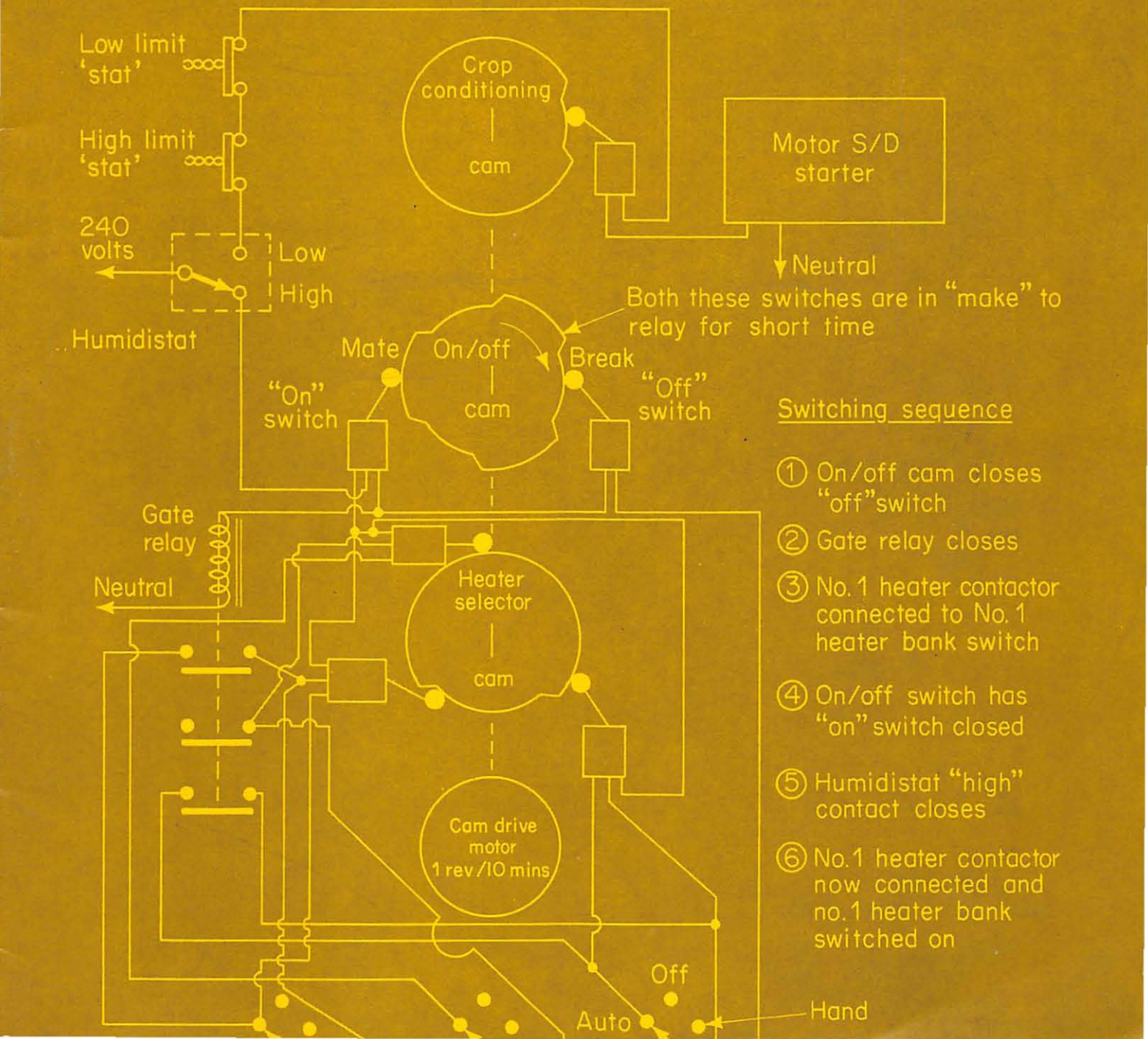
I AGR E

Volume 25
Number 2
Summer 1970

AUTOMATION IN FARMING
Electricity Supply and Installation
Automation with Electric Motors
Application of Full Automation
Solution to Manpower Drift



JOURNAL

and Proceedings of

THE INSTITUTION

of

AGRICULTURAL ENGINEERS

SUMMER 1970 Volume 25 Number 2

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The Front Cover illustration is taken from Figure 11 of Farm Electrification Handbook No. 18, by courtesy of the Electricity Council

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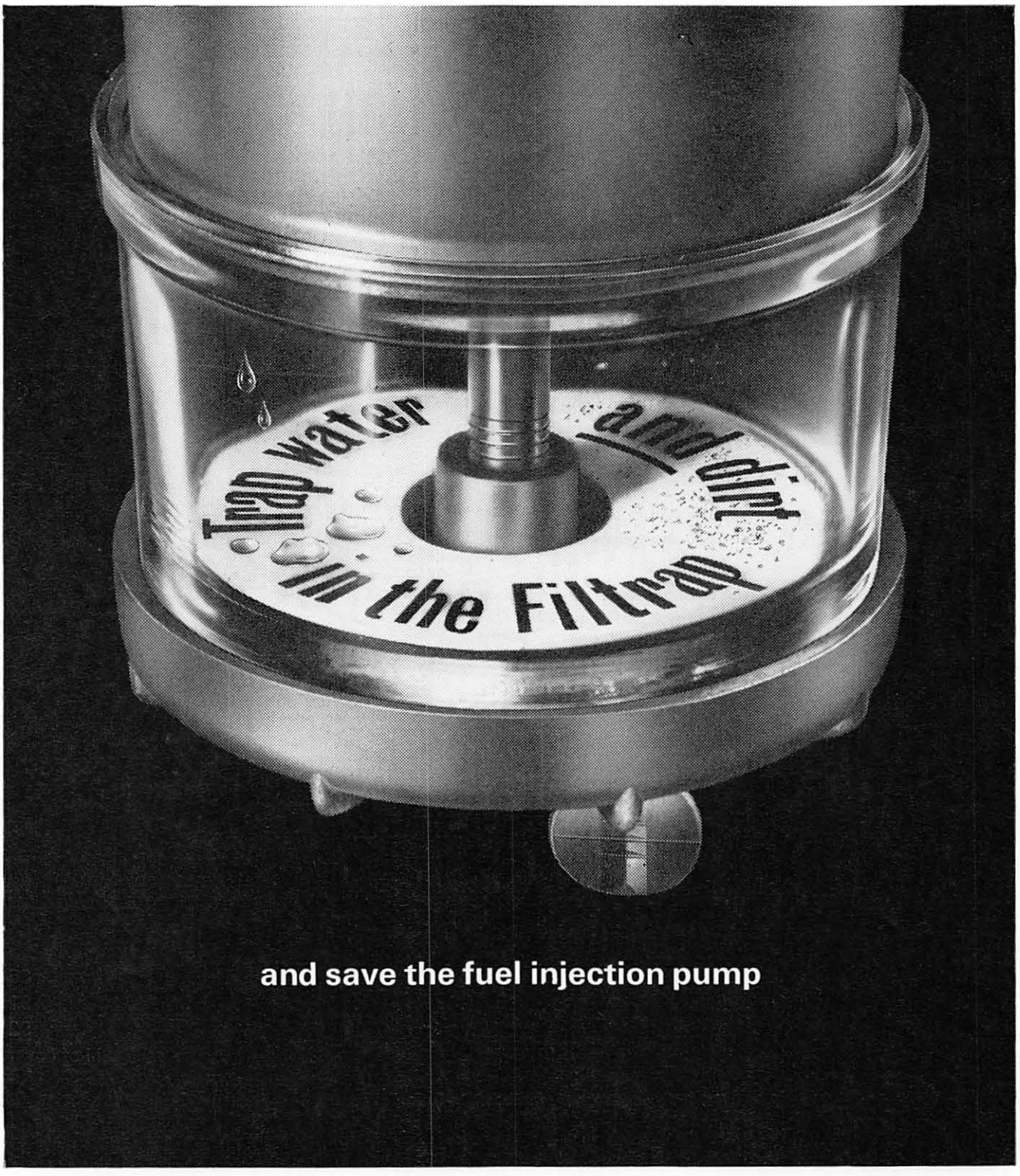

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GUEST EDITORIAL

A Conference on Automation in Farming, organized jointly by The Electricity Council and the Institution of Agricultural Engineers, was held at the Institution of Electrical Engineers, Savoy Place, London WC2 on 25 February 1970. The Conference Proceedings comprise the main content of this issue of the Journal.

The Opening Address, given by Mr Nevill Marsh, appears on this page in the form of a Guest Editorial. Stressing that this was the first Conference of its kind, Mr Marsh said it was intended to show how far progress had been made in applying existing automation knowledge to electricity on the farm. The two new Farm Electrification Handbooks (Nos. 16 and 18), published on the same day as the Conference, recorded this progress and he was confident they would be useful to all concerned.

Mr Marsh, who is a chartered engineer and a Fellow of the Institution of Electrical Engineers, has been in the electricity supply industry for nearly forty years, and has been Deputy Chairman of the Electricity Council—the industry's central body—since 1962.

He trained with Metropolitan Vickers after graduating from Cambridge University, and was subsequently on that firm's design staff. In 1932 he was appointed District Engineer of the Mid Lincolnshire Electricity Supply Company, and six years later became Engineer and Manager of the Company. On nationalisation of the industry in 1948, Mr Marsh was appointed Chief Commercial Officer of the East Midlands Electricity Board, and seven years later became Deputy Chairman of the North Eastern Electricity Board. In 1957 he was appointed Deputy Chairman of the East Midlands Electricity Board and two years later became Chairman of that Board.

AUTOMATION IN FARMING

by NEVILL F. MARSH CBE, MA, C Eng, FIEE

During the last 25 years, half a million people have left agriculture and gone to work in other industries. The present day work force in British Agriculture numbers about 700,000 farmers and workers, but within the next five or six years that figure is expected to decline to about 500,000. These are the stark facts about manpower in British Farming today.

At the same time, note should be taken of another fact, namely, that the number of individual farms is decreasing almost daily and, in fact, during the last five years approximately 30,000 farms in England and Wales alone have ceased to exist as separate entities. The concentration of farming enterprises has become an important aspect of policy. Recent legislation is intended not only to encourage concentration of farming enterprises but more immediately to bring about the amalgamation of small farming units and create co-operatives. A further impressive statistic is that throughout the post-war years productivity has continued to improve and production has continued to increase each year. In fact, over many years the increase in productivity in farming has been of the order of 6 per cent per annum and must be about the best in the country.

That, surely, indicates that agriculture is a virile industry. Its accomplishments, to which I have already referred, have been due to improvements in the many aspects of that very complex industry, including techniques, training, seeds and stock. Speaking as an engineer, it is clear to me that mechanisation has had a great deal to do with it and I feel sure that mechanisation has by no means reached its peak in farming.

At the same time, great progress has been made in the electrification of the countryside. The supply industry has completed the task of making electricity supply available to virtually all who live and work in the countryside. So, farming has at its disposal cheap, efficient and versatile energy for light, heat and power wherever it is required in and about the farm buildings. In short, electricity is helping the farming industry to meet the challenge of the 'seventies.

One of those challenges which might seem so remote and yet is so important to all concerned, is that world population increases at an alarming rate, and is already straining the resources of cheap food. It is obvious that this is causing Britain, like other nations, to consider producing more at home. So far as this country is concerned there are also important balance of payment considerations. In fact only in 1968 there was the publication of the little *NEDDY* report 'Agriculture's Important Saving Role'. **If the recommendations of the Economic Development Committee for the agricultural industry are applied, it will mean that British farming will have to show an overall net increase of 17% in production within five years, a target which will obviously impose ever increasing demands upon manpower from the productivity point of view.**

No doubt British agriculturalists will achieve this target. They are certainly already confident that given the chance they can do it. But how? First and foremost, by even further improvements in their techniques, in their equipment, stock and seeds, but equally, by greatly increased use of electricity. To adapt an old but appropriate saying, 'By more horsepower to man's elbow'.

The British electricity supply industry has the most up-to-date rural electricity distribution system in the world, and is capable of supplying any foreseeable requirements for British farmers at relatively low additional capital cost, by which I mean that the distribution system is largely there already. Furthermore, those who already work so well together in agriculture and electricity are entering into the automation age. They are rapidly taking advantage of the various automation techniques which will ensure that the maximum number of operations involving light, heat or power on the farm are carried out with minimum demands upon the ever increasingly valuable manpower—manpower which every farmer will agree is best employed in husbandry.

It is important that Conferences on Automation in Farming should seek out and discuss new applications and identify new problems which in the end will be solved by automation and electricity in British farming. □

INSTITUTION NOTES

Appointment of Honorary Fellow

Not more than once a year, the Council is allowed under the Institution's Articles to bestow Honorary Fellowship on any person who has given particularly outstanding service to the Institution or to the industry, or both. The Council has this year decided to honour a well known and very popular Past President, Mr W. J. Priest. It is the first time that Honorary Fellowship, which is the highest honour the Institution can confer, has found its way into the journalistic sector where, during the greater part of his career until he retired, Mr Priest served the industry with consistent merit and distinction.

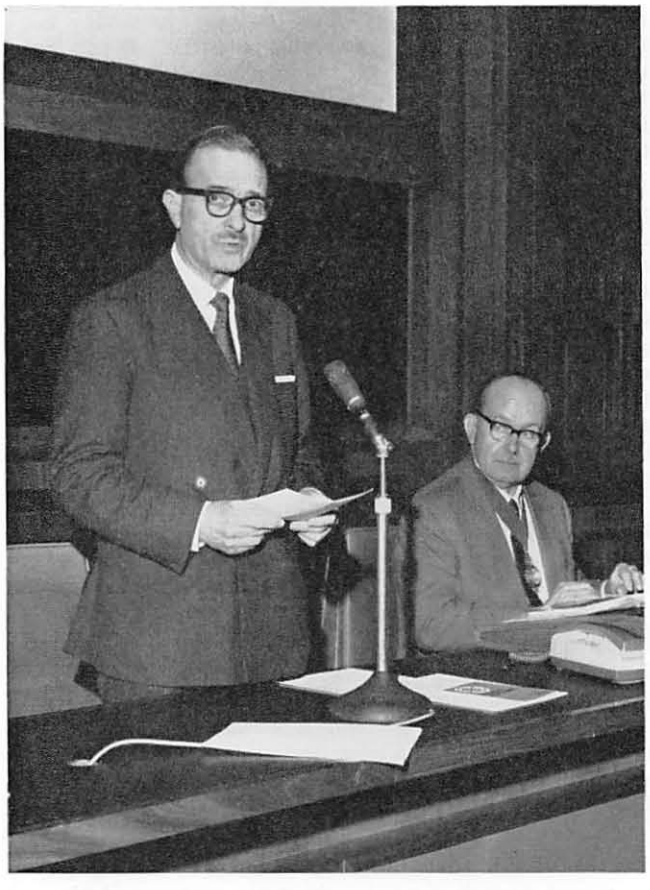
As President of the Institution from 1963 to 1965, he bore an exceptional burden because within months of taking office, the sudden death occurred of the Secretary, Ronnie Slade. "Many of us" said Mr Henniker-Wright, announcing the Council's decision at the AGM on 12 May, "will recall that Jim Priest's qualities of patience, unfailing charm and, above all, his famous 'unflappability' helped the Institution to win through a period of great administrative strain and upheaval. He was the right man to be President at that time. I believe that every member will heartily endorse the decision to confer Honorary Fellowship upon this able, kindly and well-loved figure within our Institutions' ranks".

Automation in Chairmanship?

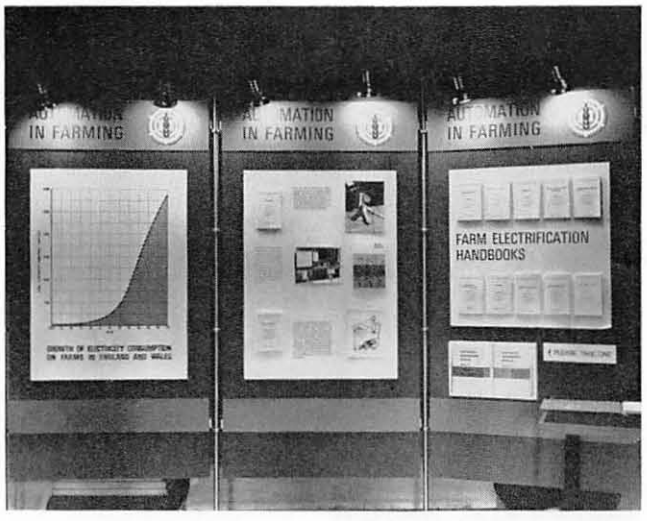
The Institution's President, George Henniker-Wright, spent a fairly gruelling seven hours in the chair at the *Automation in Farming* conference in London on 25 February. He displayed an apparently automated doggedness and unflagging disposition in the face of a lively 300-strong audience!

The event, sponsored jointly by the Electricity Council and the Institution, was opened by Nevill Marsh, Deputy Chairman of the Electricity Council, (pictured on this page with Mr Henniker-Wright seated beside him) and some of the forward-thinking observations in his introduction are reflected in our Guest Editorial on page 55 of this *Journal.*
Mr Henniker-Wright said he was glad to see so many familiar faces. It indicated the interest taken by a fair cross-section of I Agr E members from all parts of Britain, and that was as it should be. Everybody present who belonged to the Institution would join him as its President in saying how they welcomed the generous goodwill of the Electricity Council, in associating the Institution with the conference. He hoped the Institution's appreciation was amply demonstrated by the fact that its membership had been asked to regard this conference, to all intents and purposes, as its own Spring National Meeting. That would enable the Institution to place its editorial resources at the disposal of this conference publish a complete record of the proceedings in the Institution *Journal* and send copies to everyone present, whether they were members of the Institution or not.

The President went on to point out that the Institution's membership stemmed variously from the fields of education, research and development, design and manufacture, advisory work and the distributive trade. Furthermore, it covered a variety of disciplines—mechanical, electrical, chemical, biological and so on. When one came to consider electro-agriculture, it was notable that the Institution had never found any difficulty in persuading members of the electricity industry to come forward and help manage the Institution's affairs and support its activities. The President said he doubted whether any occasion would be found in the Institution's records over the past thirty years when it had not had serving on its Council one or more electro-agricultural specialists, whether in buildings or structures, power farming or whatever it might be. He hoped this close contact would continue. It was vital that it should,



Mr Nevill Marsh extends a warm welcome to delegates at the "Automation in Farming" Conference in London on 25 February.



Part of the Electricity Council's static display at the "Automation in Farming" Conference.

especially with the exciting developments that could be expected in automatic control, systems engineering and ever increasing mechanization generally, at home and overseas. In this respect, Mr Henniker-Wright emphasized how much the Institution warmly appreciated the support it consistently received from the Electricity Council, which it was happy to see among its Affiliated Organisations. "This conference is yet another symbol of that valuable association" he concluded.

The conference then got under way and its proceedings are reported fully in these pages. Reaction to the event has been varied. Comments have been heard that the subject was treated at too elementary a level for such a high-flying occasion. On the other hand, it has also been reported that new ground was broken, the increasing importance of safety in the light of automation developments was clearly established and the foundations laid for another conference to be held on this theme in the not too distant future.

The Institution and CEI

At the Institution's AGM in London on 12 May, members voted unanimously in favour of the Council of the Institution entering forthwith into direct negotiations with the Council of Engineering Institutions with a view to affiliating the Institution to CEI, provided the Institution Council notified members of the Institution of the terms and conditions that are agreed, to give members the opportunity to comment, before concluding affiliation.

This decision marks an important mile-stone in the current dialogue between I Agr E and CEI. It also heralds the near certainty that the Institution will act as the sponsoring body for qualified agricultural engineers of diploma-level attainment and ability to be registered for a new national qualification and title for this level of the engineering profession, under an extended CEI Register. "The AGM decision" said the President afterwards, "means that all future dealings with CEI will be carried on in the knowledge that the agricultural sector of the engineering profession supports CEI as being the right body to uphold the status of the engineer in our modern society. Agricultural engineers want to play their full role and to have it recognized as a valid and vital sector of twentieth century technology". CEI has on various occasions publicly acknowledged the role of I Agr E as the learned society in the field of agricultural engineering and mechanization and has welcomed the Institution's promise of collaboration in the hoped-for extension of the CEI Register to cover sections of the engineering profession that have hitherto been excluded. The successful passing of the Special Resolution at the Institution's AGM creates exactly the right background of confidence and optimism against which the Institution's future relationship with CEI can be worked out in detail.

Cultivations

More than 150 people attended the Institution's Annual Conference on 12 May, the highest figure at a National Meeting since the *AES* in 1967. This seems to support the view that coverage of the subject—cultivations—had been eagerly awaited and was overdue for treatment. Certainly this was borne out by the atmosphere of the occasion, the audience allowing no gaps in the discussion between papers.

Congratulations then to the convener, Norman Brown, of Rothamsted Experimental Station, for a programme that brought new light to bear on some contentious problems, especially in the matter of soil compaction. Most of the next issue of the *Journal* (Autumn 1970) will be given over to these conference proceedings.

Fighting Talk

"On behalf of the agricultural engineers and manufacturers of the world, I protest about my frustrations—and yours—and rebel against systems which prevent us from achieving our goals".

So said Mr Henniker-Wright, during his Presidential Address to the Institution in London on 12 May. The greatest manufacturing problem for agricultural engineers, he maintained, was the diversity of equipment and specifications necessary to meet the demands of individual farmers. "We can accept" said the President, "that farming conditions vary considerably, even within any one country. What we cannot accept is the fact that legal and mandatory requirements are imposed by Governments, and these are the factors which create the frustration and problems we have faced in the past, which confront us today, and for which there seems to be little hope in the near future".

