

EDUCATION AND RESEARCH IN AGRICULTURAL ENGINEERING IN THE BRITISH ISLES

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INTRODUCTION

It must first be recognized that the term "Engineer" may have a different meaning in the United Kingdom than in America. In Britain, commercial companies that manufacture, install and service equipment of any kind are often called engineers. Thus we have electrical contractors as electrical engineers, machinery dealers as agricultural engineers and many more. In education, the term agricultural engineering has been used to describe almost any field of study pertaining to farm equipment including what we in America refer to as agricultural mechanization, a term less used in Britain. This dual and sometimes misleading terminology has tended to indicate that agricultural engineering is a part of agriculture rather than a part of engineering, as the name implies. Studies made three to four years ago by Dr. Payne, (1) show that only about 5 to 20 percent of those working with farm equipment are actually true engineers. The remainder are concerned more

with the "use" of machinery. The British are not alone in such differences in definitions, for it is to deal with problems of terminology in America that a special A.S.A.E. committee was set up about a year ago.

It is important to note that a first degree in either Agricultural Engineering or in Mechanization as known in Canada, simply did not exist in Britain until 1962. However, there have been both M. Sc. and Ph.D. degrees in the subject since 1947. It may seem strange also, that no university has so far been willing to accept this responsibility, presumably because of small numbers of students expected. This will not be true for long, because education in both Agricultural Engineering and Mechanization is in a period of expansion in Britain and by the end of 1966, at least one University will be offering such a degree.

This apparent lack of training in Agricultural Engineering is not nearly as significant as it might seem, for British Agriculture is among the most

highly mechanized in the world and agricultural machinery is a leading export item. Nevertheless, most farm equipment designers would agree that they would have a better appreciation of the operating requirements of their equipment through a degree course in Agricultural Engineering.

Since before 1950, there have been two higher level courses in Agricultural Engineering. One is the National Diploma in Agricultural Engineering, (N.D. Agr. E.), a one year course for holders of the National Diploma in Agriculture. Examinations are under the control of the Institution of Agricultural Engineers, comparable to the A.S.A.E. or C.S.A.E. This course follows the system of National Diplomas in various agricultural subjects recognized throughout Britain as a standard of proficiency. Here again, terms used require explanation, for while the term 'diploma' implies a course at a lower level than a university degree, both in Britain and America, it also may refer to a further course following a degree in agriculture or in engineering which would be a post graduate diploma.

The second higher level course has been the M.Sc. in Agricultural Engineering from King's College, Newcastle, which follows two years of graduate work. It is open to graduates in Agriculture or in Engineering, but with different courses of study.

THE NATIONAL COLLEGE OF AGRICULTURAL ENGINEERING

It was to fill what seemed to be a gap in Agricultural Engineering Education that the National College of Agricultural Engineering (N.C.A.E.) was established in response to a request to the British Minister of Education by the Institution of Agricultural Engineers, the Agricultural Engineers Association and the Agricultural Machinery and Tractor Dealers' Association. This was granted in principle in 1959, and in 1960 a trust deed was signed by the chairman of the newly appointed

