reading merely becomes a figure on the dial of a measuring instrument. The report suggests a battery of smaller tunnels, and one of higher speed for the more advanced work appropriate to the college.

For aircraft design the equipment will be mostly testing machines and rigs for the investigation of strengths of structural components. It is recommended that one slow-speed general-purpose wind tunnel be provided here, of sufficient size to accommodate full-size aircraft parts. The provision of this will avoid interference with the programme of work in the aerodynamics section. Aircraft equipment will probably need a multitude of small items appropriate to the testing and development of instruments, electrical, and electronic work in general.

Engines and systems of propulsion will demand a good deal of equipment to cover the work. Reciprocating engines will need facilities for tests on both single-cylinder research units and complete engines up to the largest sizes. Gas turbines must also be investigated, although in the present state of knowledge of these it is difficult to foresee just what equipment may ultimately be necessary. Test rigs will be needed for problems in the development of super-charging,

carburation, ducting, propellers, accessories, and for tests on fuels and oils.

'Production and materials' will need typical workshops sufficiently equipped for students to fabricate such parts as they may be investigating, a standards room and an inspection department. The metallurgical outlook, both practical and theoretical, will need special equipment covering chemistry, metallography, crystallography and plastics.

'Flight and operations' will obviously call for an aerodrome with the usual facilities, and a fleet of aircraft of various types. Using aircraft as flying laboratories requires a very well-equipped maintenance workshop with the right type of personnel, and a comparatively large fleet of machines to ensure continuity of demonstration.

In putting forward this scheme, the aeronautical world has given a lead that might well be followed by many industries that make use of applied scientific and technical knowledge. It is becoming increasingly evident to-day that there is a distinct gap between the end of a scientific university type of training, and a correspondingly responsible position in the appropriate profession. Some postgraduate training is necessary, of an advanced technical nature, rather different from the specialized research which is the only work the universities offer at present to post-graduate students. It is obvious that such training can best be given in a school, properly equipped and staffed by teachers who are specialists both in education and the appropriate professional work. Such students need to take the telescopic rather than the microscopic view of their technology. It is not too much to hope that this school will prove to be the forerunner of many others in various industries.

It is a pity that no situation nearer the centre of London could have been found. The technology of aeronautics is so closely related to the various societies which are all established in the heart of London that a situation within say the orbit of 'London Transport' would have seemed almost a necessity. There are still one or two large R.A.F. aerodromes within this range that will surely be made redundant in peace-time by the increasing speed and range of modern service aircraft.

Probably the greatest difficulty that the Ministry of Education will meet in the administration of this college will be to find the necessary teaching staff. It must be realized, as is appreciated by all educationists, that there is something in the art of teaching, and that the man who may be an acknowledged expert on his subject is not necessarily the best to impart that knowledge to a class of students. The reservoir from which such men can be drawn at present must be extremely limited.

The Government has shown considerable courage in embarking upon this scheme at a time when the ending of the War must create a period of uncertainty in the aircraft industry. It is to be hoped that those who control the world of aircraft and aero-engine design and construction will find themselves able to take as long a vision, and provide employment for such students, with both duties and salary in keeping with the training that they have undertaken.

PROGRESS OF PLANT VIRUS RESEARCH

Plant Viruses and Virus Diseases

By F. C. Bawden. (A New Series of Plant Science Books, Vol. 13.) Second entirely revised edition. Pp. xiv+294. (Waltham, Mass.: Chronica Botanica Company; London: Wm. Dawson and Sons, Ltd., 1943.) 4.75 dollars.

IT is just over half a century since the discovery of the first virus, that of tobacco mosaic, and it is perhaps fitting that during the last ten years it is the study of this virus which has yielded such fruitful results. There are, however, some outstanding questions which need to be answered concerning viruses and particularly plant viruses. First and foremost perhaps, as suggested by Mr. Bawden, there is the behaviour of viruses in their natural environment, the cells of the host. In other words, how do viruses multiply? This aspect may, as the author hopes, provide the next great advances in knowledge of the subject. Let us hope so too, but it is such a fundamental study that one cannot see at present just how it is to be tackled.

Then there is the puzzling subject of the relationship between viruses and insects, very clearly and succinctly discussed in this book. Is there really an intimate relationship between the two, and do plant viruses actually multiply inside their insect vectors? Or is the whole question merely one of particular feeding methods whereby the virus is introduced into the right plant tissues, and of particular anatomical conditions in the insect which must be fulfilled to permit of adequate virus storage? All these questions need answering, and although we have a mass of data concerning insects and plant viruses, we really know very little about their relationships.

Then take the question of the origin of viruses dealt with in Chapter 16. The author cites the paracrinkle virus present in all King Edward potatoes, also recently discussed in *Nature*¹, and suggests that it is possible that viruses may have arisen, only to disappear with the death of their host plant. Presumably, however, if such viruses can be transmitted by insects, they would be spread to other plants and a new virus disease would be perpetuated. Unfortunately, or perhaps fortunately, so many of the new viruses which do come to light are not apparently insect-borne.

There is no doubt that previously undescribed viruses do appear in plants, even under controlled conditions, and these would undoubtedly have been lost again if they had not been carefully propagated by artificial means. There is the interesting case of tomato bushy stunt virus, which suddenly appeared in a few tomatoes in the Bristol area and one or two other localities in 1935 and then disappeared again completely until the summer of this year, when it was re-discovered affecting tomatoes near Worcester. No insect vector has ever been discovered for this virus nor has it been found occurring naturally in any other host plant. Incidentally, this virus was first purified as true three-dimensional crystals by the author and N. W. Pirie, and the purification of viruses and the properties of purified virus preparations are well discussed in Chapters 8, 9 and 10.

The author has made a special study of the serological reactions of plant viruses, and he discusses this aspect very thoroughly in Chapter 7. He also advocates in Chapter 14 a classification of plant