Fighting talk indeed! And there is a lot more of the same. It can be found on page 64.

Putting on Face

The Institution Secretary, Jon Bennett, was recently elected a Fellow of the Chartered Institute of Secretaries. He likes to describe himself as "one of the nation's faceless bureaucrats". So we asked him for a photograph. Appalled by such an idea, he produced instead this picture, created by a pavement artist outside the National Gallery.

Asked why he wore such a worried look, Mr Bennett replied that it was his normal expression in repose. "For a genuine worried look" he added, "you should see me at Institution Council meetings". He would make no further comment, evidently valuing his job. □

NEWSDESK

Registration of Engineers

"Turning now to our Institution's place in the world of engineering societies, I am fully satisfied that the precept of a three part register for engineers of all grades is correct and that it should be completed with the minimum of delay, and that the only people who are able to do it effectively are the Council of Engineering Institutions."

It might have been the I Agr E President speaking, so closely do the above words echo his recently expressed sentiments. In fact, however, this extract is from the Presidential Address of Mr A. G. Stone, the recently elected President of The Institution of Plant Engineers.

I Plant E is one of a number of reputable industry-based institutions, including I Agr E, who feel that CEI should and must take a stronger lead in uniting and cementing the engineering profession. Many engineering institutions and societies, understandably impatient at the painfully slow progress in realizing this unification, have set up an organization called *Standing Conference for Technician Engineers and Technicians Ltd* (SCTET), with Board of Trade sanction to register technician engineers for the title *Registered Technician Engineer* (*R Tech Eng*) and engineering technicians for the designation *Registered Technician* (*R Tech*).

The Chairman of SCTET, Brian Fish, said after the decision to proceed with its new register had been taken: "Members of Constituent Institutions, whose

Mr A. G. Stone

representatives have been taking part in preparatory discussions for two and a half years, now have their national title within reach. Our principal concern is with the status and recognition of these individuals, whose lack of a proper designation has been a serious disadvantage for many years". Mr Fish emphasized that throughout the preparatory work towards this important decision the concept of a joint register with chartered engineers had always been in the forefront. Parallel with the registration procedure there had to be continued efforts to establish the mechanics of such a joint register.

The decision to set up SCTET as a registering body was taken in 1969 by a majority vote of the member institutions of SCNQT (*Standing Conference for*

National Qualification and Title). SCNQT is not itself an executive body and has no registration authority; it is a consultative group of some forty engineering institutions and societies (including eight of the chartered institutions within CEI) who have been working towards the common goal of national status for diploma and certificate level engineers, parallel with the mechanism that has existed in CEI since 1965 for registering chartered engineers.

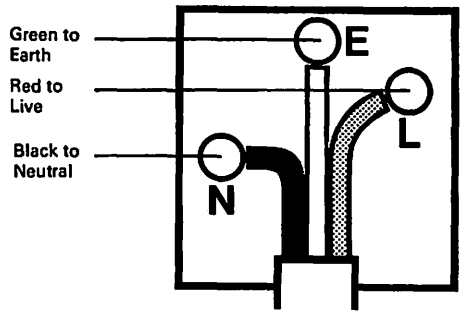
So far I Agr E has declined an invitation to join SCTET, as have a number of other SCNQT institutions, preferring to wait and see. It has been a long wait, dictated by the need to take a long view.

I Agr E is one of the Institutions in SCNQT who believe that CEI should be allowed sufficient time to take stock of all the work that SCNQT has done and then formulate proposals for an extended CEI Register, possibly linked to a scheme for affiliating suitable institutions that are not already members of CEI. Happily, if belatedly, CEI shows some indication of positive action which ought to bring results soon. In that case, it is difficult to see what function SCTET can perform except as a pace-maker in the short term. If a CEI Register and a non-CEI Register are both available together, a comparison between the two will become inevitable and what then? Can CEI and SCTET co-exist? Only time will tell.

The New Wiring Colours

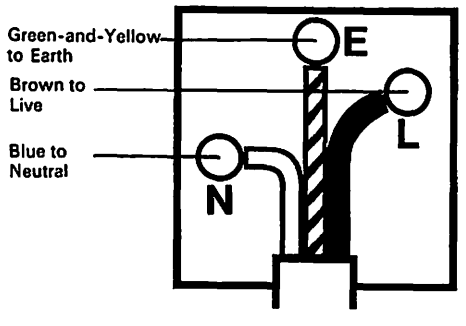
The Home Office have just issued a timely reminder that from 1 July 1970, 3-core flexes attached to electrical appliances on sale in the UK *must* conform to the new colour code (green-and-yellow for earth, brown for live, blue for neutral). No other colours will be permissible.

Old Colours



Markings on plugs
In the past, pins of plugs have been marked in many ways:
Earth
E; or symbol for Earth ⏚; or 'GREEN'; or colour green.
Live
L; or 'RED'; or colour red.
Neutral
N; or 'BLACK'; or colour black.

New Colours



In due course plugs will be marked only E or the electrical symbol for Earth ⏚; L; and N.

The adoption, internationally, of the new colours will benefit manufacturers because they will be able to use one standard flex for appliances made for home use and for export.

NIAE Subject Day on Tractor and Cab Noise

A Subject Day on Tractor and Cab Noise was held at the National Institute of Agricultural Engineering, Silsoe, on 2 July 1970. This provided an opportunity to report the results of studies of this problem by the Institute, particularly over the last two or three years. Attention had already been drawn to noise at the NIAE Subject Day on "Tractor Operator Comfort and Safety" in 1964.

NIAE acknowledge that excessive noise levels on tractors, particularly where cabs are fitted, is a concern of manufacturers and users in this country and overseas. Although there is potential for noise reduction by engine modifications, measures to effect improvements in the operators' noise environment must include cab design and attachments, floors and bulkheads and engine silencing systems. These topics were dealt with by NIAE staff, visiting contributors and by demonstrations of relevant tractor or cab design features or experimental techniques. In addition, manufacturers of acoustic materials or components and of noise measurement equipment were able to exhibit their products.

The Decimal Point

A question which arose following the decision that the UK should go metric was whether at the same time the decimal marker should be changed from a point to a comma, so as to bring the UK into line with the practice widely accepted in Continental metric countries. This change had some considerable support in industry but the Decimal Currency Board, having considered the situation and the problems affecting currency, concluded that the point should remain as the decimal marker pending any general international agreement.

It was necessary for the British Standards Institution to consider its position in the light of the DCB's decision and the Executive Board of BSI in March 1968 decided that, as there was not a consensus of opinion in favour of a change to a comma, the existing British Standard practice should not be altered and that a point should continue to be the decimal marker for all purposes (as recommended in Part 1 of BS 1991, Letter Symbols, signs and abbreviations).

Some sectors of industry which had close connections with Continental countries had used the comma as the decimal marker in accordance with a recommendation of BS 308, *Engineering drawing practice.* This recommendation, when drafted in 1964, was intended to facilitate the exchange of metric drawings (then the exception) between the UK and Continental countries and was made before the national decision to adopt the metric system.

At its meeting on 30 January 1970 the Executive Board reconsidered the question of the decimal marker and reaffirmed its decision of March 1968 to use the point. Strong recommendations to the contrary were made by the Chairman and technical sub-committee responsible for BS 308, but the Board decided that, because of the wider issues involved and in the interest of general standardization throughout the UK, British Standards must be consistent and therefore BS 308 must be brought into line with the overall recommendation to use the point. Further details are given under *BSI News* on page 76.

Going Metric: Everyday Units

One of the early issues addressed to the Metrication Board has been a demand for guidance on the metric units which will be adopted.

The Minister of Technology, when announcing in the House of Commons on 24 July 1969 his decision to set up the Advisory Committee on Legal Units of Measurement, made it clear that the Government accepted the International System of Units (SI) as the basis for the changeover to the metric system in this country. This is the form of the metric system

recommended by the General Conference on Weights and Measures, the international body set up under the Metre Convention of 1875. The United Kingdom became a signatory to the Convention in 1884 and the use of metric units has been legal here for most purposes since 1897. The metric system has steadily evolved since 1875, and the International System of Units recommended in 1960 is sufficient for all the present needs of science, technology, industry and commerce, and of daily life. It is now being adopted by all the major metric countries. The definition and complete adoption of these units in the United Kingdom will require some legislative changes, including the amendment of certain provisions of existing legislation which express measurement requirements in imperial units. The Government has made it clear that it is their intention to remove in good time any legislative obstacles to the use of metric units. For everyday life only a small selection of the units included in the International System will be needed. These are set out in the table below.

Everyday Units

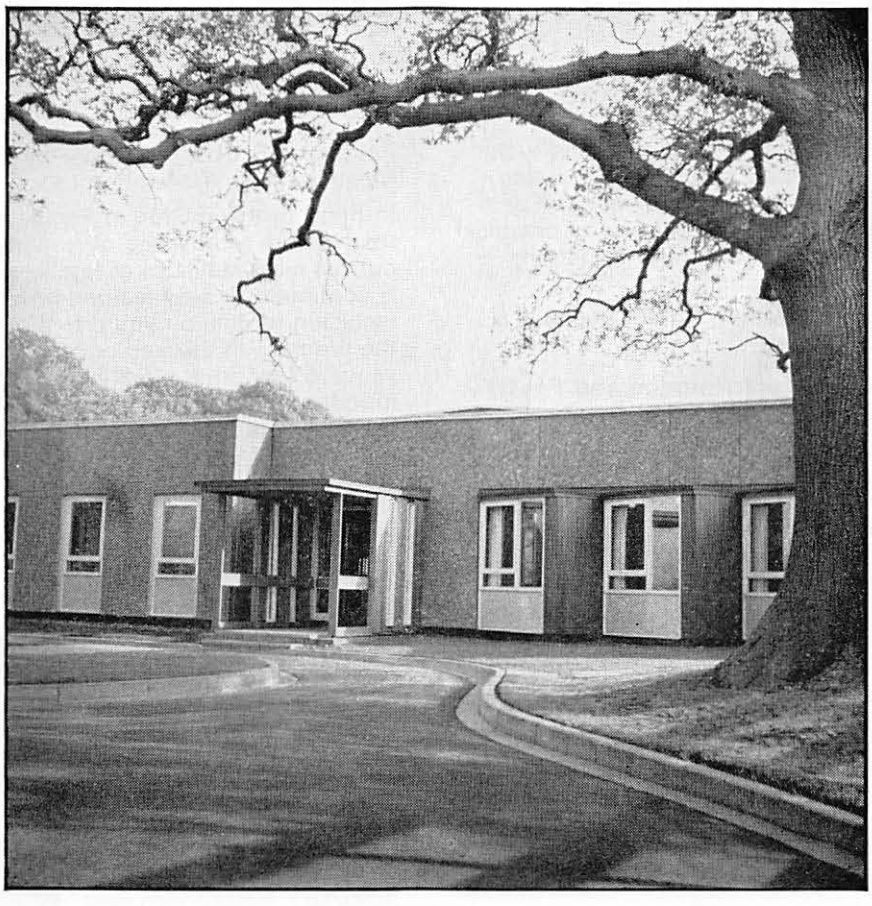
QUANTITY	UNIT	SYMBOL
length	millimetre (one thousandth of a metre)	mm
	centimetre (one hundredth of a metre)	cm
	metre	m
	kilometre (one thousand metres)	km
	international nautical mile (1852 metres)	n mile
area	square centimetre	cm^2
	square metre	m^2
	hectare (ten thousand square metres)	ha
volume	cubic centimetre	cm^3
	cubic metre	m^3
capacity	millilitre (one thousandth of a litre)	ml
	centilitre (one hundredth of a litre)	cl
	decilitre (one tenth of a litre)	dl
	litre	l
	hectolitre (one hundred litres)	hl
weight*	gramme (one thousandth of a kilogramme)	g
	kilogramme	kg
	tonne (one thousand kilogrammes)	t
time	second	s
	minute	min
	hour	h
	(also day, month and year)	
speed	metre per second	m/s
	kilometre per hour	km/h
	knot (international nautical mile per hour)	kn
power	watt	W
	kilowatt (one thousand watts)	kW
energy	kilowatt hour	kW h
electric potential difference	volt	V
electric current	ampere	A
electric resistance	ohm	Ω
frequency	hertz	Hz
temperature	degree Celsius †	°C

Notes to Table

*Strictly the gramme, kilogramme and tonne are units of mass. For most people and for ordinary trading purposes the distinction between weight and mass is unimportant.

†This unit is at present known in Britain as the "degree Centigrade". To avoid confusion with a unit used in some other countries, having the same name but used to denote fractions of a right angle, it has been agreed internationally that the name "degree Centigrade" shall be replaced by "degree Celsius". □

For straight facts about electricity... ask the Electro-Agricultural Centre



The Electro-Agricultural Centre is designed to help you with all aspects of electricity in farming. Here you can get free, accurate and unbiased information about the best equipment for your particular needs. In the main display hall of the Centre you can see examples of the latest systems and equipment for controlled livestock environment, hay drying, potato storage, feed preparation, water heating, refrigeration, frost protection and so on.

Qualified staff backed by a comprehensive library are able to deal with most problems on the spot.

What is more, the Electro-Agricultural Centre is right in the heart of the National Agricultural Centre—where further demonstrations of electrical equipment can easily be seen.

Organised visits (county or local) can be arranged through your Electricity Board. If you cannot come along, write or telephone the Centre and your queries will be promptly dealt with. This service is completely free so why not make full use of it.

The Electro-Agricultural Centre, National Agricultural Centre, Kenilworth, Warwickshire. CV8 2LS Telephone: 0203 27486.

The Electricity Council, England & Wales.

PUBLICATIONS

The following books, papers and data have been received or noted by the Institution.

Change in Agriculture—edited by A. H. Bunting

This consists of seven plenary lectures on the factors which influence or inhibit efforts to improve agricultural technology in underdeveloped and backward regions of advanced countries. Also 67 detailed case studies and a 12,000 word conclusion.

Available, price £7 10s 0d. (post free if cash with order) from Documentation and Supply Centre, Robert Maxwell & Co. Ltd., Headington Hill Hall, Oxford.

Communist China's Agriculture: Its Development and Future Potential—by O. L. Dawson

The author assesses the current status of Mainland China's agriculture and projects its prospects for sustained growth in the next decade. First, he surveys the basic features of China's land and water resources; focuses on factors related to increasing productivity and evaluates agricultural research and development; investigates the production of chemical fertilizer, the use of mechanical power, irrigation, and the development of livestock, etc.

Available, price £6 5s. 0d., from Robert Maxwell & Co. Ltd. (as previous item).

Dairy Cow Buildings Performance and Profit—by the Farm Buildings Centre.

A 150% increase in the number of new buildings and conversions on dairy farms between 1964 and 1968 is one of the striking findings of this recent survey. The survey was conducted jointly by the Low Cost Production Department of the Milk Marketing Board and the Farm Buildings Centre. Amongst the many interesting facts which the survey has revealed is the wide variation in the costs of new housing—shown to be from below £10 per cow to well over £80. The report also concludes that cost and type of housing do not have any significant influence on the performance of the cows—although better housing may improve the ease of management, which is generally regarded as a major factor in determining performance.

The Report is published as FBC 12 at 8s. (post free) from the Farm Buildings Centre, N. A. C., Kenilworth, Warwicks CV8 2LG.

Essential Electrical Maintenance—by The Electricity Council.

Electricity is being used more and more extensively on British farms, and as a result, there is a need for those living on the land to know how to carry out certain essential maintenance safely. This booklet was first produced to assist members of the Young Farmers' Clubs to prepare for their Proficiency Tests in Workshop Practice. It has proved to be so useful in preparing for the electrical tasks in these tests, that many requests have been received for its continuation with a broader circulation. It has, therefore, been revised with this in mind. Although the tasks are practical, they require a certain amount of basic knowledge of electrical terms. This book replaces *all* previous editions bearing the same title.

Published in conjunction with The Royal Society for the Prevention of Accidents, the book is available, price 2s. from The Electricity Council, Trafalgar Buildings, 1 Charing Cross, London SW1.

Farm Electrification Handbooks (Nos. 16 and 18)—by The Electricity Council

Handbook No. 16, entitled *Electric Power and Its Controls* covers the main uses of electric motors on farms. The various considerations which must be taken into account are fully described as are the different types of motors and their particular uses. This book also deals with the types of controls—normal, sequence and automatic and their economic advantages to the farmer.

Handbook No. 18 is called *Automation* (*including Electronics*) and deals with all forms of electrical controls—by timing, sequence, and temperature, etc. It also gives details of electronic controls in relation to dairy herds, pig and poultry keeping, poultry rearing and the conservation of crops. There is also a special section on the increasing importance of warehousing in modern farming. Both books are obtainable free of charge from local Electricity Boards.

Fertilizer Statistics 1969—by The Fertilizer Manufacturers Association Ltd.

In Part I of this edition of Fertilizer Statistics, the practice established over many editions of setting out the main statistics of fertilizer consumption is continued. A new feature, however, is the inclusion of data on liquid fertilizers from which the progress of this sector can be seen in recent years. A few other modifications have been introduced which it is believed will extend the usefulness of the material in this part of the publication.

In Part II, information has been drawn from a number of sources to bring together the basic statistics of fertilizer usage in European countries. It will be appreciated that the amount of information available varies from one country to another and this is reflected in the gaps in details which become apparent when comparisons of certain aspects of fertilizer usages are attempted. It should also be kept in mind that climatic variations over the European Continent and the consequent effect on the systems of agriculture found in different areas, as well as general economic criteria, influence the pattern of fertilizer usage.

In view of the current interest in closer European co-operation, it is thought that the data collected will be welcomed as a convenient source of background information by those actively concerned with the subject.

Enquiries should be addressed to The Fertilizer Manufacturers Association Limited, Alembic House, 93 Albert Embankment, London SE1.

Going Metric—The First Five Years—by the Metrication Board

Britain will be a metric country before 1975. That is the main conclusion of the first report of the Metrication Board, published by HMSO, price 12s. 6d. In his Foreword to the Report, Lord Ritchie-Calder, Chairman of the Metrication Board, says: "This Report marks the end of the beginning. The decision that Britain should 'go metric' was made in 1965. The Board itself came into existence in May, 1969, but it was taking over a going concern, thanks to the initiative already taken and the progress already made in many sectors of the economy, and by many institutions. This year, 1970, is the watershed.

'Going metric' is no longer a question of 'whether' but 'when'. We, in Britain, have made our decision. The whole world will predictably be metric by the end of the 1970's".

Meeting The Challenge—a film produced by The Electricity Council

The makers of this new film claim that, while British growers are as good as any in the world, unfortunately many are not taking full advantage of modern glass, heating and ventilating systems or automatic control equipment. Their growing techniques, although adequate twenty years ago, have failed to keep up with present day practice, so there is an urgent need for modernization. The modern techniques illustrated in the film are claimed to lead to considerable savings, and it is now possible for one man to look after half an acre of glass. Many ingenious devices have been developed by enterprising growers to save labour and make full use of growing space.

The film is obtainable from The Electricity Council Film Library, Trafalgar Buildings, 1 Charing Cross, London SW1.

Memoir No. 41—by the University of Cambridge

A summary of the papers published and research in progress by the members of the Staff of the School of Agriculture and its Associated Research Organization during the period 1 October, 1968–30 September, 1969. It also contains No. 24 in a series of articles summarizing phases of agricultural research, the current one being entitled "The Commonwealth Bureau of Plant Breeding and Genetics".

The book is available, price 3s. (post free) from the Secretary, Department of Agricultural Science and Applied Biology, University of Cambridge, Downing Street, Cambridge, CB2 3DX.

Pests of Grapevines—by Department of Agriculture, South Australia

Control measures and descriptions of the most commonly occurring pests of grapevines are contained in this bulletin.

Commercial growers should also refer to the district spray chart prepared annually by the Department of Agriculture.

Known as Extension Bulletin No. 5.70, this booklet is one of a series available at a subscription rate of 50 cents per annum from the South Australia Department of Agriculture, Adelaide. □

Presidential address

THE NEED FOR STANDARDIZATION

by H. C. G. HENNIKER-WRIGHT, MEM ASAE, FI AGR E *

Presented prior to the Annual Conference of the Institution in London on 12 May, 1970.

We are living in an age of protest. People are claiming the right to rebel against established systems. Those who protest are frustrated by the restrictions and confines imposed on them by unidentifiable persons. So today I am going to join their ranks. On behalf of the agricultural engineers and manufacturers of the world, I protest about my frustrations —and yours—and rebel against systems which have been, and —what is worse—continue to be, imposed upon us, and prevent us from achieving our goals.

Most of us work for commercial organizations, whose sole objective is to achieve maximum sales at the lowest production and distribution cost. Ford is one such manufacturer, geared to high volume production, where the objective is to achieve the economies of mass production, whilst still providing a tractor tailored to the individual needs and requirements of each customer. The greatest manufacturing problem is the diversity of equipment and specifications necessary to meet the demands of individual farmers.

The Ford organization currently manufactures ten basic tractor models. But, due to varying legal requirements and local needs and preferences, it must offer a total of over 14 million different specifications. Theoretically, one could put a Ford tractor of a different specification on every farm in Western Europe. Expressing this in another way, Ford could run all their worldwide assembly plants full time for over a hundred years and never build the same tractor twice. I think you will therefore understand why we, as agricultural machinery manufacturers, need standardization to end an iniquitous system which is grossly inefficient and costly; it is frustrating and prevents us from achieving our established goals. How much easier, how much less frustrating, and how much less expensive, if we only needed 1400 different specifications.