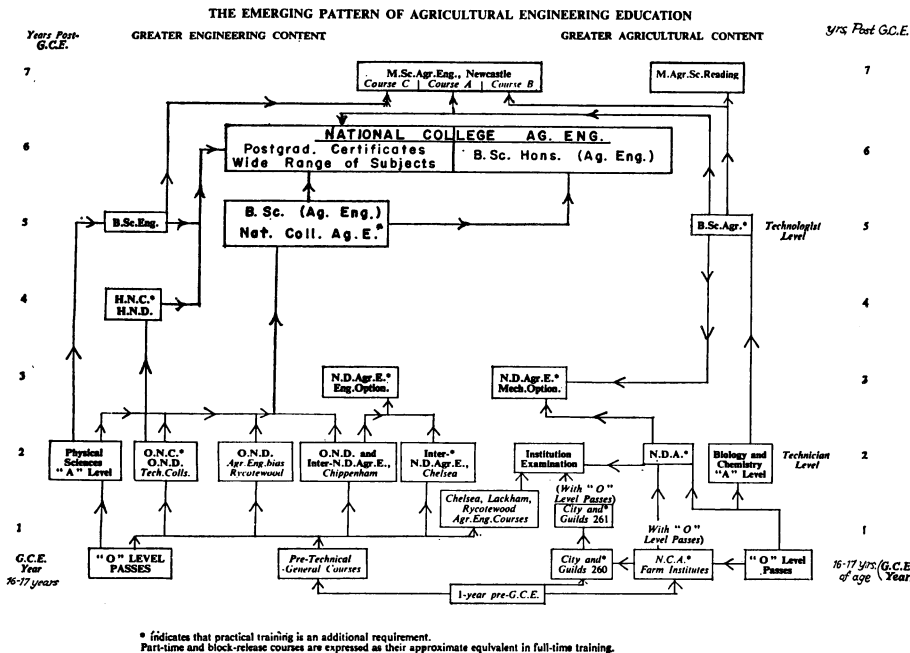


Fig. 1

board of governors. The College began temporary operations in 1962, first at Boreham House*, Chelmsford, then permanently at Silsoe, Bedfordshire, in 1963, only half a mile from the well established National Institute of Agricultural Engineering about 45 Miles north of London.

This college follows the pattern of National Colleges established in Britain since World War II to serve technologies not having sufficient numbers of students to justify provision being made at several universities. There are now eight such National Colleges in subjects such as Rubber Technology, Food Technology, and Aeronautical Engineering.

It was decided at the outset that graduates of the National College should be qualified Engineers as they are known in America. Students are awarded an Associate Degree after three years of study, which is normal for the first degree from a university in Britain since entrance requirements are higher than in this country.

The new college consists of a main building, with an auditorium, library, offices, common rooms for both staff and students, lecture rooms and the quieter laboratories. A short distance away is the workshop for building laboratory and experimental equipment, green-houses and numerous other auxiliary buildings. Almost all students live in two excellent residence buildings of fifty single rooms each, all provided with hot and cold water. Athletic activities are available also.

The college buildings along with attached farm land is located on a 70 acre tract close to Mander College farm, operated by the Bedfordshire County Council, as a teaching and demonstration farm for farm youth, both boys and girls.

The main course at the College covers a period of three years of three terms each extending from mid-October to early July. An B.Sc. honours course of four years duration has now been added** in which students may major in Engineering Design, Field Engineering, or Environmental Control***.

These courses of study completed at the Professional Engineering level are the equivalent of a general degree and result in the College Associateship (A.N.C.A.E.). This in turn now* leads to a B.Sc.

*Made available by the Ford Motor Company in Great Britain.
 **As of July 19/66.
 ***Similar to the areas of Power and Machinery, Soil and Water, and Farm Structures, respectively.

During the three years approximately half the curriculum is laboratory, field or project work to give the student a well rounded program. The first two years provide background knowledge, while the third year emphasizes application to particular problems or projects covering 4-week periods. These may be done in the laboratory or in the field.

Since the College does not have access to an agricultural faculty, some members of staff are specialists in Animal Science, Field and Horticultural Crops, Soils and Farm Management. Total academic faculty numbers between 15 and 20 persons.

In addition to regular courses there are post-graduate courses for students who wish to study Agricultural Engineering on a broad front or in a specialized field. Courses are open to holders of a degree or of equal qualification. Curricula in such courses are laid out to meet the needs of the student as much as possible. Most demand has been for courses in Tropical Mechanization, Soil Conservation Engineering and Farm Structures. Since at least six or seven of the staff members have had several years of experience in tropical agriculture, the college should be quite competent to give a thorough grounding in this now important field. Other fields of study are available. This arrangement makes it possible to accommodate students with a wide variety of backgrounds and interests, such as those coming

from the new countries of Africa.

Students at the National College may be at some disadvantage in that they have no association with students in other fields of higher education. They have an advantage however in that facilities available on the campus or close at hand at the National Institute, for both training and research, are larger and more varied than would likely be provided by a single university for many years to come.

THE NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING

It is significant that the National Institute of Agricultural Engineering, the main research and testing organization for Agricultural Engineering in the British Isles, is located close to the National College. This can be very helpful to a growing college in demonstrating research methods and/or providing certain specialized equipment or facilities.

The National Institute of Agricultural Engineering (N.I.A.E.), established in 1929, is one of several research institutes financed by public funds and administered by the Agricultural Research Council. Here research and development is carried on in a wide range of current problems. Tests are made on tractors and machines of all types except those of dairying and forestry.

The National Institute is set up in four divisions. (figure 2)

NATIONAL INSTITUTE OF AGRICULTURAL ENG'NG. DIRECTOR

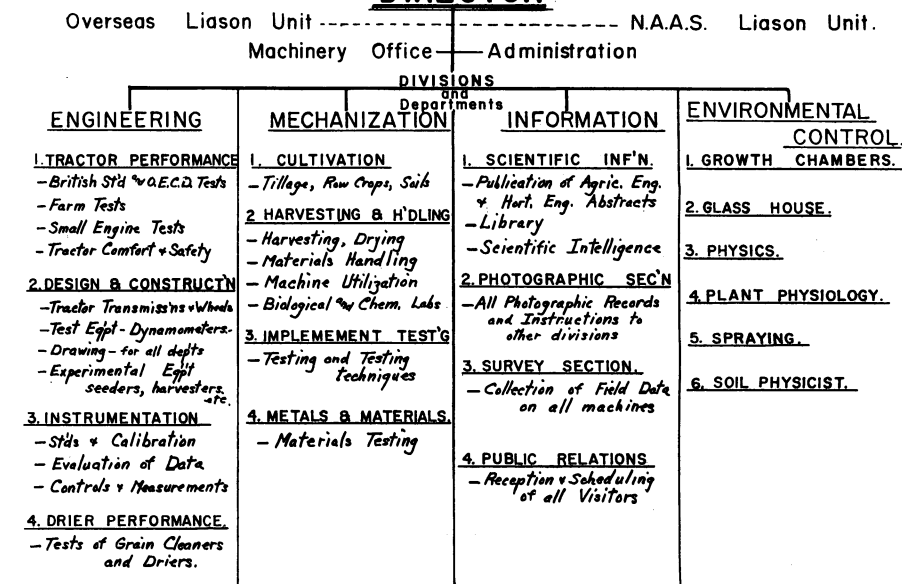


Figure 2.

1. *Engineering*: covering design, construction and testing of tractors and components; design and construction of all experimental equipment; tests of grain cleaners and crop driers, also instrumentation.
2. *Mechanization*: dealing with tillage, harvesting and handling equipment, implement testing, and materials testing.
3. *Environmental Control*: for growth chambers, green-houses and related units.
4. *Information Division*: responsible for preparation of scientific information, Agricultural Engineering and Horticultural Engineering abstracts, photography, collection of field data and public relations.

Tests made at the National Institute are of two types; prototype tests, where the information is available only to the manufacturer, and test reports for users, which report on production models for information of farm operators.

The approximate number of tests made each year is about 75, while the total number of staff members is about 360. This is very large compared to the staff involved with a somewhat larger number of tests made in other countries such as Sweden, France and Germany, but research and development personnel are included, while in Sweden, for instance, only testing is done.

The results of research work are presented in the *Journal of Agricultural Engineering Research* published quarterly by the British Society for Research in Agricultural Engineering, the governing body of the Institute; or in papers to professional societies. The Institute also publishes the *Agricultural and Horticultural Engineering Abstracts*.

Features of tractors and machines having to do with operator comfort and safety are receiving considerable emphasis in Britain. Seating and riding comfort, noise measurement, tractor cab tests, smoke testing and tire testing are examples. The Institute is noted for its pioneer development work on hydrostatic power transmission for tractors.