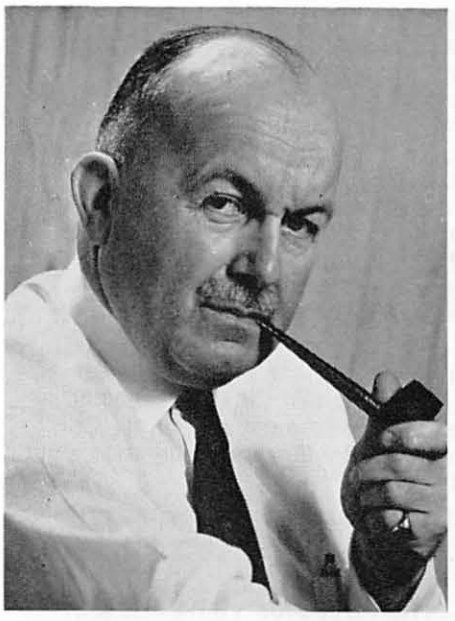
Why 14 Million Different Specifications?

We accept that in Europe, for example, the farms are small—over ten million of them are less than 50 acres—and combining these small holdings into larger economically viable units is a long, slow process. We accept too that farming conditions vary considerably, even within the boundaries of a single country. We have to supply tractors and agricultural machinery to cater for the vineyards of France, the production of cereals in the UK, root crops in Germany, the rice fields of Italy, and the forests of Scandinavia, to cite just some wide variations.

What we cannot accept is the fact that legal and mandatory requirements are imposed by Governments, and these are the factors which create the frustration and the problems we have faced in the past, which confront us today, and for which there seems to be little hope of relief in the near future. When Governments cannot agree on the definition of a 'horsepower' then one begins to appreciate the size of the problem. There are many items which create problems of great magnitude. Those which immediately come to mind are:

Lighting
Seats
Brakes
Safety frames
Safety cabs
Implements.

*Executive Engineer, Tractor Operations, Ford Motor Company Ltd. (President 1969–71, I Agr E).



I propose to deal with a few of these items, excluding safety frames and/or cabs as the legislation on these is in most cases quite specific.

Lighting

As fitted on tractors in Europe, lighting components such as lamps, reflectors and switchgear vary considerably. The reasons for the many different types of components are, firstly, to meet styling or local marketing preferences and secondly, to meet legal requirements.

Whilst a tractor manufacturer can control the design and market offering, little can be done to control legal requirements. It is on the subject of legal requirements that I would like to speak today.

To provide some background to the type of problems encountered I propose to discuss several items. First of all let us take tractor headlamps. Several types of headlamps are necessary to meet legal requirements. Some countries require headlamps a minimum distance apart. This means that the headlamps must be mounted on the side of the tractor. It needs little imagination to see what happens when a front loader is mounted on the tractor. Also, the maximum height of the lamps is controlled and therefore the headlamps cannot be fitted into the fenders on the majority of tractors. Apart from this, there is also a requirement (Italy and proposed EEC) that headlamps must be positioned towards the front of the tractor. A requirement (Italy) that the side, or front facing position lights, must be located in a similar position means that the side lamps are included in some headlamps. Special local regulations also apply where a lamp made in one country is not accepted by another country unless the tractor is manufactured in the same country as the lamp. This type of local regulation is, of course, being eliminated by agreements to accept internationally accepted standards for lamps, but these international lamps are invariably more costly than simple lamps. There is still the problem of colour of the light emitted from the headlamp, and both white and yellow beams are still necessary even with international lamps.

In my view it is out of the question to standardize on headlamps and their mountings to meet all present legal requirements. I feel that a simple type lamp to meet agricultural needs is all that is required.

Now let us look at the other end of the tractor and consider rear reflectors. The maximum legal height of rear reflectors on tractors varies considerably throughout Europe. Rear reflectors do serve a useful function. But, when you see the location of reflectors on some tractors fitted close to the ground to meet legal requirements, one wonders how long they will serve a useful function. I say this because when a reflector is fitted to the rear axle, low down on the inside of the fender or hanging over the rear tyre, it is obvious

that the visibility is severely restricted when an implement is fitted. In addition, the location is such as to be vulnerable to damage and covered in mud.

It is obvious that the best place for a reflector is on the fender with the rear lights. Provided a reasonable maximum height can be agreed upon internationally, the reflectors can be located where they will do most good under all conditions. Also—and this is important—they can be provided at minimum cost because little or no bracketry will be required.

Finally, I will deal with the subject of turn indicators. It is obvious that a more rational approach to commonize international regulations is needed. One of the main absurdities of some regulations is the number and the position of turn indicator lamps. It appears logical that when turn indicators are fitted on tractors the turn indicator lamp should be combined with the side or rear light and fitted on the front and rear of the fender. However, large angles (45°) of inboard visibility are then required, whereas if a single lamp is fitted on the fender which shows a light to the front and rear only a small (5°) inboard angle of visibility is required. It is obvious that the two-lamp turn indicator system per fender gives better visibility than the single separate lamp system and costs less, yet to meet some regulations the single lamp system must be used. This means six lamps on the fender in place of four.

A question I would like to ask is: 'Do we really need a turn indicator lamp of 12 in.² in size when a smaller lamp produces the same light output and is acceptable in many other countries?'

Problems due to inconsistency in lighting regulations are too numerous to mention, but the items raised are typical of the current situation. Let us have tractors with basic lighting equipment that is safe for use on roads—but let it be a simple system with international regulations specifically developed for tractors. Where customers require such things as turn indicators and stop lights, let it again be a simple system with international regulations specifically developed for tractors. **Tractor lighting regulations often 'hang on the coat tails of automotive regulations'. Seriously, should all automotive regulations apply to tractors? I think not: after all we are dealing with 20 mile/h tractors and not 120 mile/h cars.** So let us not have duel intensity lights and sophisticated electrical systems. All that is required on tractors is simple, safe and reliable lighting equipment. We must not forget, it is the customer who finally has to pay for all the complications that new regulations bring.

Seating

In Europe at the present moment there are two areas that require test approval on seats, and each has different test procedures. As a result a seat and seat suspension which is developed to pass the test in one does not necessarily pass the test applied in the other and vice versa. I think this is ludicrous as it does not matter on what operation or what part of the world the tractor is operating the shocks, etc, felt by the operator are similar. My plea here is that if we are to have seat test procedures we should have one procedure which will be acceptable everywhere.

Braking Systems

I realise that tractors today, as they were 25 years ago, are the maids of all work. However, with the advance of technology and experience, braking systems on tractors are vastly more efficient than they were two decades ago from the following aspects:

(a) Pedal effort to give the required deceleration has been considerably reduced;
(b) The resistance to fade has been considerably improved;
(c) Compensation of rear wheel braking has also been improved.

However, in certain countries we are now faced with having to fit a unit to supply power braking to trailers: even though it has not been necessary in the past with higher rated speeds than will be legally allowed in these countries when, in the near future, 25 km/h becomes the maximum legal speed of agricultural tractors. I can see no reason, nor have I heard of any good reason, why this law should be applied to *agricultural* tractors—as in the main they very rarely tow more than one trailer. I would agree that if the tractor is used as a 'semi-industrial' machine on more or less permanent haulage, using larger than average trailers, it should be fitted with an auxiliary means of applying power brakes to the trailers. This will considerably reduce the work to be done by the tractor and can, if correctly adjusted, prevent jack-knifing.

Whilst on the subject of brakes I would like to mention the difficulty that some original equipment manufacturers are in when they convert a standard agricultural tractor into a light industrial tractor in the United Kingdom. The law states that on industrial tractors the brake shall operate on the last moving part of the rear axle. I realise that this is a carry-over from commercial vehicle regulations. But, here again, my plea is that the Government review this, take the light industrial tractor on its own merits and bear in mind:

(a) The amount of time that it is used for travel along the highway;
(b) The speed at which it travels;
(c) The fact that braking systems forward of the rear axle, which in many cases are oil-immersed, are vastly more efficient than a brake at the outer end of the rear axle because they are fully sealed and less susceptible to dirt ingress.

The above are just a few examples.

I would now like to dwell for a short time on OECD tests. As you may or may not know there are OECD-approved national testing stations in 19 countries, namely; Austria, Belgium, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, UK, and Yugoslavia, which currently undertake to test tractors and equipment to any of the procedures laid down. The work done at one station is not always correlated with the work done at another station. I feel that two or three test stations should be made responsible for, say, seat testing and that they should collaborate with one another to ensure that:

(a) They have similar equipment;
(b) They co-ordinate their test procedures.

Likewise, two or three stations should be made responsible for carrying out p.t.o and drawbar performance tests. This would make the manufacturer's job that much easier when marketing products internationally.

I contend that thousands of hours of expensive executive time have been wasted over the years in committee. Agricultural engineers, who have very rightly appreciated the need for standardization and elimination of these costly and time-consuming variations, have laid down the rules and the methods. For example, the OECD test is accepted worldwide as the basis for testing agricultural tractors, but I know of no single authority which uses this to the full in its existing form. I am often appalled at the number of local variations which are added.

Special committees have been established at international level to spell out standardized criteria, but their recommendations have yet to be implemented and supported at Government level. Today, Governments are preaching that increasing productivity is the only answer. I would therefore appeal to every Government, on behalf of this Institution, to accept the recommendations so assiduously and carefully compiled by their agricultural engineers—and to remove as quickly as possible, the mandatory and legal requirements imposed locally—and to enable us to cut down the far too numerous specifications we are all currently forced to produce.

This is probably one of the greatest contributions which any Government could make to assist an industry which is supplying over £1000 million worth of agricultural machinery every year to the farmers of Western Europe. □

SPECIAL RESOLUTION TO NEGOTIATE I AGR E AFFILIATION TO CEI IS PASSED UNANIMOUSLY AFTER ONE AMENDMENT

The AGM of the Institution was held in the Main Hall of I Mech E London on 12 May 1970

1. Annual Report

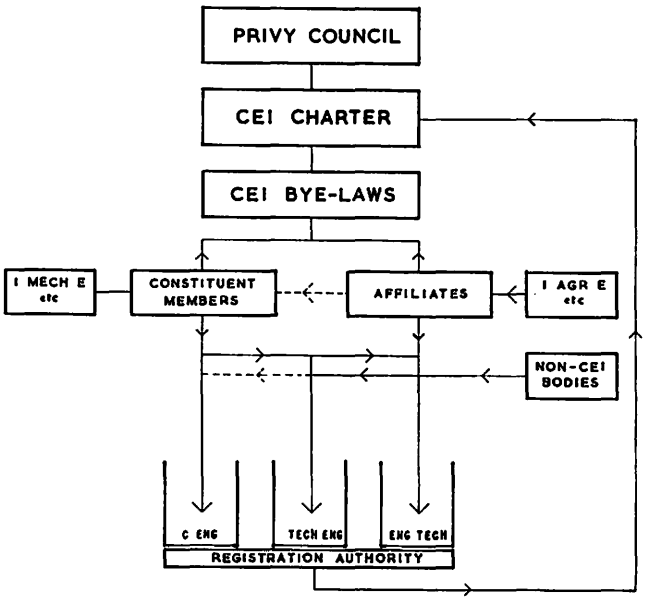
After the meeting had been declared open and the Minutes of the previous AGM approved, the President formally moved the adoption of the 1969 Report of Council.
The President recalled that his predecessor, Theo Sherwen, at the previous year's AGM, had said he thought the Institution was about to turn a corner. 1969 had shown this to be so and there had been several notable advances.

Speaking of the CEI situation, the President said, "We are not at the end of that road yet but the position looks to me a lot more promising than it did a year ago. We shall be discussing this later on the agenda so I shall not dwell on it except to say that, as your President, I think you ought to know that a relatively small number of your officers have laboured and worried about this complex situation for many more hours than the few paragraphs in the Council Report might suggest. The SCNQT negotiations have been particularly tough and your Institution has had to make a firm stand, quite often opposing the majority view in SCNQT on many matters affecting the future registration of engineers, so as to ensure that the recognition of our Institution by CEI has the best possible chance to succeed. In this matter, our Secretary, Jon Bennett, has proved to be a particular tower of strength and we should be grateful for this".

The Membership Committee had been kept busy. The new regulations were working out well, generally speaking, although the requirements for the Fellowship grade, particularly as regards experience and responsibility, still needed a little clarification. There were also problems about Part III interview procedure to be ironed out and this avenue might have to go eventually, even if it were replaced by something else. The President said he thought the Membership Committee deserved a lot of praise; they did the most difficult job of the lot; they tended to get shot at and they did not flinch from the business of keeping the standard right. The same went for the Examination Board, one of whose tasks it was to keep the ND Agr E going in the face of grave anxiety and unrest about where we were all getting to in the field of technical education in the 'seventies.

The President reported that although National and Branch activity had been of a high order, he hoped we were paying sufficient attention to putting on the sort of meetings on the kind of subjects that our members really wanted.
"I think this is important" said the President, "and I do think that members should speak out if they feel we ought to do things differently. My Council colleagues know my views on this. **I know we are a learned society for the industry and we have to act as an outlet for information on high level research and technological advances in the industry. I think we do a good job of that at our Conferences and in the *Journal*. But is that enough? Do we get across sufficiently to the ordinary 'grass-root' member who earns his living in this business and do we understand enough of his practical day-to-day requirements and problems? Sometimes I wonder".**

The President said that the *Journal*, *Yearbook*, *Diary* and various other Institution paperwork had fared rather better than in the two previous years when finance had been a problem. He proposed to leave finance to the Hon. Treasurer, other than to say that he thought an outstanding job had been done on modernizing and streamlining the Institution's economy. **"We are financially out of the red and sailing on a fair wind. We have now got to work hard to keep it that way. It isn't easy. We can't just rest on one good year. But we do have a sound basis from which to plan ahead and gather further strength as an Institution for our industry".**
The President thanked his Council colleagues for their support during his first year of office. The motion to adopt the Council Report was then seconded and carried.



This might be the "landscape of the 'seventies" as described by the Secretary, Jon Bennett, at the Institution's AGM (see next page).

2. Accounts and Auditors Report

The Hon Treasurer, Mr E. S. Bates, moving the adoption of the Accounts and Auditors Report for 1969, said that the year had turned out almost exactly in accordance with budgetary forecasting and was, if anything, an improvement upon the estimates. He said a start had been made on reinforcing the investment portfolio. **Following the Institution's registration as a Charity in 1969, it had proved possible to take advantage of tax-exempt capital accumulation investment in 1970. This would ensure that the 30-Year Anniversary Endowment Fund was profitably and securely invested until such time as the Fund was required to assist the Institution's development.**
Looking to the future, the Treasurer said it was hoped to improve the financial liquidity of particular Institution activities, such as publications, by exploiting advertising, sales and other revenue potential. This meant having a well-staffed and equipped secretariat and measures had been taken in 1969, by way of salary grading and pension schemes, which were directed to that end.
The Accounts and Auditors Report were adopted. A motion was also carried, re-appointing Messrs Geo. Little, Sebire and Company, Chartered Accountants, of St. Albans, Herts, as Auditors to the Institution for 1970.

3. Council 1970-71

The Secretary reported that as the number of nominations for Council did not exceed the number of vacancies, those nominated were deemed, under the Articles of Association, to have been duly elected. A full list of the Council for 1970-71, appears on the inside back cover of this *Journal*.

4. Special Resolution

The final item at the AGM was the following proposal, which members were asked to pass as a Special Resolution:-

That the Council of the Institution forthwith enter into direct negotiations with the Council of Engineering Institutions (CEI) with a view to affiliating the Institution to CEI on such terms and conditions as shall be mutually acceptable to the Institution Council and the CEI Board of Management, to the end that such national qualifications and titles as are or shall hereafter be required and bestowed by authority of the Charter of CEI shall extend to include members of the Institution who are suitably qualified.

The President said it continued to be his own view that it would be a wise thing to get this Special Resolution through and then let the Council get on with it, knowing that they had the strength of the membership behind them. The President then asked the Secretary, Mr Jon Bennett, to give a factual report of the situation as it now appeared at this point in time.

Mr Bennett said he would confine himself to making the landscape of this situation as clear as possible, to help members make up their minds one way or the other. The best way of considering a landscape was to look at a map of it and that is what he had tried to devise, by means of a diagram (see opposite page).

Those parts of the structure that had existed since 1965, were, of course, CEI itself—essentially, the Board of Management, its various Standing Committees, and its Secretariat. Its authority stemmed from the Charter and Bye-laws which, in turn, were sanctioned by HM Privy Council. CEI could not therefore alter its Charter or its Bye-laws without Privy Council authority. On the left of the diagram was the box signifying the constituent membership of CEI, currently the fourteen chartered institutions, from whom the Board of Management drew its serving personnel on an elected representational basis. At the bottom of the diagram, the CEI Register was represented by three boxes, but, in fact, the left-hand box was the only one at present in existence. This was the C Eng box, that had existed since 1965, and which was open to corporate members of constituent member institutions of CEI. In short, a person who could satisfy the degree-level and other requirements for corporate membership of one of the constituent member institutions was then routed through to the left-hand box and became a chartered engineer.

Such was the position today. One had now to look at what might lie ahead.

CEI's Bye-laws provided for affiliate membership, but those Bye-laws were broadly worded and could be flexibly interpreted. That flexibility might well prove to be an advantage in that CEI would be better able to take account of the individual problems and requirements of bodies seeking affiliation. However that may be, the "Affiliates" box did not yet exist. It would almost certainly come into existence this year or next, and CEI had considered that this Institution, among others, might be well suited to take serious advantage of the close family tie that it would offer. A blue-print from CEI of the rules of affiliation was still awaited but this should not now be long in appearing.

Running parallel to the creation of an affiliation mechanism was the setting up of two additional boxes in the CEI Register. The middle box was intended for technician engineers, and the Institution Council believed this to be of absolutely crucial significance to the agricultural engineering community. The third box, for technicians, would also be very important indeed for those whose attainment was around the City and Guilds Technician level of ability.

The immediate objective—which was understood to have a very high priority in CEI—was the middle box. It was about as certain as it could be that this Institution would be asked by CEI to be the sponsoring body for agricultural engineers seeking entry to that box via our MI Agr E grade. To be of maximum effect, the Institution ought therefore to be in the right posture at the affiliate point in the mechanism.

If all this came about, then a person entering the Institution as a corporate member should be able to get through to box 2 in the CEI Register. When box 3 was developed, the hope was that many of our Associates would be eligible to filter through to it.

Finally, there were two other things to bear in mind. One was that having integrated the Institution thus far into the CEI complex, a foothold would have been established from which to pursue the question of access by Fellows of I Agr E to box No. 1. This aspiration, which CEI were fully aware of and were ready to listen to, was shown by a dotted line between "Affiliates" and box 1. The Institution might well be better placed to discuss making that dotted line a solid one if it were already affiliated to CEI. Secondly, there was reason for believing that the affiliation mechanism might provide for those affiliates who later wished to transfer to constituent membership and were prepared to meet the stringent requirements, to do so. This was by no means certain. In any case, the Institution Council was not at all happy that, even if this dotted line became solid, the Institution should necessarily travel along it. It was simply part of the picture and it was as well to have the whole story.

Moving the Resolution, Mr J. H. W. Wilder (Fellow) said the sequence of events over the past year or two—the frank and cordial relationship with I Mech E, the increasingly amenable disposition of CEI, and the Institution's strong voice in SCNQT and elsewhere—suggested that the tide was moving providentially in the Institution's favour. **These were exciting and historic times for the Institution and its members and he was proud to propose this Special Resolution, which, if carried, would point the way ahead for the Council, and help bring the agricultural engineering community into a constructive relationship with CEI and its member organizations in the engineering profession.** Mr T. Sherwen (Fellow) warmly endorsed Mr Wilder's remarks and seconded the proposition.

Mr D. J. B. Calverley (Member) moved an amendment, to be appended to the main Resolution, and reading as follows:—

The Institution Council shall notify members of the Institution of the terms and conditions that are agreed, to give members the opportunity to comment, before concluding affiliation.

Mr Calverley said that, as Chairman of a Branch, he believed Council could count on the broad support of the membership at large and he thought it was very right that members should be guided by those who were involved in these negotiations. The responsibility for action should remain with the Council, who would be faced with the decision whether to become affiliated or not.

There was however another point he would like to make. The strength of the Institution and of the Council lay in the membership, because by numbers they gave authority and by subscription they gave finance. Mr Calverley said that, speaking as a member at 'grass-root' level, he was aware of some anxiety and concern about the Institution in the field. Several of his own Branch members had been very worried that the Institution might be over-reaching itself in apparently trying to achieve parity with chartered institutions. Many of the activities that we were bound to carry out in order to maintain the interest of our members did not necessarily attain the standard that a professional organization required and it was sometimes very disheartening when one considered the work, the money and the energy that went into trying to maintain membership and influence within a Branch area.

Mr Calverley said he would like to feel that Council was aware of this hesitancy and that it would recognize that members sometimes needed to be interested and wooed. Only for that reason, said Mr Calverley, did he make to move this amendment that the Council before concluding the affiliation with CEI should inform the members of the conditions that CEI would impose on the Institution and of the effect these would have on the organization and functions of this Institution.

The amendment was seconded by Mr G. Spoor (Member) and, after some discussion, carried by a small majority. The substantive motion was then put to the vote and carried unanimously. □

RECOGNITION OF THE INSTITUTION BY THE COUNCIL OF ENGINEERING INSTITUTIONS WILL BE MOST GRATIFYING TO THE WHOLE OF THE AGRICULTURAL INDUSTRY

. . . J. W. BEITH

"*This is most important as it will help the employers of our industry to engage top quality engineers for positions of authority from members of your Institution.*"

Such were the sentiments expressed during the Toast of the Institution proposed by Mr Beith, the current President of the Agricultural Engineers Association Ltd, and Managing Director of Massey-Ferguson (United Kingdom) Ltd. He was speaking at the Institution's Annual Dinner in St Ermin's Hotel, London, on 12 May.

His speech came after Mr C. Culpin, the Institution's President-Elect, had risen to extend a warm welcome to all members who, with their friends and other guests present comprised the three-figure attendance.

Mr Beith then rose, as Guest of Honour. "I am not an engineer myself" he confessed "but I come from a family of engineers—mining engineers it is true—but nonetheless engineers. But for certain fortuitous circumstances I should have become one myself. Happily however the tradition is being carried on by my elder son who is currently busy building dams and harbours in Brazil. You will therefore perhaps believe me if I tell you that I am very sympathetic to your cause, despite having begun my career on the sales —I beg your pardon—marketing side."

Mr Beith said he was convinced that anybody who had been associated with the agricultural engineering business must take his hat off to the tremendous achievements in that field over the last 150 years or so. Agriculture was still our most important industry but it could never have remained this way without mechanization. It had probably started when some unknown farmer four or five thousand years ago thought it would be easier to *push* his digging stick, and eventually attached a long thong of leather to it by which his woman could pull. But even two years ago a report from a so-called developed country had described a mechanized farmer as one who owned a hoe, and a highly mechanized farmer as one who possessed *two* hoes.

In fact mechanization as such had not really come until the 19th century, when it made its appearance with the introduction first of the steel plough, followed by the advent of mechanical mowers, reapers and threshers, and later the application of steam, but in a very clumsy and limited manner. At the same time, it was also true to say that until some thirty years ago the mechanical reliability, particularly of the prime mover, had been such that it provided more than a trifle of risk to makers and users alike, besides which its effectiveness and versatility had been very restricted. But thanks to the perseverance and imagination of a large number of engineers and farmers, recent years had witnessed the appearance of the type of mechanisation properly so called today and which enjoyed universal application. "In fact", said Mr Beith, "I personally prefer the distinction the French make when they call it motorization rather than mechanization because this is really what it is. After all mechanization as exemplified by the horse drawn equipment of the early days existed before the advent of the tractor".

But if progress had already been dramatic it was nothing to what lay ahead. The drift of labour away from the farm was continuing at a high rate and the farms themselves were getting bigger every year. **Mr Beith wondered how many people realised that there were today in the UK more tractors in use than there were full time farm workers on the land. Mechanization and indeed automation of ever larger establishments would therefore provide ever increasing scope for our engineers.** "You will gradually be having to deal more with integrated systems than with individual machines and installations", said Mr Beith. "As manufacturers of agricultural machinery we are collectively a pretty mixed lot today but from what I have said it is obvious that through the development of integrated systems our destinies are going to be linked together more and more and, this being so, we may just as well face the future together whether we be large multinationals or medium and small independent specialists".

Mr Beith here put in a word for the smaller companies. He surmised that as the medium to large companies became bigger so would they be forced to streamline and shed some of their specialized activities. This would provide an opportunity for the specialists in the small companies themselves to become stronger. Indeed there would be more scope for them than ever, provided they themselves kept up with or ahead of the times and the new environment.

But our collective future did not lie alone in supporting the agricultural industry in this country however large or however important that may be. Increasingly we had to look at the whole world as our market. However, to do this we had to be more outward looking. "After all" said Mr Beith, "what is exporting but the projection of domestic skills into lands different from our own and separated from it in varying degrees by barriers of distance, of language, of habits and customs (in more senses than one) and other obstacles both natural and artificial?"

With the annihilation of space, and this was going on all the time, the world was getting smaller; so distance was being removed as an obstacle. The language problem, particularly in commerce, was becoming less, largely because English—rather fortunately—was being adopted more and more as the trading language of the world, but also because so many of our young people were taking the trouble to become proficient in foreign languages, which was a great thing in itself. It was true that not everybody was endowed with the ability to speak other languages but if one could not learn to speak another language at least one should try to learn to understand it. If even this should prove difficult it was important to learn to speak one's own language and to articulate it properly so that the other chap could understand it.

As for artificial barriers these were being dismantled quickly and increasingly in many areas. EFTA was a reality; the Kennedy Round was bringing further relief and it would only be a matter of time before we were in the Common Market.

In fact how could we afford not to be involved? "To refuse to sell abroad would be analogous to a firm in the South of England today deciding it could dispense with doing business in Wales, Scotland or Ireland", said Mr Beith. Whether we liked it or not, markets both individually and collectively were constantly getting bigger. Perhaps people did not realise that we were today the only major industrial nation with a home market of its own of less than one hundred million people, viewed from the standpoint of the Common Market as a single home market for all its members. But if we were to go into the Market, continued Mr Beith, then we must bring about substantial changes in our own approach. Our industry's share of trade in world markets was diminishing. Others, particularly Continental manufacturers, were taking a lead, and what was more they were expanding in the growth markets of EFTA—while many of *our own* firms continued to pursue the less active markets of the Commonwealth and Asia. It had often been said that general machines could not be exported in quantity, because the local man with specialist knowledge would always be able to better the imported machine, in design and in price. But was this really true? Germany was the leading exporter of agricultural machinery to the UK. If we *excluded* combine harvesters, West Germany still accounted for 20% of all the imports into Britain. These products were expensive, but the farmer continued to buy them because they had been tailored to meet his needs. So machines *could* be exported, as Germany had shown, provided they were designed right.

Under the benevolent eye of her husband, Mrs H. C. G. Henniker-Wright is here seen receiving a floral welcome from the Institution, presented to her by a young member of the staff, Miss C. S. Hicks.

"We must, therefore, learn to engineer for all the many and varied working conditions of Europe and indeed the world at large. This is what our Continental competitors are doing and if we do not follow them we shall lose ground, in some cases if we are not careful, to the point of extinction. We have shown that we could do it in the past under different circumstances perhaps; we have the ability and now it is just a question of adopting the right attitude".

Mr Beith said he feared no speech was complete without a word about ergonomics. A great deal—and quite rightly so—had been said about providing greater comfort for the operator and generally looking after his health rather better than we had done in the past. We were all human and recognised the need for this. We should also realise that everything we could do to improve the lot of the operator would ultimately result in greater productivity. Reduction in the factors leading to fatigue and a more pleasant environment would result in more hours worked per man or in greater production during the same number of hours. It was therefore not merely a matter of creature comforts. "I have always maintained that everything we produce in, say, a tractor, is functional—that there are no sophisticated frills", said Mr Beith. "Everything serves a practical purpose and this is as it should be, even into ergonomics. I was asked once about the cigarette lighter as a fitment! In my view there is no question but that a fitted lighter can lead to greater productivity and provide a safety factor". In a high wind the chances were that the driver would have to get off the tractor and seek shelter in order to light his cigarette, thus having to lose time. Conversely if he attempted to strike a match or use an ordinary lighter his attention could be distracted long enough to lead to an accident. For too long, said Mr Beith, we in the farm machinery industry had not paid the attention we should, to this question of operator comfort and safety. The question we had to ask was—"Are we going to take a lead by studying the user's needs, or is legislation required to force us to meet those needs?"

Recalling that he had already said what a good job engineers had done in the past, Mr Beith said that by the same token the industry was going to continue depending on them for the future. He concluded with these words. **"Therefore, it is most gratifying to the whole of the Agricultural Industry to hear that the Institution of Agricultural Engineers is endeavouring to be recognized by the Council of Engineering Institutions and I understand that CEI is now formulating its Rules for Affiliate Membership by suitably qualified, specialist institutions such as yours. If you do succeed in your negotiations, this will be of maximum service to our industry, because in the process of time, it will increase the status of the members of the Institution and there will be a more select and highly qualified membership. This is most important as it will help the employers of our industry to engage top quality engineers for positions of authority from members of your Institution".**

Mr Beith wished the President, and Members of Council, every success in affiliating the Institution to the Council of Engineering Institutions.

Responding to the Toast of "The Institution", Mr H. C. G. Henniker-Wright, the Institution President, said he himself could claim a family background of farming

in East Anglia but he did not quite go back to the leather thong propelled plough attached to a woman—nor, fortunately, did his wife. However, it could truly be said that farm mechanization had freed the farmer, his wife and his children, from a life-time of sweated drudgery on the land.

Mr Beith had done well to say we should all be more outward looking, breaking down barriers of language, habit and custom, and overcoming obstacles, both natural and artificial. As the newly-elected President of AEA—a richly deserved and very enthusiastically supported election if ever there was one—Mr Beith would know that demolition of obstacles must be accompanied by the building of bridges. That was the task of his Association. There was a great need today for good communication. It was good to hear the President of the AEA taking a world-wide view of the problems and challenges that confronted the agricultural engineering industry. It was a great industry and its record was one of massive achievement. It was what the world needed.

"Certainly this is an industry of which our Institution is proud to be a part", said the President. "Why do I say this? Because our Institution is rooted in this industry no less than in the engineering profession which feeds that industry. The Institution has a foot in both camps—the industry and the profession—and our task in the Institution is to see that in every way the lines of communication are kept open, and kept busy, between the two". The President said this was what the Institution tried to do at Conferences like the one earlier that very day on "Cultivations" which had been a great success. It was what our Branches tried to do during their lecture sessions all over the country. "When we can, we like to work with other bodies like the Mechanicals, as with the Tractor Symposium we are putting on next October. And I recall that we were able to collaborate with AEA last summer in the very useful 'Metrication' Conference at Silsoe. I am sure this is right and I hope we shall continually seize every suitable opportunity of harnessing our two organizations to the common good".

The President recalled that he had spoken a moment ago of bridges that needed building, or to put it another way, of fords to be constructed! We were trying to construct one now—"a bridge, not a ford" he interjected—between our Institution and CEI. **The Institution's simple aim at this time was to see that agricultural engineers were afforded the same privileges, had an equally influential voice, rose to the same stature and enjoyed the same place in the sun as those in many older-established branches of engineering.** Agricultural engineers were expected to bear much of the same cross as their brothers but to enjoy much less of the limelight. It was not good for our industry that this should be so. The President said that perhaps the most heartening of the many heartening things he had heard today was the importance that Mr Beith, speaking with the voice of his industry, had attached to the success we hoped to achieve in linking the Institution effectively and constructively to the Council of Engineering Institutions. **The importance of this Institution being able to sponsor qualified agricultural engineers to an extended CEI Register could have enormously beneficial repercussions, provided the negotiations with CEI reflected imagination, calm judgement and an unselfish regard for future generations of engineers. "I think we have tried to set this tone in our talks with CEI" said the President "and I think they have recognised it.** We are not alone in this because at our Dinner tonight we have the Presidents and Secretaries of The Institution of Heating and Ventilating Engineers and The Institution of Plant Engineers. In certain respects their problems resemble our own. Events have shown them to be courageous and stalwart allies of our Institution during the past two years, and we honour them for it".

The President concluded by thanking Mr Beith, for his generous sentiments and, on behalf of all members, wished him every success in his term as AEA President. □

FORTHCOMING EVENTS

UK, County, and Regional Shows

JULY

31, August 1, 2—Durham County Agricultural Society, Lambton Park, Chester-le-Street. Inquiries to C. H. M. Gray, secretary, 69-71 Claypath, Durham (tel: 0385 5222).

AUGUST

1, 2—Durham County Agricultural Show as above.
1—Brecon County Show, Brecon. Inquiries to M. J. Pritchard, FAI, secretary, Coliseum House, Brecon (tel: 0874 2261).
1—Dumfries and Lockerbie Agricultural Society, Showfield, Park Farm, Dumfries. Inquiries to W. Bell, secretary, 3 Dinmont Avenue, Dumfries (tel: 038-772 369).
1—Perthshire Agricultural Society, South Inch, Perth. Inquiries to T. S. Wilson, secretary, 28 York Place, Perth (tel: 0738 23780).
2—Rutland County Show, Oakham. Inquiries to Mrs. E. M. A. Bushell, secretary 19b High Street, Oakham, Rutland (tel: 0023 2018).
3—Tyneside Agricultural Society, Tynedale Park, Corbridge. Inquiries to B. H. Richardson, Tyneside Chambers, Hexham, Northumberland (tel: 0434 2292)
3, 4—Turriff District Agricultural Association, Turriff. Inquiries to J. Clark, secretary, Maybank, Turriff, Aberdeenshire (tel: Turriff 2258)
5—Airedale Agricultural Society, Myrtle Park, Bingley. Inquiries to Mrs. H. M. Thornton, 2 Park Road, Bingley, Yorks. (tel: 097-66 4400/4148).
5—Nantwich Show, Dorford Hall Park, Nantwich. Inquiries to P. Ellson, secretary 19 The Square, Sandbach (tel: Sandbach 2251).
8—Abergavenny and Border Counties Show, Glebe Lands, Llanwenarth, Abergavenny. Inquiries to Mrs. J.D. Davies, Show Office, Cattle Market, Abergavenny Monmouthshire, (tel: 0873 3892).
8—Bakewell Agricultural and Horticultural Society, Bakewell. Inquiries to R. Boocock, secretary, Farmers' Club Office, Bakewell, Derbyshire, (tel: 062-981 2736).
11—Keith Show, Seafield Park, Keith. Inquiries to G. W. Philip, secretary, Central Banffshire Farmers' Club, Clydesdale Bank Buildings, 161 Mid Street, Keith, Banffshire, (tel: Keith 2705).
13, 14—United Counties Agricultural Society, Nantyci Showground, Llysonnen Road, Carmarthen. Inquiries to P. G. Francis, secretary, The Mount, Queen Street, Carmarthen, (tel: 0267 6465/7).
19—Vale of Glamorgan Agricultural Society, Penllyne Castle Park, Cowbridge, Glamorgan. Inquiries to C. Neathey, secretary, Lanrest, Peterston-super-Ely, Cardiff CF5 6ND, (tel: 044-66 219).
19, 20—Pembrokeshire Agricultural Society, Withybush Aerodrome, Haverfordwest. Inquiries to G. G. Williams, secretary, 'Cathedine' 17 Cherry Grove, Haverfordwest, Pembrokeshire, (tel: 0437 2262)
27—Monmouthshire Show, Monmouth. Inquiries to B. Breakwell, secretary, Hadnock Court, Monmouth, (tel: 0600 2768).
31—Kenilworth and District Agricultural Society, Kenilworth, Warwickshire. Inquiries to John Margetts & Sons, secretaries, 12 High Street, Warwick, (tel: 0926 42612).

SEPTEMBER

2—Mid-Somerset Agricultural Society, Shepton Mallet. Inquiries to L. J. Edwards, secretary, c/o Chamberlaine Bros. & Edwards, Shepton Mallet, (tel: 0749 2226).
3—Buckinghamshire County Agricultural Society, Hartwell Park, Aylesbury. Inquiries to Miss P. Morris, Suite C2, Elsinore House, Buckingham Street, Aylesbury, Buckinghamshire, (tel: 0296 83734).
5—National Game Fair of Wales, Dryslwyn Castle, Carmarthenshire. Inquiries to P. G. Francis, secretary, The Mount, Queen Street, Carmarthen (tel: 0267 6465/7).
10—Montgomeryshire Agricultural Association, Welshpool. Inquiries to Morris, Marshall & Poole, secretaries, Welshpool, Montgomeryshire (tel: Welshpool 2266/8).
10—Westmorland County Agricultural Society, Longlands Showfield, Kendal. Inquiries to J. H. Williams, Low Holme, Kentmere, Kendal, (tel: Kentmere 22).
10—Yeovil Show, Barwick Park, Yeovil. Inquiries to R. A. Russell, secretary, 28 Market Street, Yeovil, Somerset, (tel: 0935 4014).
12—Romsey Agricultural and Horse Show Society, Broadlands Park, Romsey. Inquiries to Lt.-Colonel A. G. B. Walker, secretary, Chattis Hill House, Stockbridge, Hampshire, (tel: 026-481 868).
17—Thame Show, Princes Risborough Road, Thame. Inquiries to J. B. Hornby, secretary, 11 Buttermarket, Thame, Oxfordshire, (tel: 084-421 2737).
19—Newbury and District Agricultural Society, Hennick Court, Newbury. Inquiries to L. W. Spencer, secretary, 33 Baily Avenue, Thatcham, Newbury, Berkshire, (tel: Thatcham 3599).
23—Frome and District Agricultural Society, Showfield, Frome. Inquiries to Col. G. E. Drought, secretary, North Parade, Frome, Somerset, (tel: 0373 3600).

OCTOBER

14—Royal Jersey Agricultural and Horticultural Society. Autumn Show, Springfield. Inquiries to C. A. Puddy, secretary, Springfield, St. Helier, Jersey, (tel: Jersey 34517).

Other UK Activities

AUGUST

28, 29—British Timken Show, Duston, Northampton. Inquiries to F. E. Fisher, secretary, British Timken Division of the Timken Roller Bearing Co, Duston, Northampton, (tel: 0604 52311).

SEPTEMBER

15, 16, 17—International Sportsground Machinery and Equipment Exhibition, University of London Athletic Grounds, New Malden, Surrey. Inquiries to the Organiser, Institute of Groundsmanship, 108a Chessington Road, West Ewell, Surrey, (tel: 01-393 8027).
23, 24—National Potato Demonstration, National Agricultural Centre, Kenilworth. Potato production from seedbed to harvest. Inquiries to W. D. Draffan, director of administration, R.A.S.E., National Agricultural Centre, Kenilworth, Warwickshire, (tel: 0203 56151).
30—Power in Action 1970 (Tractor and Farm Machinery Demonstration), Charity Farm, Otley, nr. Ipswich, Suffolk. Inquiries to B. J. Bell, Hon. Secretary, East Suffolk Farm Machinery Club, Agric. Education Centre, Witnesham, Ipswich, Suffolk, (tel: Witnesham 350).

Forthcoming events—*continued*

OCTOBER

6, 7—Joint I Mech E/I Agr E Symposium, on agricultural and allied industrial tractors at I Mech E. 1 Birdcage Walk, London SW1. Inquiries to I Mech E or I Agr E, (see page 75).
21, 22—National Sugar Beet Autumn Demonstration, Owmby Cliff Farm, nr. Caenby Corner, Lincolnshire. Inquiries to British Sugar Corporation Ltd, 134 Piccadilly, London, W1, (tel: 01-499 3491).
27, 28, 29—Royal International Dairy Show, Olympia, London W14. Inquiries to F. R. Francis, secretary, Royal Association of British Dairy Farmers, 17 Devonshire Street, London W1, (tel: 01-580 6903). Medals for 'new implements' and awards for trade stands.
30—Agricultural Machinery and Tractor Dealers' Association annual convention, Leamington. Inquiries to secretary, A.M.T.D.A., Penn Place, Rickmansworth, Herefordshire, (tel: Rickmansworth 77241).

Overseas Activities

AUGUST

4, 5, 6, 7, 8, 9—Dublin Horse Show, Ball's Bridge, Dublin, 4. Inquiries to Commercial Superintendent, Royal Dublin Society, Ball's Bridge, Dublin, 4, (tel: Dublin 680645).

SEPTEMBER

1, 2, 3, 4, 5—Wéhaté International Horticultural Technical Fair, Poeldijk (nr. The Hague). Inquiries to Wéhaté, P.O.B. 24, Naaldwijk, Holland, (tel: 01740-6444).
5—20—Feria Mundial de la Avicultura (World poultry fair), Feria del Campo, Madrid. Inquiries to Comisario General, Avenida de Portugal (Feria del Campo), Apartado de Correos 11044, Madrid 11 Spain.
6—13—Vienna International Autumn Fair, Vienna. Inquiries to Wiener Messe, AG, 1, Messeplatz, Postfach 124, 1071 Vienna, Austria, or to the Austrian Commercial Delegate in Great Britain, 1 Hyde Park Gate, London, SW7, (tel: 01-584 6938, 6218/9).
17—27—Helsinki International Trade Fair. Inquiries to Finnish Fair Corporation, Helsinki 25 Finland, (tel: Helsinki 440 011).
29, 30, October 1, 2, 3—Nairobi Show (International Agricultural Show and Trade Fair), Jamhuri Park, Nairobi, Inquiries to Major H. A. Collins, P.O.B. 30176, Nairobi, Kenya, East Africa,

OCTOBER

1, 2, 3—Nairobi Show, as above.
5—8—Réunion de Travail de la Commission Internationale du Génie Rural (study conference of the International Agricultural Engineering Commission), relating to experiments, etc, in farm and horticultural engineering and allied computer developments. Inquiries to Secrétariat du Comité d'organisation, Dr. S. L. Mansholtlaan 12, Wageningen Holland.
12—16—International Dairy Equipment Exhibition, Sydney. Inquiries to Industrial and Trade Fairs Pty, Ltd, 3rd Floor, ADC House, 77 Pacific Highway, P.O.B. 428 North Sydney, N.S.W., Australia.
19, 20, 21—Landbouwbeurs Agricultural Fair, Zuidlaren. Inquiries to Stichting Prins Bernhardhoeve, Brink o.z., 12a Zuidlaren, Holland, (tel: 05905 1201).

The Institution cannot accept responsibility for the accuracy of the foregoing information. Dates and venues may be changed without notice, and readers are advised to obtain confirmation of all details before making travel arrangements. □

NEWS FROM BRANCHES

Scottish Branch

According to Reg McLatchie of *Farming News* (by courtesy of whom the above photograph of a spell-bound audience is reproduced) the Scottish Branch reached a mile-stone in its history with their conference on "Grassland—Current Techniques" on 5 March. This annual gathering was held for the first time in the new town of East Kilbride.

Papers included "Improved Marginal Grassland Production" by A. MacLeod of West of Scotland Agricultural College, "Modern Approaches to Lowland Grass" by S. M. Brown of Greenmount Agricultural College, Northern Ireland, "Review of Conservation Machinery" by R. D. Mathews of West of Scotland Agricultural College, "Practical Experience of Barn Hay Drying" by T. J. D. Simpson of North Berwick and finally two contrasting papers by two farmers on silage systems—"Extensive" by J. B. Cameron of Fife, and "Intensive" by H. B. Christie, Chairman of Dourie Farming Company Limited.