In addition to the location at Silsoe there is also the N.I.A.E. Scottish station located at Bush House near Edinburgh, supported by the Scottish Department of Agriculture, which spe-

cializes in problems more easily solved under the prevailing conditions of climate and soil. The present emphasis is on hay and grain drying and on potato harvesting. An extensive grain drying plant which was just being set up in 1964 has facilities for mixing up to 30 tons or 1000 bus of grain within a range of 1% moisture, also for both heating and cooling of drying air. Provision is also made for drying samples in sacks, since about 60% of commercial grain is still handled this way. This experimental drier is used for both grain and hay and will provide information with which to evaluate commercial units.

Potatoes are an important crop in the British Isles but much of the land contains stones or clods which have in the past been impossible to separate by machine. This separation now seems to be quite successfully accomplished by a bank of electronic sensors connected to nylon fingers and is based on the fact that radiation will pass through potatoes but not through silicon in stones or clods. A special rotary ridger also developed here, reduces the number of clods formed during cultivation.

Research is now being started on the work necessary to operate tractor and implement controls in an attempt to locate those which should be automated. Tractors in the field are equipped with instruments which relay information back to the base station.

Discussion of Education and Research in Agricultural Engineering would not be complete without mention of the Institution of Agricultural Engineers (I.Agr.E.) (3). This British counterpart of C.S.A.E. was established about 1938, with similar objectives. Member interests have been classified into four groups as follows:

1. Field Engineering; similar to what is normally recognized as soil and water.
2. Farm Buildings; which includes farm electrification, farmstead engineering and materials handling.
3. Farm Management and Mechanization; management of livestock, crops, fertilizers, pest and weed control.
4. Machinery Design; similar to power and machinery.

Fulfilling one of its objectives of promotion of high standards in agricul-

tural engineering education, the Institution obtained recognition by the Ministry of Education, in 1951, of a National Diploma of Agricultural Engineering (N.D.AGR.E.) as a qualifying mark. The Institution is responsible for the examinations which are held each year at selected locations. In late 1963 there were about 2000 members and over 100 new members were admitted in 1964. Candidates for membership may prepare at a number of colleges and universities.

In 1955 the Institution also laid the groundwork for the formation of the National College.

In addition to the education and research as outlined at the National level there are five major universities giving training in Agricultural Engineering and/or Mechanization.

ABERDEEN

The North of Scotland School of Agriculture at Aberdeen, founded in 1904, serves ten northern counties of Scotland. Although degree courses of B.Sc. and higher in agriculture are offered by the University, a major part of staff teaching in agricultural engineering is involved with the training of students for the Scottish Diploma in Agriculture, and the one year certificate course in Agriculture, as well as with advisory and extension work for area farmers. In Scotland the last named activities are the responsibility of the colleges of agriculture which could involve the staff in much routine work. In England however, extension work is carried out by the National Agricultural Advisory Service, (N.A.A.S.), while certificate courses are taught in Farm Institutes.

The College has a new building program under way which should consolidate instruction in the area of agriculture generally. Except for classroom space in Aberdeen, all agricultural research facilities and the engineering shop building are located five miles away at the College Farm at Craibstone where a junior college houses students in certificate courses for both boys and girls.

EDINBURGH

The Edinburgh School of Agriculture is noted for its post-graduate work in agriculture in the biological sciences. Twenty-six Ph.D. programs were listed in 1964, 13 of these outside Britain. Agricultural Engineering instruction

with a staff of three is confined to service courses, while research seems to be left mainly to the Scottish station of the National Institute located a few miles away. Farm buildings, often considered as a separate division from agricultural engineering or mechanization in Britain, has a staff of two. In Edinburgh as in Aberdeen, the Extension personnel are based with the College.