Discussion repeatedly drew attention to the need to brush up on established techniques rather than adopt entirely new ideas. Healthy re-emphasis was placed on the production and utilisation of grass. The whole programme, in fact, stayed close to the problems facing farmers—particularly, Mr Archie MacLeod's paper on marginal and hill land improvement.

"A thundering good day" was how the Conference was summed up during the closing remarks by Mr C. Culpin, the Institution's national President-Elect.

Yorkshire Branch

A branch meeting was held on 23 January at York. The meeting was addressed by Dr M. J. F. Hawker of the Askham Bryan College of Agriculture and Horticulture on the subject of 'Environment Control of Livestock Buildings'.

Dr Hawker first defined the limits of his talk as the control of the temperature humidity and ventilation of livestock buildings, and gave figures of values for these factors which had been determined as giving optimum comfort to the animals housed, and emphasized the problems of deciding when various kinds of livestock were ideally comfortable, with performance and veterinary state the only reliable criteria.

The various methods of ventilation were described, with building insulation for the retention of the heat generators by the body heat of the animals. Charts of figures were shown to indicate quantitatively the heat generation of various animals, and the insulation values of several building materials. The effects of radiation were described, and the comfort effect of different wall and roof temperatures in various atmosphere temperatures.

Dr Hawker concluded by illustrating the application of his research figures to the design of suitable animal buildings.

The discussion afterwards concentrated on the economic effects of different methods of insulation, ventilation and humidity control and Dr Hawker contributed much additional information in the course of this discussion.

At Selby on 20 February the Branch heard a most interesting talk given by Mr C. S. Elliot of NIAB on the subject of 'Crop Variety Development with particular reference to suitability for mechanical Handling'.

Mr Elliot reviewed the functions of NIAB as the chief testing station for seeds of all kinds, divorced from plant breeding. Seeds and plants are received from British, European and to a lesser extent from American/Canadian sources and any new variety of cereals and potatoes is compulsorily tested by NIAB before release to the market. For other seeds, e.g., beet and peas, testing was not compulsory but much work was done in conjunction with plant breeders.

Mr Elliot considered that the greatest advances in recent years in making crops suitable for mechanical harvesting or handling had been achieved in the development of high yielding monogerm sugar beet, in new even ripening varieties of peas and brussels sprouts. He stated that, contrary to popular belief, so called "combine" or short strawed barleys were not bred for combines, but happened to appear at the same time as combines in Europe.

Much amusement was caused by Mr Elliot stating that at NIAB crops for human consumption were tested for taste and those for animal feeding or manufacturing for nutrition.

A wide selection of slides was shown illustrating various crops and aspects of the work at NIAB and a lively discussion followed the talk.

West Midlands Branch

At a meeting of the Branch at Mid-Warwickshire College of Further Education on 2 March, Mr R. F. Norman of the CIBA Agrochemicals Ltd., spoke of "The Potential Use of Helicopters and Aircraft in Agriculture".

Mr Norman said that of a potential 2·6 million acres, it was believed that only 0·5 million acres of crops were sprayed by aircraft in the United Kingdom each year. The main areas of development lay in the application of fungicides, insecticides, limited herbicides, granular insecticides and fertilizer for agricultural and forestry needs. The ultra low volume technique of spraying gave application rates of approximately 0·75 pint per acre (1 litre per hectare) using electrically driven units mounted on a boom. This would increase the flying time between refilling and hence increase the overall rate of work—at present about 400 acres per day. Similar developments with granular products gave application rates of 10–15 lb per acre whereas fertilizer application rates of up to 200 lb per acre at present amounted to about 6 acres per trip and an operational cost of 20–25 shillings per cwt/acre. These developments were with a

spinner suspended from a helicopter, 12 feet above the crop. Some of the operational problems were, apart from obstructions such as pylons, lines and buildings; the drift and over-flying hazard with intensive inter-cropping; onlookers who will stand in the spraying area and hidden courting couples. Mr Norman said finally that the glamour of aircraft should not be allowed to overshadow the economic problems and that there was undoubtedly a place for a small number of effective small operators but it was not a real growth industry in Britain.

Speaking at the Annual Dinner of the West Midlands Branch in Birmingham on 24th April, Mr H. C. G. Henniker-Wright of Ford Motor Company Limited (the Institution President) said that the Institution was in active negotiation with the Council of Engineering Institutions in the matter of integration of agricultural engineering within the CEI complex. He congratulated the Branch on their progress, enthusiasm and sound financial position. He spoke of the importance of training young people for the many opportunities offered by the British agricultural engineering industry, which was a world leader both in the export field and in technological advances.

The President's remarks were endorsed by Dr J. R. Botterill, Director of (UK) Engineering, Massey-Ferguson Limited, who proposed the Toast to "Agricultural Engineering and the West Midlands Branch of the Institution" and by Mr W. T. Price, CBE, MC, of Leamington Spa, former Principal of the Harper-Adams Agricultural College.
The newly-elected Branch Chairman, Mr L. P. Evans, was absent owing to illness but he was represented by his wife, who was asked to convey to him best wishes for a speedy recovery. The retiring Hon Secretary, Mr Dudley Rowe, being the newly-appointed Vice-Chairman, conducted the proceedings in the Chaiman's absence. Guests included Mr H. M. Marklew, Principal of Leamington Spa's Mid-Warwickshire College, Mr D. Wain, Head of its Department of Engineering and Mr S. W. Rea, its Deputy Head. The Institution's National Secretary, Jon Bennett, and senior headquarters officials were also present.

The Warwickshire College of Agriculture was represented by its newly-appointed Principal, Mr G. H. Jackson and the Agricultural Engineers Association by Mr T. V. Knox and Mr F. Dean Swift. Mr H. V. Billington of Leamington Spa, the retiring Chairman, reported on the progress of the Branch (and its Wrekin Sub-Branch based in the Shropshire area) and congratulated Mr John Chambers on the award to him in 1969 of the rare distinction of Honorary Fellowship of the Institution. Mr Billington thanked his officers and Committee for all their help during his year of office and, proposing a Toast to "The Guests", said how delighted he was to see so many ladies present. In jocular vein, he drew attention to the many similarities between combine harvesters and women, "full of riddles, very expensive to acquire and maintain, and with infinitely variable motivations. A man starts with a 'pick-up' and before he realizes it, he is 'in the bag'!" He concluded: "One thing a man can do with a harvester which he cannot do with a wife is to switch it off and throw a sheet over it when not required!" □

These happy faces at the West Midlands Branch Annual Dinner are (left to right) Mr W. T. Price (Guest speaker), Mr H. V. Billington (Branch Past Chairman), Mrs Billington, Mrs Botterill, Dr J. R. Botterill (Guest speaker from Massey-Ferguson Ltd), Mrs Evans (wife of Branch Chairman, Mr L. P. Evans, who was absent due to illness), Mr G. Rose (Branch Hon Secretary), Mr H. G. G. Henniker-Wright (Institution President), Mrs Rose, Mrs Rowe, Mr J. K. Bennett (Institution Secretary), Mr D. Rowe (Branch Vice-Chairman).

THE INSTITUTION OF MECHANICAL ENGINEERS
(Automobile Division)

and

THE INSTITUTION OF AGRICULTURAL ENGINEERS

will hold a

TWO-DAY JOINT SYMPOSIUM

TO BE HELD AT:
I MECH E HEADQUARTERS
1 BIRDCAGE WALK, LONDON SW1
TUESDAY - WEDNESDAY 6 - 7 OCTOBER 1970

AGRICULTURAL AND ALLIED INDUSTRIAL TRACTORS

LIST OF PAPERS AND AUTHORS

TUESDAY SESSION

1 WORLD TRACTOR MARKETS
by C. L. Baker, Director of Engineering, Massey-Ferguson, Toronto

2 SPECIAL REQUIREMENTS FOR TRACTORS IN GERMANY
by F. J. Sonnen, DLG Prufstelle fur Land-Maschines

3 THE SPECIAL NEEDS OF INDUSTRIAL TRACTORS
by R. H. Ayres, Massey-Ferguson (UK) and Dr J. R. Botterill

4 SPECIAL REQUIREMENTS FOR TRACTORS IN JAPAN
by Masoyoki Kisu, Institute of Agricultural Machinery, Japan

5 A STUDY OF TRACTOR NOISE CONTROL
by J. Matthews, NIAE, Silsoe
J. D. C. Talamo, NIAE, Silsoe

6 THE WAY DEMANDS OF IMPLEMENTS WILL CHANGE TRACTOR REQUIREMENTS
by D. Fleming-Brown, Ransome, Sims & Jeffries

7 PREDICTION OF FUTURE DEVELOPMENT IN TRACTOR DESIGNS IN THE USSR
by Dr I. P. Kerov, Assistant Professor, Moscow Automobile & Road Construction Institute

8 THE AUTOMATED CONTROL OF TRACTOR MOUNTED IMPLEMENTS
by P. A. Cowell, University of Newcastle-upon-Tyne

9 TRACTOR BRAKING & ACTUATION
by J. E. Gannon, Chief Engineer, Tractor Brake Group, Girling

10 PARAMETER OPTIMISATION OF TRACTOR HYDRAULIC SYSTEMS
by J. A. Caywood, Ford Tractor Operations
H. S. Basrai, Ford Tractor Operations

WEDNESDAY SESSION

11 THE DYNAMIC PERFORMANCE OF TRACTOR IMPLEMENT COMBINATIONS
by M. J. Dwyer, NIAE, Silsoe

12 TRACTOR ENGINES
by C. J. Hind, Perkins Engine Group

13 THE DEVELOPMENT OF TRACTORS IN THE USSR
by V. V. Guskov, Kafedra Institute
J. S. Kaviarov, Chelyabinsk Tractor Factory
P. I. Boikov, Minsk Tractor Factory

14 THE FIAT OUTLOOK CONCERNING 4-WHEEL DRIVE TRACTORS
by F. Negro, Fiat

15 GROUND DRIVE SYSTEMS FOR HIGH-POWERED TRACTORS
by L. E. Osborne, NIAE, Silsoe

16 THE POWER WEIGHT & SPEED RELATIONSHIP OF TRACTORS
by Dr A. R. Reece, University of Newcastle-upon-Tyne

17 TRACTOR TYRES
by E. L. Warrilow, Dunlop
B. J. Anstow, Dunlop

18 HYDROSTATIC TRANSMISSION FOR AGRICULTURAL & INDUSTRIAL VEHICLES
by L. W. Eyles, Lucas Industrial Equipment

19 DESIGN CONSIDERATIONS RELATING TO TRACTOR CABIN SUSPENSIONS
by D. H. Hilton, NIAE, Silsoe

20 LABORATORY SIMULATION OF FIELD LOAD SPECTRUM
by G. Singh, Massey-Ferguson, USA

REGISTRATION

TWO-DAY (including pre-prints, lunch and light refreshments)	£15 0 0
ONE-DAY (including appropriate pre-prints, lunch and light refreshments for the day).. ..	£10 0 0
BOUND VOLUME (optional)	£5 5 0
PRE-PRINTS (supplied separately)	£3 10 0

A SYMPOSIUM DINNER WILL BE HELD ON THE EVENING OF TUESDAY, 6 OCTOBER AT ST ERMINS HOTEL, CAXTON STREET, SW1.

Tickets £2 10 0 (excluding wines)

Application for tickets to either: J. E. Lonsdale, Institution of Mechanical Engineers, 1 Birdcage Walk, LONDON SW1 (01-930 7476) *(Cheques payable to "I Mech E")* or H. N. Weavers, Institution of Agricultural Engineers, Penn Place. RICKMANSWORTH, Herts (Rickmansworth 76328) *(Cheques payable to "I Agr E")*

BSI NEWS

The following information has been made available by the British Standards Institution.

Metric Data Sheets for Shaft Fits

Two very useful aids for designers, engineers and students have been published by the British Standards Institution in the form of data sheets which indicate fits for metric-sized shafts and their holes. They are: BS 4500—Data sheet A: *Selected ISO fits: Hole basis.* BS 4500—Data sheet B: *Selected ISO fits: Shaft basis*

The innumerable enquirers who, ever since the issue of BS 4500: *ISO limits and fits,* have been asking for metric versions of the data sheets based on BS 1916, will particularly welcome these new publications.

Data sheet A gives limits of tolerances for holes and shafts for ten hole basis fits which between them cover clearance, transition and interference fit conditions. Data sheet B gives a corresponding selection for shaft basis fits. These two sheets are not conversions of BS 1916 Data sheets C and D, but are based on the 'Selected fits', section of BS 4500 and offer a useful introduction to that standard to students and to those many potential users who will be glad of guidance in choosing fits from the very wide range provided by the Standard.

Printed on stout cartridge paper, they may be used in their folded form or opened out for use as wall charts.

Copies of BS 4500 Data sheets A and B may be obtained from the BSI Sales Branch at 101/113 Pentonville Road, London N1. Price by post 5s (subscribers 4s). Bulk discount on 100 or more copies.

The Decimal Point

The decision to issue an amendment to the British Standards Institution's widely used BS 308: *Engineering drawing practice* has now confirmed the earlier decision to use the decimal point in Britain's metric change in the face of strong recommendations to the contrary (see *Newsdesk* on page 59).

An amendment to BS 308 is therefore being issued recommending only the point for use as the decimal marker on all engineering drawings. The reference in paragraph 3.4 of PD 6424 '*The Adoption of the Metric System in Engineering: Basic Programme and Guide*' to the practice recommended in BS 308 will also be amended accordingly.

Kitemark Licence for Garden Tool Manufacturers

The latest garden tool manufacturer to receive a licence to use BSI's Kitemark is William Mills and Co. (Sheffied) Ltd.

The company's Pattern No. 305 solid socket, square mouth shovel has been approved by BSI as conforming to the requirements of British Standard No. 3388 Part 1 which deals with the design, dimensions, materials, manufacture and testing of forks, shovels and spades.

During the preparation of this British Standard the primary aim was to ensure the quality and long life of these tools by giving definite requirements to be met in manufacture and by laying down stringent tests for the finished article. The issue of a Kitemark licence means that BSI has tested the article itself in accordance with the standard, and that an inspection scheme has been set up to ensure continued compliance with the requirements. Other Kitemark licensees under BS 3388 are English Tools Ltd., Wigan, and Spearwell Tools Ltd., Wednesbury and Sheffield.

Revised Specification for Transmission Chains

The British Standards Institution has published a revision of BS 228, the Standard for roller chains and chain wheels, which has now been brought in line with the relevant Recommendation of the International Organization for Standardization and is written in metric units. The revision, BS 228: 1970: *Transmission precision roller chains and chainwheels,* is a companion work to BS 2947: *Steel roller chains and chainwheels for agricultural and similar machinery* and BS 4116: *Steel roller chains for conveyors: Part 1: Chains and chainwheels.* In revising BS 228, the data for chainwheel cutters has been omitted, the intention being to include these in a separate composite standard for cutters.

The revised Standard specifies fifteen sizes of transmission chain, varying in pitch from 8.0 mm to 114.3 mm, each in single, duplex and triplex types, plus a further five sizes suitable for cycles and mopeds. Design details of suitable chainwheels are also included. Other information provided includes chain measuring loads and chain breaking loads (which are also shown in pound and inch units in an appendix for information purposes) and marking requirements.

Copies of BS 228: 1970 may be obtained from the BSI Sales Branch at 101/113 Pentonville Road, London N1. Price by post, remittance with order, 19s (subscribers 16s).

Metric Sized Ducting for Grain and Fodder Conveying

The British Standards Institution has published BS 4286: *Steel ducting for grain and fodder conveying: Part 2 Metric units.* The imperial version of this Standard, which has now been re-numbered as BS 4286: Part 1: Inch units, will co-exist with it for as long as is necessary. The new specification has been prepared principally for the benefit of designers who are now contemplating the production of new machines to metric dimensions.

Compliance with this Standard will give the benefits of rationalization in manufacture and storage and also offer the advantage of interchangeability between different manufacturers. It specifies a range of lengths, internal dimensions and thicknesses of material for the round type of grain and fodder conveying steel ducting. Drawings illustrate the various types of tubing suitable for the manufacture of ducting.

Butt joints are specified for the smaller diameters, but dimensions of flanges suitable for joining the two largest sizes are shown and these are intended to facilitate the use of quick, coupling methods.

The dimensional tolerances in the Standard are in no case unnecessarily close and are consistent with the requirements of interchangeability and the production of good quality ducting.

Copies of BS 4286: Part 2 may be obtained from the BSI Sales Branch at 101/113 Pentonville Road, London N1. Price by post, remittance with order, 10s (subscribers 8s).

Revision of British Standard for Wrought Steels

The British Standards Institution has published BS 970: *Wrought steels (blooms, billets, bars and forgings): Part 4:* 1970*: Stainless, heat resising and valve steels.* Part 4 is the first Part to be published of the five Part revision of this Standard. The four Parts still to be published are:

Part 1: Carbon steels
Part 2: Direct hardening alloy steels
Part 3: Case hardening steels
Part 5: Spring steels

The specification is presented in three sections:— Section 1—General requirements; Section 2—Specific requirements for stainless and heat resisting steels; Section 3—Specific requirements for valve steels.

A feature of the revision is that the various steels are identified by the new six digit steel designation system (advanced information of this was given in PD 6290: 1967) in place of the previously used 'En numbers'. In addition, the opportunity has been taken to align the compositions of the steels with those demanded in practice, to introduce steels not covered by the previous edition of BS 970 and also to introduce permissible variations on product analysis.

The Standard is written in imperial units, it being intended that the metric version of the Standard will be published as soon as possible.

Copies of BS 970: Part 4: 1970 may be obtained from the BSI Sales Branch at 101/113 Pentonville Road, London N1. Price by post, remittance with order 23s (subscribers 20s).

More Names for Pesticides

The British Standards Institution has recently published a supplement to the 1969 edition of BS 1831: *Recommended common names for pesticides* containing 30 further recommended common names. The new supplement gives additional details including recommended pronunciation, full chemical name, structure, other non-proprietary names and a classification of the compounds by use.

Supplement No. 1 (1970) to BS 1831 (PD 6007) may be obtained from the BSI Sales Branch at 101/113 Pentonville Road, London N1. Price by post 10s (subscribers 8s).

Rules for Abbreviations of Titles of Periodicals—Anglo-American Agreement

Since the publication of BS 4148: *The abbreviation of titles of periodicals* in 1967 there has been the opportunity of working in co-operation with the American National Standards Institute (ANSI) to produce a common Anglo-American standard in the field. This work has been highly successful, and the speed with which the resulting revision of BS 4148, now published, has followed the original edition is fully justified. BS 4148 Part 1: 1970 *Rules* is in very close accord with the corresponding USA Standard (Z39.5), confining itself to the principles by which abbreviations are made. Also in common with the practice followed by ANSI, a Word-Abbreviation List associated with the rules contained in this standard will be issued separately (as Part 2), and this will be updated at regular intervals. It is hoped that the principles themselves will need only occasional minor adjustments.

The advantages of having a standard common to the major English-speaking nations are doubtless self-evident, from both a national and international viewpoint. There are also indications that the provisions of these standards will be influential beyond ANSI and BSI.

The present standard's approach to the construction of periodical title abbreviations is simpler and more 'mechanistic' than that of the previous edition. It is therefore worth repeating the caveat contained in BS 4148: 1967 (1.2) that 'exact reconstitution of a title or word from the abbreviated form . . . cannot . . . always be expected: any degree of abbreviation worth adopting must assume access to authoritative lists of serial publications'.

Consequently the aim here is maximum consistency, so that it may be possible to identify a periodical from its abbreviated title, referring where necessary to some authoritative list of serial publications for an exact reconstitution of the full title.

Copies of BS 4148 Part 1 may be obtained from the BSI Sales Branch at 101/113 Pentonville Road, London N1. Price by post 10s (8s to subscribers).

Tyres and Rims for Farm Trailers and Implements

The British Standards Institution has published a revision of BS 3486: *Wheels for agricultural machinery, implements and trailers: Part 2: Tyre and rim sizes.* It is recommended that new designs of machinery, implements and trailers should use tyres and rims to this Standard, which mainly concerns trailed implements; it is envisaged that self-propelled implements will often be able to employ those which appear in BS 1495 which covers design details of light and medium tractors and similar vehicles.

The choice of types was governed by existing practice and usage in the United Kingdom, though current trends and American and Continental standards and practice were taken into account. The aim has been to select from existing standard sizes with the object of variety reduction.

Copies of BS 3486: Part 2 may be obtained from the BSI Sales Branch at 101/113 Pentonville Road, London N1. Price by post, remittance with order, 7s (subscribers 6s).

Metric Standard for Farm Machinery Components

The British Standards Institution has published a metric version of the Standard for agricultural pick-up reel tines (finger-like projections attached radially to rotating reels and used to harvest certain ground crops).

This Standard BS 3665: *Agricultural pick-up reel tines: Part 2:* 1970: *Bat fixing (metric units)* will co-exist with the imperial version of BS 3665, first published in 1963 and now re-designated BS 3665: *Agricultural pick-up reel tines: Part 1:* 1963: *Bat fixing (imperial units)*. The imperial version will remain in existence until the changeover to the metric system has been substantially completed in order to facilitate the replacement of tines in existing machines.

Two thicknesses of tines are specified in the Standard, Type A being suitable for certain green crops such as peas and Type B for grain crops, beans and small seeds. Certain dimensions, the number of coils and the materials of the tines are also specified.

Copies of BS 3665: Part 2: 1970, are available from the BSI Sales Branch at 101/113 Pentonville Road, London N1. Price by post, remittance with order, 7s (subscribers 6s). □

Automation in farming

FIRST STEP TO AUTOMATION—ELECTRICITY SUPPLY AND INSTALLATION ON FARMS

by H. H. LAWRENCE, C Eng, MIEE

Presented at a Conference held jointly by the Electricity Council and the Institution in London on 25 February 1970, with Mr H. C. G. Henniker-Wright, President of the Institution, in the Chair.

The Chairman introduced the first speaker, Mr H. H. Lawrence, the Assistant Commercial Manager in charge of contracting and technical activities in the South Eastern Electricity Board Area. He had had over forty years experience in the electricity supply industry, most of the time dealing with commercial matters. For many years he had been a contributor of articles dealing with contracting and applications of wiring on farms to technical journals. Mr Lawrence was a Member of the Institution of Electrical Engineers' No. 8 Sub-committee which dealt with the Agricultural Section of the IEE's Wiring Regulations.

Introduction

Mr H. H. LAWRENCE said he would start with a general approach, as he saw it, from the Electricity supply side. It was almost inevitable that he would say certain things which were already known to some of those present, and he asked those members to bear with him in the matter.

In recent years there had been a very considerable increase in the use of electricity on farms, and the considerations affecting installations were taking on some of the aspects of industrial power installations, the great difference being the environment in which work was carried out.

Electric wiring on farms was subjected to heavy wear and tear in conditions which were far from ideal for installing cables, switchgear and electrical apparatus. Coupled with that was the changing use of the buildings, the growth of the number and size of machines used and the rapid changes which were bringing about automatic operation and reducing the amount of labour needed.

In a relatively short number of years, the size of general farm requirements for electricity had changed from a few lights and small motors to installations in which there were tens and sometimes hundreds of horsepower or kilowatts used. Indeed, the stage had now been reached where farmers were using some four times more electricity than the domestic consumer per installation, and it was growing rapidly. Although the electricity used on farms represented only 2% of the national use, it was, nevertheless, equal to the amount of electricity that would be used in a million homes.

Looking to the future, one foresaw that farming would be controlled from an operations room, and the farmer would have to be trained in feeding the information to a computer. Probably other computers elsewhere dealing with different aspects of operations would also talk to his computer and feed him further information, such as market prices, population, nutrition, weather and other factors which affected him. It would then use that information to decide what he should grow, when and where to grow it, when to harvest, where to send the products, and it would help him to keep his accounts and generally take all the guesswork out of farming. Of course in doing that it would remove all the interest and incentive for him to be an individualist, but it would mean one thing, that is, he would be absolutely dependent upon electricity.

The Supply of Electricity

Progress was already being made quickly along those lines, and the Electricity Council had decided it was time to look at the problem of power, and he had been asked to tackle the job. The result was Handbook No. 16 in the series *Electricity in Agriculture*, which attempted to deal with the problems of getting electricity to the farm, of seeing that the installation was right for the job that had to be done, and of maintaining it in good working order. Before one could start considering automation and before electricity could be put to work, it was necessary to provide an adequate supply and an adequate electrical installation.

Mr Lawrence said he desired to clear up one matter immediately. It concerned single-phase and 3-phase electricity supply in rural areas. It was well known that 3-phase electric motors were smaller, cheaper to buy, and required very simple starting mechanisms; therefore one liked to think that there was 3-phase electricity supply so that that type of equipment could be used. On the other hand, 3-phase electrical installations brought problems in the form of increased voltages—instead of 240 volts there was 415 volts, which was medium pressure—stricter wiring requirements and, of course, the problem of getting it to the farm from the nearest point where it was available. When it was a long way away—and it could be many miles—it could be a very expensive operation. So one was still at the stage where single-phase motors might be the type of electric motors which could be considered from the economy point of view. Although they might be rather more expensive to buy and were sometimes a little larger, at the same time they could nevertheless do the same job at the same running cost. The difference in efficiency between the single and 3-phase motor was marginal, and the difference in the number of units they used was so small that running costs could be discounted. Therefore, each case would have to be considered individually, and the matter would have to be discussed with the local electricity supply officers. Only they could give a final answer whether the farmer should have 3-phase electricity supply or use single-phase in more remote circumstances. It took a long time between asking for a supply and getting it, but that was not because no one was doing anything about it. The electricity supply people were probably working as hard as they could, but there was a great deal of 'to-ing' and 'fro-ing' involved—waiting for committees to make decisions, Ministry of Power requirements, and Post Office Telephone clearance where circuits might be in proximity, and so forth. Such matters could take anything from two to three months to get cleared. Therefore, the moment a farmer knew he wanted an electricity supply or a larger supply, he should get going straight away, and get those matters cleared out of the way before planning too deeply.

The environment on and around farms provided some of the worst conditions in which electrical installations and equipment had to work, and it could not be over emphasized that regular inspection by experienced electrical contracting engineers was essential to maintain safe and adequate working, and guard against breakdowns which could cause considerable interference and setback to production.

Safe Use of Electricity

To revert to the Handbook, those in the industry never regarded electricity as inherently dangerous. In fact it was claimed to be a very safe source of energy provided the equipment and the wiring were well maintained and that meddlesome interference with apparatus was not permitted. That was the theme running throughout the book, and it was hoped that the message would be well propagated. As with many books of instruction, much of the advice seemed all too obvious, yet experience in the field was that common sense and precautions were often overlooked. What was being said was not new. Indeed, the very first wiring regulations issued in 1882 gave very much the same advice. To take a few quotations from those first regulations, to which some of the signatories were eminent persons who were or who ultimately became Presidents of the Institution of Electrical Engineers, in the introduction to the first regulations the following comments were found:

'The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded

against by testing or probing with electric currents . . . it cannot be too strongly urged that amongst the chief enemies to be guarded against are the presence of moisture and the use of earth as part of the circuit . . . The chief element of safety is the employment of skilled and experienced electricians to supervise the work'.

In the section dealing with '*The Wires*' (Regulation 9) we read: '*every part of the circuit should be so determined that the gauge of wire to be used is properly proportioned to the currents it will have to carry*'. Regulation 17 said: '*where wires are put out of sight, as beneath flooring, they should be thoroughly protected from mechanical injury and their position should be indicated . . . N.B. the value of frequently testing the wires cannot be too strongly urged . . . the escape of electricity cannot be detected by the sense of smell as can gas, but it can be detected by apparatus far more certain and delicate. June 21 1882*'.

Very similarly warnings were expressed in the present day language in the 14th edition of Wiring Regulations now in operation, so that after 90 years, there was little new which could be added to the emphasis on the need for frequent testing and inspection. How frequent should testing be? Certainly not less than every third year and every year when working conditions were particularly arduous.

Installation

To turn to the provision of an adequate supply for the present and future needs of the farm, the costs of providing the supply and the electrical installation were largely the cost of labour for trained installers, and the professional engineers needed to give advice and supervise the work. Economics thus dictated that adequate provision should be made for future requirements when work was being carried out at the present time. Farm supplies had increased from a common place 5 to 10 kW of twenty years ago up to 50 to 100 kW now, and sometimes several hundreds of kilowatts were required for the larger installations.

Some of the power used on the farm was still provided by other fuels, such as petrol for the tractors and oil and gas for heating applications. **It was not improbable that the electrical requirements in another twenty years might be as much as 500 kW. Substation sites would therefore have to be very much larger than at the present time, but there was need now to provide adequate space for the installation of larger transformers and the controlling switchgear.** Similar reasoning also applied to the customer's main switchboard which was often built up on a similar pattern to that used for a factory installation, and which should have provision for future extensions without the need of it having to be reconstructed at considerable expense. A frequent requirement in farm installations was taking the supply between buildings, and that could often best be done by the use of underground cables which should have ample spare capacity which could be provided at no great additional cost in the first instance. Mr Lawrence recommended that even if the immediate requirement for an underground cable was only a two wire connection, it was better to lay a four core cable in the first case, and use pairs of conductors connected in parallel. If that were done, it was possible to change the arrangement at a later date for a three or four wire arrangement for a three phase supply, or to use the cable as two separate two wire circuits for 'on' and 'off-peak' load installations. There was not very often a need to secrete cables in farm installations, and the suggestion was that they should be taken around the outside of buildings at a height beyond the reach of animals, but where they could be easily inspected and maintained as occasion arose.

He had very strong feelings about the use of all insulated installations in which not only the cables but as many component parts of the control equipment and the frames and coverings of appliances were made of insulating material. The aim should be to reduce the amount of material which had to be earthed, even although in every installation there was some that needed earthing. There was an increasing number of types of switches and auxiliaries and accessories which were now covered with insulating material. There were even small motors which were totally insulated, and did not need to be earthed. **One could see a time coming when electrical accessories could be made of all-insulated material, and there was no reason why, as knowledge of plastic materials improved, customers could not be offered completely all-insulated wiring systems. Mr Lawrence recommended cutting out as much of the metal covering electrical equipment as possible.**

Earthing of the supply of course was a deliberate act by the supply authorities. Without deliberate earthing supply lines could be at almost any pressure, which could of course be dangerous. It was necessary to tie down the system somewhere near the normal potential of the earth. Normally it was the customer's responsibility to provide a connection between any of the equipment which required to be earthed and the earth itself. There were some circumstances in which Electricity Boards might help in that connection. One way in which a Board might help to provide earthing was by bonding on to its underground cables, by running an overhead wire or by using protective multiple earthing. Protective multiple earthing was a system whereby the earth and neutral conductor were joined together in many places so that they were common and the neutral could be used to provide the earth connection.

Electrical installations on farms needed to be of best possible quality, and must be carried out by trained and competent electricians. Cut price wiring led to loss of quality and safety. The life of an installation might be twenty or thirty years and the extra cost spread over that time was small and justified.

The same principle applied to maintenance. Regular inspection and testing was essential. Even small defects should receive prompt attention and not be allowed to develop into serious faults. In order to help in making maintenance easier, the following advice was given.

The main switchboard and other control points must be kept clear of obstructions at all times. Every switch and control must be clearly labelled to show what circuit and machines were controlled. A protected wiring diagram should be displayed at the main switchboard. Spare fuses of the correct size should be available for immediate use. It was best if they were ready in spare fuse carriers. The telephone numbers of the electrical contractor and the local electricity service department should be marked on a label attached to the switchboard. All persons required to operate the electrical equipment should be instructed in procedures and should know what action to take in an emergency. Any indication of overheating, smell of burning or experience of even the slightest electric shock should be reported at once, and the faulty circuit switched off until repairs were made. Electrical installations should be tested at least once every year and the report should be kept for reference.

Other speakers who were to follow would deal in more detail with the control of electric motors and application of electric motors on farms. **The electrical contractor needed to know at the earliest possible date of the proposals for automatic control and the associated circuits in order that he could make adequate provision in his layout for the control points and for the additional wiring that might be required between the controls and the apparatus which was to be controlled.** There was probably no organisation better equipped to give advice on electrical installation work for farms than the Electricity Boards, which had liaison with the specialist sections of the Electricity Council and the facilities for exchanging information on the latest developments.

The Chairman thanked Mr Lawrence for his most interesting contribution. One point of particular interest was his continual emphasis on safety, because safety was probably the biggest problem on the farm today. The Chairman, in another part of agriculture, was continually involved in matters of safety, and in September the regulation regarding the use of safety frames and/or safety cabs on new tractors came into effect. □

AUTOMATION WITH ELECTRIC MOTORS—TYPES AND CONTROLS

by J. T. TAYLOR, MI Agr E

Presented at a Conference held jointly by the Electricity Council and the Institution in London on 25 February 1970, with Mr H. C. G. Henniker-Wright, President of the Institution, in the Chair.

The Chairman introduced Mr J. T. Taylor, whose initial training was with the electricity supply industry. His subsequent activities were concentrated on rural electrification schemes, and the sale of equipment to farmers. In 1954 he joined a major electrical equipment manufacturer, and had since been engaged in the development of electrical equipment and the sale of agricultural machinery. He had contributed several articles on the subject both to the agricultural press and the TV networks. He was the manager of the Agricultural Unit of English Electric AEI Machines Ltd.

Introduction

Mr J. T. TAYLOR said that in present day technology, extensive effort had been put into the design and production of automatic and semi-automatic processes. The reason was to conserve man hours and the eventual lowering of production costs. Until recently only the large industrial concerns could possibly consider entering into that field of control due to the development costs and engineering design overheads which had to be borne by individual installations. It would be accepted that any special design carried out and engineered for one particular installation must, and indeed did, involve an enormous amount of money and effort. Therefore, in considering that application to the agricultural industry, it was suggested that the primary feature was a basis of approach that would produce a system of automated operations at a relatively low cost. That undoubtedly meant that a compromise would have to be agreed between the farmer on the one hand and the retailer and manufacturer on the other.

It was possible, of course, to automate fully or partly almost any type of equipment, but it might often prove uneconomical. The alternatives that could assist in producing a scheme more likely to be acceptable to a farmer were:

(*a*) It was necessary to have a layout of equipment that could be fitted into a continuous flow system.
(*b*) The minimum of manual control must be considered and accepted to eliminate the necessity of superfluous automatic electrical devices.
(*c*) Above all, it must be remembered that the electrical control could only work within the limits imposed by the mechanical components of the complete system.

It was intended, therefore, to describe the basic electrical components and controls at present available as a knowledge of those was necessary to undertake the preparation of an automated scheme. The papers indicated the concern of both manufacturers and the supply industry of the need of good installations.

In that particular section, Mr Taylor drew attention to the protection of the electric motors and controls incorporated into a proposed scheme. Although modern electric motors were designed to operate at much higher temperature levels than were previously in use, the reduction of frame sizes for given horsepower ratings had led to the inevitable situation where the electric motor was, when running at full load, on its absolute maximum rating. It was, therefore, particularly important to remember that the correct motor must be chosen for the job in hand, adequate overload protection was necessary, and correct installation and control was essential.

Types of Motors

First, to consider the motors themselves, as they formed the necessary means of power, and any failure could bring the whole system to a standstill, the principal types of motors could be divided broadly into the following classes: AC induction, AC synchronous, AC variable speed and DC motors. From tables that would be found in the new Farm Electrification handbook entitled *Power*, it would be seen that the AC induction motor provided by far the greatest variation in performance, and emphasized the original statement that it was important to select the correct motor for the job in hand.

In quantity alone, the 3-phase squirrel cage and the single-phase capacitor motors accounted for most of the motors installed. That was because of simplicity of operation and servicing coupled with the low initial outlay. It should be noted that the current motor manufacture was in metric dimensions in accordance with BS 3979 : 66. Mr Taylor showed some slides illustrating a typical 3-phase motor in metric dimensions. The motors were interchangeable with continental machines.

There were five main enclosures for the motors, namely, enclosed ventilated or protected, drip proof, totally enclosed, fan cooled (not suitable for mounting outside on equipment without weather protection), flameproof and weatherproof. **With modern farming conditions, the totally enclosed fan cooled motor was to be preferred for almost every application on the farm.** The possible exception was in the case of milking machines and machinery which was working in conditions where no dust or moisture was apparent.

Selecting Motors

With regard to the selection of motors, where the choice had to be made by the farmer or electrical installation engineer, the details to be considered were given in Tables 1, 2 and 3 under the headings *Application, performance and hp range*. However, it was necessary to emphasize the following points which must be taken into account before making the final choice.

First, there were supply conditions. Information could be obtained from the local electricity supply office whether there were any limitations to connected power load, any limitations to starting current, voltage-frequency-number of phases, and whether neutral wire was available.

Secondly, starting conditions would determine the type of motor and whether there was frequency of starting, whether direct-on-line starting was permissible, and whether the load involved a long running up period.

Thirdly, there were local conditions—dust, abrasive or otherwise, dampness, exposure to weather, and ambient temperature.

Fourthly, there were load conditions, and whether they were continuous or intermittent, whether there were any periods of prolonged shutdown, and whether the machine was standing idle for long periods under adverse conditions.

Fifthly, there were the mechanical conditions. Was the motor shaft horizontal or vertical upwards or downwards? Was the type of drive solid or flexible coupling, pinion, pulley and belt? Was the mounting by motor feet, end-shield or flanged frame and, if foot mounted, did the motor run inverted? That point was particularly important as there was normally a drain hole provided in the motor frame to allow condensation within the motor to escape. If the motor were mounted in an inverted position and subjected to outside weather conditions, it would be possible for water to enter the machine and cause damage to the motor windings.

Starting Methods

All motors required some method of connecting and disconnecting their windings and the electricity supply. Starters were designed to perform that function safely, and

use of the correct type would ensure that the installation complied with both the IEE Wiring Regulations and Farm Safety Regulations. Methods of starting were given in Table 4 in the Handbook, but again a little more emphasis on the alternative types available would probably prove useful. There were the hand operated starters, which included:

(*a*) a drum type starter with a separate under-voltage coil and release suitable for star-delta or series parallel operation;

(*b*) a starter having a line contactor and a 'changeover' lever to effect the following start sequence: star-delta, series-parallel; stator-rotor and auto-transformer;

(*c*) a starter fitted with two contactors and similar to an automatic starter except that the time delay was determined by the operator holding the start button in for the required run-up period.

There were also automatic starters which were designed to operate in any fully automatic system. They included contactors and relays necessary to replace manual operation.

To comply with Farm Safety Regulations it was necessary when the starter was more than six feet from the motor to have an emergency latched out stop button or isolator adjacent to the motor. Although the drum type starter had been in common use, it was not generally appreciated that when the emergency stop button was latched out, it was still possible to turn over the machinery by moving the starter handle to the 'start' position. The other hand operated type described complied with the new safety regulations because the stop button, when latched out, prevented the reclosing of the line contactor until the emergency button was reset.

Overload Protection

Overload protection was becoming increasingly important and essential in these days of tightly rated prime movers. There were several different types of relay which operated either by the principle that the line current of an electric motor was directly proportional to the load on the motor, or by direct reaction to the temperature of the motor windings.

Of the first type the thermal overload relay was the most popular due to low cost and ease of selection. The thermal overload operated by using the motor line current to heat up a bi-metal strip which reacted by bending and operating a mechanical trip switch in the coil circuit. By using a separate bi-metal strip in each phase of a 3-phase supply, operating on a differential slide arrangement, the relay provides single phasing protection. It could also provide ambient temperature compensation which was of great importance in a device which otherwise might well be affected by variation in ambient temperature. The thermal overload relay was easily matched to the rating of the motor by use of a number of heater elements which heated up a given amount over the range of current specified. Thus the same relay could be used with a number of different heater elements to cover a range of, say, 1-7·5 hp.

The second main type was the magnetic or solenoid pattern relay. That type of relay had lost its earlier popularity due to greater size and higher cost than its thermal equivalent. The relay operated directly on the motor current, the coil being sensitive to the variation in current. Adjustment was effected by using a dashpot time delay.

The other main method of protection was the direct-acting type which had been used for some years in the form of embedded bi-metal thermostats. They carried a small microswitch directly operated by a diaphragm or reed which was embedded in the motor windings. The thermostat thus operated when the temperature of the motor windings reached a danger level as occurred in a continuous overload condition.

After all, the failure of a motor commonly known as 'burnt out' was simply due to the temperature of the inside of the motor becoming so high that the insulation of the winding melts, and a short circuit condition was provided. **It would be agreed that whilst the normal types of relay would give overload protection, a more positive method would be an advantage, particularly in automated schemes. That could be provided by a thermistor actuated protection system, and was in fact the most reliable for preventing motor burn-out from sustained overloads, stalling conditions, high ambient temperature and single-phasing conditions.**

A small detector known as a Positive Temperature Co-efficient Thermistor was embedded in the motor winding during manufacture. That was connected to a motor thermal protection unit, a transistorised relay which sensed change in resistance in the PTCT. That remained constant up to a pre-determined critical value above which a small increase in temperature resulted in a large change in resistance. The relay was connected to the control circuit in the same way as a conventional overload relay.

One of the most important features to be considered in fuse selection was the correct rating for the motor to be protected. The fuse should provide protection against a short circuit condition, and also a surge current condition well in advance of the normal operation of a conventional overload mechanism. Two main types were commonly used—the cartridge fuse or rewirable fuse. In built-up controls the cartridge fuse had become more popular due to the lower initial cost, ease of installation and greater reliability.

With regard to controls, the basic type starters for operating electric motors had been covered previously, and special automatic type controls were listed in Table 5 of the Handbook. It was not considered necessary to repeat all of those as their use must be judged on the actual type of control required.

Maintenance

On the question of maintenance, when it came to servicing, an electric motor was usually one of the most neglected machines on the farm. That probably was an advantage, because inexpert attention could cause more harm than good. There were, however, certain points which every user should remember: (1) Keep the motor dry. Do not wrap it in an enclosed polythene plastic sheet as it would tend to retain condensation. (2) Keep it as clean as practicable. (3) Keep the grease in the bearings eased by running the motor at frequent intervals during any long period of non-use. (4) Many motors today were supplied with bearings which were packed with grease for life, but if provision for lubrication existed, it was important to use the recommended lubricants as advised in the motor manufacturer's instructions. (5) In such cases as in (3)—probably in crop drying installations—it was advisable to have the motor inspected by a competent electrical engineer before it was needed for those essential tasks. In conclusion, Mr Taylor emphasized the necessity to employ only competent electricians for installation work, particularly where automation schemes were concerned. It was also essential with that type of equipment to carry out correct maintenance.

He asked whether it was not high time that the agricultural industry took stock of itself, and asked the question whether it could afford not to invest and expand into more modern techniques.

The **Chairman** thanked Mr Taylor, and said he was intrigued by the way in which Mr Taylor had kept the cost of electric motors down. A rough calculation showed that if he had maintained the same price per pound of the electric motor as in 1956, the price of the electric motor which weighed 170 lb would have been just over £102 today instead of £35, which was a very great achievement. □

THE APPLICATION OF ELECTRIC MOTORS FOR FULL AUTOMATION

by G. P. PRINT, FI Agr E

Presented at a Conference held jointly by the Electricity Council and the Institution in London on 25 February 1970, with Mr H. C. G. Henniker-Wright, President of the Institution, in the Chair.