GLASGOW AND AUCHINCUIVE

The West of Scotland Agricultural College at Glasgow, along with its 410-acre college farm about 40 miles away at Auchincruive, serves the 12 counties in the western part of Scotland which is the main dairy farming district in the country. A total college staff of about 120 carries on an extensive teaching and research program. The College is also responsible for extension work with each county office having a staff of six to eight, one of which is a specialist in engineering.

Students are trained for the five Scottish Diplomas in Agriculture and for the College Diploma in Agricultural Engineering. Research is confined to biological subjects, but a good study on hay drying was recently completed, sponsored by the South of Scotland Electricity Board. Another project of importance is the "cubicle" or "free stall" system of housing for dairy cattle installed about 1962: a system now gaining interest in Canada. This was the first installation in the British Isles to combine cubicles with a slatted passage and pit for manure removal.

The Department of Agricultural Engineering and Surveying at Glasgow has a total of six staff members, while the separate Department of Farm Buildings has four. The College Diploma in Agricultural Engineering (C.D.A.E.) is awarded to students who complete three terms of 10 to 12 weeks each, and who already hold a degree, diploma or a National Diploma or National Certificate in Engineering or in Agriculture. The curriculum is not the same for both. The College also provides instruction in some, but not all, of the courses of the National Diploma (N.D.AGR.E.). The final examination for the National Diploma in Agricultural Engineering may also be taken by students with suitable entrance qualifications.

NEWCASTLE-UPON-TYNE

The University of Newcastle-Upon-

Tyne with its large modern agricultural building is the only University in Britain presently offering a master's degree in Agricultural Engineering. Since a first degree in this field is not yet offered at Newcastle, students are holders of a National Diploma in Agriculture, in Engineering, or in Agricultural Engineering, or they are from the new National College at Silsoe.

Since this is an engineering course, students take different courses of study depending upon their background training. A higher proportion of foreign students are to be found here as it is an advanced degree.

Space at the university is somewhat limited, but when combined with laboratories at the research farm at Nafferton, about 15 miles away, they probably provide the most complete facilities in Britain for research in soil mechanics. Some good basic work was also being done in grain drying. There is a staff of about six.

It can be said without question that more agricultural engineering research was in progress at Newcastle than anywhere in Britain except at the National Institute. The importance of the Department in the School of Agriculture is indicated when eight pages of a 56 page annual report is given to listing the 25 research projects in progress.

UNIVERSITY OF READING, BERKSHIRE

Agricultural graduates from Reading, with one of the largest faculties in the country, along with those from Edinburgh and Glasgow, have played an important part in agricultural development both in Britain and abroad. There is no Department of Agricultural Engineering or Mechanization at Reading, and the staff is not large, but a measure of specialization is offered in Mechanization and Farm Buildings to honor students in Agriculture. Courses of instruction in Farm Mechanization and Farm Buildings may be taken for the degree of Master of Agricultural Science (M.Agr.Sc.) over a period of two years. Courses are also available for the degree of Ph.D. in the same area of study, but over a three year period.

Some good research projects were in progress on automatic control of tractors in the field, using buried control cable, and also on sugar beet harvesting.

In all of the research in agricultural engineering in progress in Britain it is significant that the area of farm electrification is mentioned least. Reasons are lacking for this apparent omission, but one or two possibilities may be suggested. One is that research, such as crop drying, includes the use of electricity. Another more likely reason is that the Electrical Development Association (E.D.A.), now under the Electricity Board of Britain, has done a great deal of research and development work in uses of electricity for crop drying, heating and materials handling. The E.D.A. research station at Reading has done some excellent basic work on grain chilling, a new development now in the news in America. This station is now a part of Reading University which will make a significant addition to a faculty of agriculture not found elsewhere in Britain.

In conclusion it may be said that although agricultural engineering education has so far largely been at the applied level; or in 'Mechanization' rather than in 'Engineering', the organization of the National College is a very significant step in the engineering aspects of the profession and there is already evidence that the idea will spread to universities. Research too, already on a solid foundation at the National Institute, the University of Newcastle and at Reading University, will follow the lead of education to give Agricultural Engineering its rightful place in the list of professions in Britain.

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