The Chairman introduced Mr G. P. Print, the South Eastern Electricity Board's Agricultural and Horticultural Engineer. Mr Print had been concerned with farm electrification in the electricity supply industry since 1945. He had also carried out a number of missions in the field for the United Nations, including a period of eighteen months as resident engineer setting up an administration centre in Yugoslavia. He had written a number of papers on farm electrification, and presented one on Farm Food Preparation at the recent VII Congress of the Commission Internationale du Genie Rural, in Western Germany.

Introduction

Mr G. P. PRINT said the application of electric motors to agriculture had generally followed the practice set in industry. It was usual to find machines designed with provision to accommodate a motor, or the motor built in as an integral part. There were now not many, if any, of the large single motors driving a power line shaft. Individual motors for a specific and single purpose were the accepted norm. That gave greater flexibility in the use of the machine with increased efficiency. A large single motor working under light load was inefficient and had a poor power factor. It was, therefore, important that the correct size of motor was selected for a machine and carefully matched to the work required. It was not satisfactory to have the motor overloaded or that the machine should be overpowered. In the former case, assuming that a suitable overload protection device was installed in the motor itself or the motor starter, and no motor should be used without overload protection, the motor would cut out and be a constant source of nuisance and irritation to the operator. In the latter case, if a machine were over-powered by fitting a motor larger than necessary, efficiency was lowered. The first cost of the motor would be higher than that of a smaller size and running charges would generally be higher as the tariff charges in most electricity board areas had a basis of maximum demand or installed load charge.

In certain cases the load on the motor could be varied by controlling the rate of input to the machine, such as grain grinding or crushing mills where the rate of feeding the grain into the mill could be adjusted to give the desired load on the motor. For that purpose it was essential for an ammeter to be fitted with the maximum full load current of the particular motor clearly marked and for it to be placed in a position to be plainly visible to the operator when adjusting the grain feed to the mill.

The conditions on farms in which electric motors were installed were seldom ideal, the majority of applications having a high level of dust and dirt in the atmosphere, particularly sites where grain and grain products were handled and where livestock was housed. Where milk was produced or handled it was usually damp, or even wet, and generally with high levels of humidity. Totally enclosed motors should generally be used. In fact, he would prefer to say invariably. There were very few exceptions to be found on farms where an open type motor was really satisfactory.

Some manufacturers, however, still fitted open frame motors of the protected type and many were fitted in the past. It was false economy as a motor failure from dust or damp accumulating on the windings, or even vermin being caught in the rotor when the motor was started causing a short circuit, would not only cost more to repair than the difference between a totally enclosed and an open frame motor, but there was also the inconvenience of a machine being out of action whilst the necessary repair or replacement was carried out.

Motor Control Gear

Many breakdowns and subsequent losses could be avoided by using the correct motor control gear. The main functions of control gear were that the motor could be started from rest as and when required; the supply current could be kept within prescribed limits during the starting period; the motor would develop the required torque; the motor was protected against the effects of abnormal conditions; personnel were protected against electric shock and accidents, and the motor could easily be stopped, either automatically or manually at the end of a process.

Different types of motor starters were required for the following reasons: the type of supply available, that is single-phase or polyphase; limitations of starting currents on the supply system; the required performance of the motor, that is, starting torque, speed control, braking, reversing, sequence control, etc.

Bearing in mind the above and what Mr Taylor had said about it, there were certain exceptions with small motors, usually below 0·75 hp which had inbuilt thermal protection and a starter was not strictly necessary to provide overload protection to the motor. A starter would still be required for those small motors, however, when installed for automatic operations. Small motors with inbuilt protection were being used on farms generally to drive small portable grain augers, small hand power tools, etc. which could be plugged directly into switched socket outlets. It was usual in those applications for the motor to be started 'light', that is, before the load was applied.

In most cases today a motor would be supplied complete with a suitable starter, matched both to the motor and the workload, that being done either by the motor or the equipment manufacturer. If a motor were purchased separately, advice should be sought from the manufacturer or other competent person. It was a requirement in any case to ascertain from the Electricity Board if the motor could be accepted on the supply and if there were limitations on starting current.

Direct-on-the-line starters would give a high torque, but demanded heavy current at start, which might be as much as six times, or more, the normal running full load current. The exact amount would depend on the design, type and size of motor. To give the figures of one particular manufacturer as an illustration, a squirrel cage, 3-phase, 25 hp motor with full load current of 33 amperes, would take 750 per cent of full load current with direct-on-line starting, that is, 237 amperes; the starting torque provided being 200 per cent of full load torque. It was most unlikely that a motor of that size would be permitted to be connected to a farm supply with direct-on-line starting unless there was an adequate size supply transformer adjacent to the load. The local district manager of the Board must be consulted, and it was only on his authority that the motor would be permitted with direct-on-line starting. That authority was given under the Electricity Acts to protect both the distribution system and other consumers on the system.

The alternative to restrict the starting current on 3-phase supply was by using either star-delta starting or a slip ring motor. Taking the example given previously of a 25 hp motor with 33 amperes full load current, the starting current on star-delta was 230 per cent (76 amperes) which was a considerable reduction on the current of 237 amperes required when starting direct-on-line. The starting torque, however, was only 65 per cent of full load torque. The slip ring motor with a rotor type starter would provide up to 200 per cent starting torque with low starting current, but the cost of the motor with starter was considerably higher than that of the comparable size squirrel cage type with star-delta starter.

The general principles described for 3-phase also applied to single-phase starting. By the use of condensers in separate starting windings in the motor 100 per cent starting torque could be obtained with a current of 400 per cent of full load, the starting windings being automatically switched out when the motor reached full speed. Perhaps the most widely used type of starting for single-phase motors was now the series-parallel. The main windings in the motor were in two halves which were connected in series for starting and changed automatically or manually to parallel when the motor was up to speed. With that arrangement a starting torque of 80 to 120 per cent of full load torque was obtained with a starting current of 150 to 200 per cent of full load current.

A starter should have overload and no-volt protection facilities. The overload device would cut out the motor should a load be applied greater than the motor was designed to accept. Overload devices were generally adjustable and must be correctly set to give the required protection. The 'no-volt' coil was inserted to prevent a motor, and the coupled machine, restarting should there be an interruption in the supply to the motor.

Some manufacturers were now fitting thermal devices in, or on, motors to disconnect the supply should the temperature of the motor rise above an acceptable safe level. Generally the cause of a temperature rise in an electric motor above the level at which it was designed to run was due to overloading. Overload protection devices, such as thermistors, could be used to control other motors fitted with automatic starters. An illustration of that was a thermistor in a motor driving a forage chopper-blower for filling silage towers which was used to control another motor. The grass to the chopper-blower was fed from a dump box by a cross auger driven by separate motor. Owing to the nature of wet grass an even feed by the auger was difficult to achieve, and large masses or lumps of grass went into the chopper-blower from time to time overloading the motor. The consequent rise in temperature of the motor windings activated the thermistor and tripped the starter of the auger motor which cut off the grass supply to the chopper-blower. The chopper-blower motor continued to run, the load was relieved, the motor windings cooling the thermistor again cut in the auger motor to restore the grass feed to the chopper-blower.

The Transmission of Power from Motors

The term 'torque' had been quoted, which was the frictional resistance of the load which must be overcome for the motor to start. The torque required would vary with the type of machine and the duty it was required to do, and would fall into one of four main groups: First, light, such as a clutch drive (the load being applied after the motor had reached speed); secondly, constant torque, for example, compressors, conveyors, etc; thirdly, fan and centrifugal pump drives where the starting load increased as the square of the speed, and fourthly, high inertia starting loads such as cubing presses and bandsaws. The selection of a starter must take into consideration the type of load.

The transmission of power from a prime mover to a machine was usually now in a compact unit, the electric motor being very suitable for mounting on, in, or very close to a machine. Long belt drives were now only seen where tractors or old internal combustion engines were still being used as prime movers. Long flat belts, a prominent feature of the steam age, not only took up valuable floor space, but were difficult to guard effectively if the prime mover were not a fixed unit. There was also a limit on the speed that a flat belt should be driven, whereas the higher the speed of the belt the greater the power that could be transmitted by a given size of belt.

The types of farm machines had changed in recent years from a majority driven at slow speeds to a larger number now being driven at comparatively higher speeds. It was usual now to carry the impeller of centrifugal fans of up to 40 hp or more on the motor shaft, fans of that type and size being used extensively for crop drying. Axial flow fans were also carried on the motor shaft and there was no limit to the size. These fans, running at motor speeds of 960, 1440 or 2850 rev/min eliminated any transmission losses and effectively increased efficiency. There was also the saving in costs. Besides fans there were other machines which could be directly driven from a motor. A number of hammer mills had the hammers mounted directly on the motor shaft and usually with a motor speed of 2850 rev/min. For machines requiring slower speeds, the vee rope was still used extensively, as were roller chains and sprockets and geared units. In each case the drives were compact needing the minimum of space.

In the case of belt or chain drives the motor was mounted on slide rails to permit the tensioning of belts or chains. It was important to have correct tension, to prevent slip in the case of belts and the thrash of chains. If the tension were too great there would be undue strain on the motor and machine bearings. The pulleys or sprockets must be carefully aligned whenever an adjustment was made or excessive wear would occur. The direction of rotation of an electric motor could usually be changed quite simply by changing the leads over in the terminal box on the motor. The correct rotation of the machine should be checked. With many machines it would be obviously apparent if rotation were not correct but on some, such as fans, hammer mills, etc, it might not be apparent, and the machine may run with very poor performance.

Automatic Controls

The flexibility of the electric motor permitted easy control which could be automatic and remote from the motor when required. One of the first applications of automation to farming processes was to water pumping—the motor being started and stopped either by a float or pressure switch activated by the level of water in a reservoir or tank. In either case the pump with motor could be any distance from the reservoir or tank, a light cable was all that was necessary to convey a signal from the float or pressure switch back to the motor starter to stop the pump when the water level was sufficiently high, and to start it again when the water level dropped.

The reduction in the size of grinding mills was the direct result of a degree of automation being applied. The small mill could be started and left unattended to be automatically switched off as soon as a given quantity of grain from a hopper feed was ground—a flap valve or diaphragm operating a switch to stop the motor.

From that comparatively simple beginning there were now many variations to the automation of grinding or crushing mills in farm feeding systems. The control could be in the meal bin with the mill fed from a bulk supply of grain, or even in the feed hoppers at the livestock feeding point. It was also fairly simple to arrange for the mill to start up automatically as well as stop. By using proportionating equipment the protein concentrates for a balanced diet could be added to grain to make a completely automated feeding system, requiring the minimal operational attention.

Time switches could also be used to control the automatic delivery or release of food to the feeding point at pre-set times.

In crop conservation ventilating fans and heaters for drying could be controlled automatically according to the prevailing weather conditions and the material being dried. The motor and heater being switched on or off by a humidistat at any set level allowed the farmer to dry or condition grain or hay when the weather conditions were most favourable for the purpose.

Thermostats were widely used automatically to control temperature in stock and crop housing by switching on and off heaters and ventilating fans. Full air conditioning was seldom used in this country at the present time, but when it was complete automatic control of the environment could be obtained by thermostats and humidistats so that both temperature and relative humidity levels could be maintained as required. □

AUTOMATION—A SOLUTION TO THE DRIFT FROM THE LAND

by G. SMITH, NDA, NDD, FI Agr E, and V. M. OWEN, B Sc, C Eng, MIEE, Mem ASAE FI Agr E

Presented at a Conference held jointly by the Electricity Council and the Institution in London on 25 February 1970, with Mr H. C. G. Henniker-Wright, President of the Institution, in the Chair.

The Chairman introduced Mr G. Smith and Mr V. M. Owen, the authors of the final paper to be presented. The paper would be presented by Mr Smith, who was the Regional Mechanisation Adviser to the East Midland Region of the National Agricultural Advisory Service. Mr Owen was for a long time a senior officer at the Electrical Research Station, Shinfield. He was now on the staff of the National College for Heating, Ventilation, Refrigeration and Fan Engineering, specializing in environmental engineering.

Introduction

Mr G. SMITH said that the Conference had heard about the availability of electric power, which from a practical point of view, was necessary in order to realize automation to any great extent. It had been told how to harness the power required to do the job. It had not been told how to think. First of all, it was necessary to think at least five years hence and, if possible, ten years hence. Some 20,000 pairs of hands were being lost each year. If an investment broke even now, it would be into profit in five years' time if it replaced labour.

Progress had been held back by people with a misconception about new-fangled things. History had shown that it took wars to make people try new ideas. Automation could replace labour and it could make jobs easier, but it was controlled by equipment which most would never understand, and which it was necessary to have the courage to trust. At present a great deal of trust was lacking.

The foreword of the handbook dealing with automation in agriculture, Farm Electrification Handbook 18 stated that agriculture was still on the threshold of automation, but some processes were well advanced into that exciting phase. **Automation was the art of replacing human supervisory functions by robot supervisory functions. It was concerned mainly with using electronic techniques to simulate human brains. One of the main means of advancement had been the development of integrated circuitry. Application of automation had been eased by the development of digital electronics. The reasons for manual control actions should be logical. Digital electronics was logical.**

Automation could replace manpower, but only where that automation was correctly formulated. Subject to that formulation being hard fact, control parameters could be set and limits could be arranged to modify control functions by means of electronic, fluid or mechanical logic. Where quality was a matter of opinion only, then automation had no part in its control. Where an action was performed for the good of the process, but which itself could not be a rule of thumb decision, then that action was called judgment. There was no place for automation in that circumstance.

A practical example of that was a yard of beasts each with its own electronic identity permitting individual feeding to a set daily amount. Each time feeding occurred the weight of the beast was recorded. Let one say that the desired weight should be 10 cwt and when that weight was reached the beast was ready for market. But was it ready? The weight was there, but was the finish? It was also stated in the foreword to the booklet that there was no substitute for a good stockman or man of the soil. That did not mean that a good deal of sophisticated, highly technical work requiring men with expertise could not be carried out by automation. Mr Smith said he would pick out appropriate examples from Farm Electrification Handbook 18. Some farming enterprises lent themselves to factory methods, such as the poultry industry.

Poultry

Laying birds were credited with a productive life of 12 months or so, and a great deal of uniformity. Thousands could be housed under one roof in cages and treated as one. Feeding could be mechanized, drinking was on a help oneself basis. Eggs could be mechanically collected, graded, trayed up and any soft shells discarded. The droppings could be conveniently and unobtrusively stored for future disposal, or mechanically conveyed under programmed control.

All that could be controlled together with the intensity of lighting, by means of several mechanical programmes. That would be mechanization, but if the programmes were integrated using logic circuitry an automated control would result. That could allow certain permissible functions to proceed even if others failed. What was the workload of one man in that kind of business when he had to do everything manually? It was said that 6,000 to 10,000 birds could be managed when egg collecting was manually carried out. Would it be reasonable to obtain the necessary capital and incur the subsequent charges in order to automate the job? Obviously it would not, as the net return would be reduced.

If, on the other hand, circumstances permitted increasing the number of birds, then the correct ratio of increased productivity of the man must be related to the increased cost. It could be seen that automation could not eliminate the man, but it could increase the magnitude of his ability. By implementing the automation mentioned one man could supervise 15,000 to 20,000 birds.

Milk Production

Milk production formed a large part of farming activities. It was a demanding job, a seven-day-a-week job, a twice-on-Sundays job. It had been stated in Farm Electrification Handbook 18 that one man had increased his cow handling ability by 250 per cent through the better design of parlours and associated feeding. The basic speed of milking had changed very little. There were still slow milkers and fast milkers.

Some help in further increasing cow handling speed was in sight in the form of an automatically removed cluster which was removed from the udder when all teats had stopped milking. A cluster not in use, in a parlour holding unmilked cows, was quite unacceptable to any cowman. In that case the automatic cluster release increased man's cow handling speed by challenging his sense of satisfaction.

Various methods of feed handling in the parlour were explained in Farm Electrification Handbook 18, and generally they all satisfied the aim for which they were designed—to feed according to yield. From that point of view it was very much a case of 'you pay your money and take your cake'. The real searching question 'which system should I adopt?' only occurred when cow numbers got past the 200 mark.

Automated Recording

Could automation in any way relieve the cowman of so many chores that his cow handling ability improved to such an extent that a further £30 per cow could be invested economically over a herd of 100 cows or about £25 over 200 cows or £17 over 400 cows? For 200 cows the cost of identifying each cow and feeding to anticipated yield would cost something like £5,000. To invest that, one must save the equivalent of half a man or increase the output of the existing team by half a man's work. For perhaps a further £5 per cow one could record yield, record heat period by manual read-in or service, including print-out in the office. Included in that cost would be instant identity

check by digital read-out in the parlour on demand by pressing a button.

That was the latest large herd management aid and as yet unproved from an investment point of view. So far there was one experimental unit in this country, but it was hoped that two important research centres would be able to carry out proving work shortly, one in the United Kingdom and one in Europe—in fact, the one in the United Kingdom had materialized. No doubt progress would be watched with great interest.

The principle of operation was interesting but unfortunately not explained in the Handbook owing to lack of information at time of going to press. In brief it was as follows: A crystal oscillator produced an audio frequency which was processed to produce two frequencies 5 KHz apart. All necessary harmonics of the lower frequency ending in 5 were produced and summed with all necessary harmonics of the higher frequency ending in zero. They were amplified to produce a signal of 10 volts conducted to each trough in the parlour by coaxial cable and radiated by means of an antenna coil wound around a ferrite core. The cow had a transducer attached to a neck band containing three tuned circuits which transferred the radiated signal to a receiving antenna built in at the side of each trough.

The radiating antenna was arranged in a null position with respect to the receiving antenna. Proximity of the neck band transducer allowed the three tuned circuits to select from the radiated signal and transfer their signals to the receiving antenna. The signal transduced was thus a three code. Receiving amplifiers were gated to the codes. A clock pulse of 2 KHz allowed sequencing, with the first cow controlling sequence initiation, subsequent read-out and feeder control.

A control system using a three code interpretation would allow a total herd number of 100 cows to be recognized within the frequency spectrum 5 KHz-175 KHz. The digital read-out could be reduced in numbers by neglecting the first three digits and dividing by five. Thus the lowest count with a three code would be 30,000 or 30: 5 = 6. Whereupon with a three figure read-out it would appear as 006 cows.

For experimental work where accurate output data suitable for application in advisory work was required, cows, fattening beasts or pigs must be managed in groups. Single housed animals did not respond as well to varying food intake for example. The equipment outlined could be made to feed suitably transduced information into a data bank from which individual animal data could be extracted, permitting a fuller analysis than present techniques allowed. Where large numbers of animals especially milking cows were being managed, office work in connection with yield and breeding could account for considerable time. If print-out of yield, etc, were made on a machine compatible with an optical character reading device, much tedious extraction work was eliminated, and cost of a memory store saved.

Other Automatic Control Applications

Many tall stories had been related regarding labour saving which could be expected from fully mechanized feeding via tower silos. Many could tell the tale of sweat and toil stemming from over-confidence in machinery which could not think. Never had there been a more untrue saying than 'out of sight, out of mind', where top unloaders were concerned. The ammeter perhaps did allow some stoppages to be averted if the operator was fast enough or in fact close enough to raise the winch.

Control circuitry could now think fast and apply correction to prevent unloader blocking and consequent breakages. Time was saved, perhaps one hour twice a day, allowing other chores such as adding to bedding, generally appraising the stock and a host of other essential husbandry tasks. Two hours a day could be a quarter of a man's time. It could be worth an investment of £2,500, perhaps not now but in a few years time. In that case not only did the control equipment save valuable time, it saved expensive repairs and by no means least it made for better man/machine relationship.

During the last 20 years corn harvest and the drying of grain had become a relatively easy task. Some still had difficulties, but they were usually due to the inability to create sufficient profit to invest in respectable equipment. The drying of grain could be controlled to a precise degree without the need of labour, but scale of enterprise must always bear greatly on the degree of sophistication that could be economically worthwhile.

In the case of simple on-the-floor drying and storing acceptable accuracy of control could be obtained for reasonable expenditure. A schematic diagram of a controller was shown in Handbook 18 which within the accuracy of the humidistat could perform excellently, requiring little manual help. For that type of grain drying and for that matter hay conditioning also, that type of automation had done much to reduce the management labour content of drying.

There was still a considerable following for continuous dryers and of course various trades relied upon them. Those driers usually required constant supervision except where automatic moisture control equipment had been fitted.

There had been teething troubles which had in most instances been overcome. Moisture sensing equipment took complete charge of the grain flow through the drier. That was a true application of automation with consequent saving in labour, if only over a period of four to six weeks on the farm. Apart from saving the spare man which most farmers had not got, uniformity of moisture content was a great help toward trouble free storage.

Pig feeding research had shown that wet feeding had a slight economic advantage over dry. That was fortunate as it was easier to arrange automatically. The booklet dealt with various available systems and showed how thinking could be built into such a procedure.

Automation in feeding pigs allowed time for that 'eye of a good stockman', the part of livestock management that made the difference between profit and loss. The advances in ration production on the farm had been enormous over the last few years. The increase in the use of barley, especially in cow rations, had enabled farmers to use the maximum of what they grew.

The proportioning methods used in ration production ranged from entirely mechanical, in the form of set speed ratios of augers, to fully integrated conveying, weighing, grinding and mixing units. Usually the number of ingredients were limited to 4, 5 or 6 or even less, permitted of course by commercially available balancers. Except for one example proportioning was controlled by weight or time. The process could be continuous or batch. In the case of batching the mix could be controlled by switch setting in conjunction with backward counting, or by punched card. The production of feed rations on the farm could be cheaper than buying-in, if only by reason of saving transport costs and process profit.

The extent of labour saving by automation depended largely on the scale of enterprise. Simple rations required in relatively small quantities could be produced with very little labour, perhaps 30 man minutes per ton, and that could often be fitted in at convenient times.

Full automation came into its own in ration production on the 50-ton-per-week holding where large numbers of poultry, pigs or milking cows were kept. On that kind of scale an automated plant could save one man.

Much experimental work was constantly producing evidence challenging the farmer to improve his methods and so his profit. Ventilation and temperature control applied to stock housing such as poultry and pigs were now accepted. To do that with any accuracy was quite impossible by hand, but with the current widespread use of solid-state voltage control, such methods were within the economics of agriculture.

Motorized variable transformers, costly by reason of their construction, could be superseded by the thyristor. Apart from the benefits of environmental control on animal production it was also important that those who worked in that environment were better suited. Comfort zones for pigs, poultry or cattle should be acceptable to workers.

Because of the need to provide better working conditions and to enable marketing contract supplies to be maintained, certain root vegetables were stored indoors. The enemy of most crops in storage was desiccation due to too high a temperature. Environment sensors such as thermistors, resistance thermometers or simple thermostats of the bi-metallic strip or vapour pressure types, were now put to work to control fans and refrigeration. Temperature, if too high or too low, could permit desiccation. To combat that, humidifiers were fitted, controlled by various types of humidity sensing devices. In the case of potatoes, both for ware consumption and processing, onions and red beetroot, automatically controlled environments were maintained for several months. That kind of control would be impossible without the various electrical devices.

Grading and packaging in industry conjured up fantastic machines performing apparently impossible feats of unbelievable dexterity. Unfortunately much of the grading and packing work on farms must continue to be carried out by hand. It was difficult to see the time when anything but simple mechanisation was applicable. Size and weight grading could be controlled but quality could not. Automation found little application except for egg grading; chickens, too, were fairly uniform, which made automatic eviscerating possible.

Farm Electrification Handbook 18 showed how automated control functions allowed labour to do more in a day including many tasks which required judgment. Other aspects of automation, outside the brief of the booklet, which could have important repercussions on employment in agriculture were the robot tractor and the thinning of row crops by chemicals. Both those inventions were governed by automation processes—electronic logic. □

Automation in farming

GENERAL DISCUSSION

Chairman: H. C. G. HENNIKER-WRIGHT, Mem ASAE, FI Agr E*

Conducted at the Conference held jointly by the Electricity Council and the Institution in London on 25 February 1970.

The **CHAIRMAN** thanked Mr Smith for presenting his paper, and recalled that in doing so Mr Smith had stated that those concerned ought to be looking ahead at least five if not ten years. The Chairman said that, speaking personally, he had hoped that those present would have learned more about what was being developed to take them into that era than what had been developed, both from the electricity supply side and also from the industry, to enable farmers and others to develop plant that would be suitable when the new developments came about. The greatest frustration was when the farmer bought a new piece of equipment only to be told six months later that it was out of date.

In his experience, automation basically did not replace men. Industry had made that quite clear. What it did was to change the work category of the men employed. It enabled one to produce more for the same manpower or man hours of work, and enabled costs to be kept down, which had been very ably demonstrated by Mr Taylor in the case of electric motors.

The **Chairman** said he was somewhat disappointed that more had not been heard about the part that electricity had played in the development of the horticultural side of the agricultural industry, because in his view it was probably a good deal further ahead than much of general agriculture. In the United States there had been many publications on the development of feed lots so far as beef was concerned, because beef production under feed lots would no doubt become a very big part of the agricultural industry if Britain entered the Common Market to keep the price of beef down. Electricity in the United States had played a very big part in the development of those feed lots to ensure that the animals received a balanced diet to enable them to attain their optimum weight in the shortest possible time.

MR R. A. BAYETTO (Electricity Council) said that he was deputising for **Mr W. J. Guscott**, Chairman of the Electricity Industry's Agricultural Committee, who was unfortunately unable to be present. Had Mr Guscott been present to open the discussion he would have said that during the last financial year, British farming used 3,277 million kWh of electricity, which was approaching twice the amount used ten years ago, and sixteen times that twenty years ago. The likelihood was that British farming would go on taking electricity in increasing quantities each year so that by 1974, the industry expected to have to supply farms with 4,700 million kWh of electricity.

Mr Guscott's Committee was constantly concerning itself not only with the rate of development, but with the ways in which electricity was being used on farms. Obviously, it was in the interests of both the agricultural and electrical industries to supply electricity for electro-agricultural processes which were attractive to the respective economies. Tariffs were changing and despite the great increases in the price of almost everything one could think of, the cost of electricity rose very slowly.

Costs apart, why was it that electricity had become so essential to British farming? Mr Guscott felt first and foremost it was because of its amenity value. There must be many amongst the audience who remembered that the very first requirement for electricity in any farm or rural dwelling was for light. Subsequently, in his experience and that of many others concerned in the business, electricity made rapid strides very easily for the more domestic applications in the rural areas—rather more quickly than in the towns.

To come to that part of the development which was, he suggested, of more concern to the Conference, there were many farming operations which could not be accomplished effectively without the aid of electricity. Even so, until recently those and other uses of electricity were made with manual controls. But now, the crunch was really 'on' in farming, from the work point of view, as Mr Marsh had indicated in his opening remarks at this Conference. The loss of manpower in British farming was of the order of 30,000 per annum, and was continuing at that alarming rate.

As was seen in the publicity for the Conference, an attempt was being made to answer the question 'Who will do their job when they leave for industry?' Mr Guscott suggested—in fact he was certain—it would be largely electricity itself, by application not only of more and more automatic controls, but by automation itself.

Two papers had been presented—in fact, two Farm Electrification Handbooks, one dealing with *Power* and the other dealing with *Automation*. It was the teaming up of power with automation which was going to answer the ever increasing work problem in British farms. That would be true whether it occurred on part-time, small farms or the biggest in the land.

'We have had these papers presented to us in a clear way by the team of authors who have pooled their knowledge and experience for our benefit', concluded Mr Bayetto, quoting Mr Guscott. 'It remains for us to discuss the

* President of the Institution

various points they have made with a view to adopting them or adapting them and also, I hope, by raising fresh problems which these same good people may help us solve. This is an open session for the benefit of us all. I trust that you will not hesitate to question and to offer advice'.

MR C. CULPIN (National Agricultural Advisory Service) said that the merits of automation in agriculture were fortunately non-controversial. His own view was that the incidence of automation could not have been better organized if it had been planned to the last detail in the national interest. It had begun at the right time, it was developing at a reasonable speed, and it must become very important indeed in the 'seventies.

He chose to say 'developing at reasonable speed' because the whole development of mechanization was now ready for it. There was no great advantage in automation before mechanized handling processes were reasonably reliable, and that was being speedily achieved. It applied especially to stock farming where power had only recently been applied on an extensive scale. However, it was still an achievement to operate a simple electrical switch and have a machine get on with the job of feeding cattle or cleaning out manure.

Fortunately, automatic devices which regulated and controlled the application of power seemed to be adaptable to a wide range of uses. Once it was possible to perfect the mechanical handling, automation became logical and desirable.

There was every reason to be proud of the achievements in forage feeding at the NIRD and at Bridgets Experimental Farm, and on many commercial farms. Mechanized forage feeding was difficult, but the battle was being won. At both NIRD and at Bridgets pre-determined quantities of forage and additives were fed by press button systems. It was not surprising that automatic systems were not yet so foolproof that someone was still needed to keep an eye on them.

Of course, the economics of practical application had to be questioned. As Mr Smith indicated, the saving of a man often justified spending considerable capital sums; but there would be cases where the enterprise was small and the saving limited, and where only limited automatic control would be justified.

Mr Culpin said he wished to emphasize a point made by Mr Smith about the inspection of stock. There was sometimes unreasoning suspicion of automation of stock feeding, and it was necessary to point out that automatic feeding provided opportunities for inspection which could not possibly exist when manual work was being performed. What could be better than the type of liquid pig feeder which automatically fed each pen in succession, allowing a full check of several hundred pigs in the few minutes taken to feed them? The fact that the man did not necessarily have to be there on Sunday afternoon was surely a considerable advantage.

One of the points of development in the seventies would be improved environment control in stock buildings. Mr Owen had justifiably drawn attention elsewhere to the need to avoid confusing environment control with installing a fan or two. More application of the engineering knowledge that was available was needed. In fact, more soundly based engineering calculation was required, and a little less guesswork. It must, however, be added that it was not *all* engineering. Animal health factors must also be considered, since they could produce nasty shocks if overlooked.

Not a great deal had been heard about automated manure handling systems. With any new intensive livestock enterprise there was apt to be serious trouble if the manure system were not given high priority. One wondered whether there was any hope of seeing large pig and cattle buildings automatically cleaned out. Obviously it could be done, but capital cost was a serious problem.

Mr Smith had taken some trouble to explain the complex equipment which might be capable of feeding stock not directly according to yield, but according to a mixture of past performance and future potential if desired. One did not question the need to explore such possibilities, and it was fortunate that there were farmers who were taking an active part in such developments; but it was doubtful whether it was necessary for most manufacturers to become engrossed in such problems at present. On the other hand, the relatively simple automatic controls which fed according to milk yield of the day seemed likely to be much better than simply dividing cows into broad yield groups and then feeding a standard quantity, and one would expect such types to prove economic in the long run.

Driverless tractors had obvious attractions, but economic application to field work was clearly a difficult problem. The main type of development in field equipment, in the immediate future, must be increasing the use of automatic controls to assist the tractor or machine driver. For example, one looked forward to an automatic control which would permit a high-powered tractor engaged on ploughing to follow the furrow while running with all wheels on the unploughed land. It was known that where constant adjustment was needed, a good automatic control could do the job better than a human hand.

Mr A. W. GRAY said he proposed to confine his comments to the paper 'Automation'. In the foreword the author stated: 'Mechanization must take over the drudgery and Automation must be used to perform complicated control functions . . .' It was on the implication in the latter part of that statement 'Automation must be used to perform complicated control functions' that he proposed to comment. While he did not think for one moment that the author would suggest that automation was only applicable to 'complicated control functions', because that was a widely accepted understanding of the term 'automation', Mr Gray felt that it might be as well if what was meant by the term were defined.

To many the word 'automation' conjured up visions of semi-conductors, thermistors, transistors, transducers, etc., all incorporated into a very expensive, mysterious and often temperamental piece of control equipment—something which the boffins understood, but which was beyond the ken of ordinary mortals. Anything more likely to put the farmer off automation was difficult to imagine. So far as Mr Gray was concerned, automation meant providing automatic control of anything from a single piece of equipment to a complete process using the simplest reliable equipment available.

A ball-valve controlling the water level in a tank, a thermostat controlling a heater to maintain a set temperature or a time switch to energize a circuit for predetermined periods of time were all samples of automation, and yet were not considered complicated control functions.

It was not so long ago that the magic word 'electronic' was the promotion catchword applied to almost anything which was in fact electrical. The industry would be doing itself and its farmer friends a service if it avoided making the same mistake of building up a mystique around the term 'automation' and making it clear that by automation was meant the provision of an efficient and reliable system of automatic control.

As those who had had the opportunity of reading the book would appreciate, it contained a wealth of very useful and interesting information under the various headings, but Mr Gray admitted that he was left with the feeling that the subject matter was 'Mechanization' and that 'Automation'—the provision of automatic control—played a rather minor part. That was particularly true of Chapter 7—Control of environment in the Specialized Root Vegetable Store.

As far as could be seen, except for the diagram at the top of page 71, the only reference to control equipment in the fourteen pages was a mention of a thermostat on page 70 and 75. One would have thought that rather more emphasis could have been placed on the use of ambient air

storage as that was now a practical proposition for carrots and onions, and had been shown by the work at the NVRS now that suitable and reliable differential thermostats were available to ensure that the fan only came into operation when the stack temperature was above that of the ambient air.

Referring to Chapter 2—Automation of Forage Handling—all the systems dealt with referred only to silage. Were there difficulties in dealing with hay, chopped if necessary, which precluded the feeding of hay by the automated systems described? If so, could the author suggest how they could be overcome?

Secondly, turning to page 63, item b 'Solid state control equipment' and particularly to the chopped sine-wave type of controller, experience had shown that when more than one of that type of controller was connected into an installation, the operation could be erratic. It was suggested that due to harmonics set up in the system by the controllers, mutual interference or cross-talk could take place between individual controllers resulting, in extreme cases, of complete loss of control. Could any of the authors, or anyone with experience of that trouble, suggest effective means of obviating it?

MR G. MAY (Hampshire) said he entirely agreed with Mr Lawrence when he referred to maintenance as being an important subject, but he asked, 'Where could one get maintenance as a farmer?' It was almost impossible in North Hampshire to get any electrical contractor to give a contract for maintenance, or to carry out any maintenance.

Another difficulty concerned the failure of one phase in a 3-phase supply. One was then left with two phases working; the old control units did not necessarily stop a motor running, and it burned out. Farmers felt the Electricity Board should pay for this or provide modern control units. The suggestion was made that on large farms there should be a large transformer. Sometimes buildings were scattered, and Mr May was not at all sure that it would not be better to have high tension wires going to several transformers rather than one with very heavy low tension cables.

A further difficulty was that tariffs were based on the connected load. One large motor driving several machines, not used together, needed less horsepower than a number of smaller motors, but there was more to pay for the larger connected load of the latter.

Another point was that machines usually broke down at the week-end, and he reminded engineers that milking and such like went on twice a day seven days a week.

Mr Taylor talked about controlling fans. The difficulty about controlling fans was that sometimes the wind would blow the fans in the opposite direction when switched low or off, and when the automatic control switched them on again, they burned out. It would be interesting to know whether there were any means of stopping that happening.

Reference was made to totally enclosed motors. Mr May regarded the total enclosure of motors as essential in farming systems, where moisture and dirt were excessive. It would be interesting if engineers were to go round to such places as the Royal Agricultural Show and see how many motors on stands were not totally enclosed. Probably the majority were not. He asked whether there was any way whereby farmers could be protected against manufacturers not supplying to a suitable BS specification.

Mr Smith made reference to large cow units, and Mr May wondered whether it was right to go in for large cow units. He thought it might be better to go in for one-man units of, say, 100 cows each, rather than having two men in one cow unit with 200 cows. One man was then solely responsible for 'his' cows, and took a more personal interest in individual cows.

In talking about controlling the environment in a house, one usually thought in terms of regulators based on temperature. He doubted whether temperature was one of the leading factors to consider. There was the question of moisture and fumes, particularly when thinking in terms of piggeries.

Finally, in Mr May's view the papers which had been presented in the morning were some twenty years out of date. The Conference 'Automation' surely implied looking forward to the future, but there had been very little if anything about the future. He suggested that the Electricity Council who organized the Conference were completely out of touch with commercial reality (thinking farmers were still peasants). Could not some up-to-date practising engineers be elected to the Electricity Council?

Mr Taylor, in reply, said that the authors had been asked to present specific papers, and whether or not they fitted in with automation was a matter of judgment.
On the question of failure, there had been instances where two phases went down leaving one with only a single-phase; but with the correct type of starter, there would be single phasing protection in the starter, and it would cover any unfortunate incident. On a good starter there would be single phasing protection and ambient temperature compensation.

As to breakdown at week-ends, the Electricity Board should provide a 24 hour service within its territory. His own company operated an after sale service scheme which worked 24 hours a day, and during the guarantee period was free of charge.

He deplored the fact that there were drip-proof and ventilated motors, but the reason given was that they were slightly lower in price, and the farmer was not prepared to pay for a motor when he could see similar equipment with a lower priced motor. However, Mr Taylor's company was adamant that it would not sell anything other than TEFC motors to the agricultural market. It was false economy. The difference in price was probably £5 or £7 for a 5 hp motor, and the economy was not worth it. It was good insurance to pay the extra and keep out dust and dirt.

The question of reversing fans was a problem, because generally speaking the type of motor used in a fan drive had a very low starting torque. Once they were rotating sufficient torque was required to stop them and reverse them, and if wind were blowing through the building, it was a problem. The real answer was probably to have an automatic shutter control when the fans were not working.

Reference was made earlier in the day to not having starters on small motors. The regulations laid down that all motors from $\frac{1}{2}$ hp upwards should have adequate means of control by a starting switch. Mr Taylor felt that was a doubtful way of expressing it. A switch to most people was a device for switching on or off, but it had no inherent overload protection. If a motor was fitted onto some equipment and plugged into a three pin socket if the supply failed it would stop. Most people did not pull the plug out, and when the supply was restored, the machine started. If a starter were fitted, a contactor would drop out if there were no supply, and it would not go back until a button was pushed. This was obviously an important safety feature.

The **Chairman** referred to the question of week-end failures and maintenance, and said that the farming industry had to look after its equipment in the same manner as the manufacturing industry looked at their equipment, because down time on equipment in large firms was very expensive. The way in which industry in general overcame that was by preventive maintenance which was carried out on a regular scheduled basis.

Mr Print, in reply, said that all Electricity Boards would give a 24 hour service. The point to remember was that if somebody was called out at a week-end, it was likely to involve double pay straightaway plus transport, and it could be quite expensive.

Most Boards would carry out maintenance, but it was a problem. A farmer should go to a contractor who was on the register of the NICEC. If he employed an electrical contractor who was on that register, he could complain if

necessary to that Council, and they would inspect the work. They also carried out periodical inspections, and if the work were not up to their standards, they would erase the name of that contractor from the register.

As to large transformers, if the buildings were a reasonable distance apart, the Board would wish to put up separate high-voltage lines and additional transformers. There was no restriction on that. The farmer would have to justify the Board's capital expenditure.

On the question of tariffs, it was a touchy subject. Most Boards were looking at tariffs, and speaking for his own Board, the matter would be taken care of if the farm were 40 kvA and above. The farmer in that case would be advised to go on to a different tariff from the ordinary standard tariff with a maximum demand indicator.

Mr V. M. Owen, in reply, said that automation was progressing all the time, and there was more and more each year. It was built up gradually.

With regard to fans, the simplest answer was to not switch them off, but use an automatic speed change.

On the manufacturing side, manufacturers in general did not like after sale service. They preferred to make equipment which would last 10 to 20 years, without undue attention.

As to the question of fumes, by the proper selection of the fan's duty, by controlling ventilation and proper distribution, fumes could be eliminated. Air movement was very important. It was desirable to control air distribution and air movement. If air distribution were designed properly and fumes were taken out from source, the problems in airflow control could be avoided.

Relative humidity did not present a problem in a house which was adequately insulated against heat loss, and where due attention had been given to ventilation, particularly air distribution.

MR W. R. PITTS said that most farmers were fully aware of the benefits of automation, both complete and partial, and if there were a slowing down on the part of farmers to accept automation, it was because of failure in the continuity of supply, this being very critical for the intensive management of livestock. What guarantee could be given by the Electricity Board that there would be no failure of power?

Mr Print, in reply, said that the industry was trying constantly to improve its system. Heavier lines were built and additional lines for 33,000 volts, and they in turn were reinforcing the system. As far as lower voltages such as 11,000 volts were concerned, an effort was being made to link up wherever possible to give rings, so that if there were a breakdown it could be fed in another way.

Economics indicated that rural development was a dead loss to the industry, but despite that, the industry endeavoured to improve the system. It was doubtful whether it would ever be possible to give a guarantee of supply. In the case of many breakdowns the faults were on the premises themselves.

Mr R. A. Bayetto pointed out that the electricity supply industry had a statutory duty to give a supply, and to continue to give it. It did so to the best of its ability, and a great deal of capital expenditure was involved in this continuing operation. The records showed that the duration of supply failure on the electricity system continued to decrease every year, and it was now very small indeed.

Something positive could be done about it, and those concerned could help themselves to a greater extent. For instance, one assumed that Mr Pitts was in close touch with his Electricity Board, and that he had some appreciation of the operation of the area. If he could put a value on the electricity outages, and if he knew what his minimal requirements were in emergency conditions, he could calculate his justifiable capital investment for standby.

Mr G. Smith, in reply, said that farmers might not know that one could arrive at the frequency and duration of electricity failure of a particular supply circuit at any particular time of the year by asking the Electricity Board. Such information was called for when it was necessary to look at grant aid schemes and the provision of stand-by services.

MR P. G. FINN-KELCEY (Consultant) said that one of the vital factors that the Conference had not considered was how did one decide which processes to automate or in what order one might automate certain parts of a process.

In order to get the priorities right, the first consideration was the degree of skill or powers of judgment that were required of the operator for a certain job. Where an operator had to use his initiative and take remedial action necessary to overcome an unusual set of circumstances, displacement of the man might not be possible until the reliability of the equipment could be improved. A good example of this was in the operation of a continuous grain drier where it was feasible to automate the control of the moisture content of the grain leaving the drier, but unless blockages of elevators and conveyors could be virtually eliminated, automation of the drying process would be scarcely worth while.

Secondly, one must consider the number of hours per day, per week or per annum that the equipment was used, because that would have a marked effect on the economics of the process. An example of this was to be found in orchards where for half of the year, grass mowing, top spraying and herbicide application could provide almost full time occupation for a tractor driver in a 70 acre orchard. All the driver had to do was to traverse the orchard on a pre-set pattern of movement, driving down the centre of each avenue of trees. If guidance of the tractor were automated, the operator could be much more profitably employed in training the trees, removing diseased growth, etc.

The third factor to consider was the rapidity of response required and whether the speed of a whole process was restricted by the slow response of an operator or operators. The separation of stones, clods and potatoes on a potato harvester exemplified this and the employment of expensive and complex equipment such as the highly successful X-ray sorter, was fully justified.

Mr Finn-Kelcey had been concerned with the automation of tractor operation and had come up against a number of factors which were not concerned with the electronic control of the tractor, but which showed up the weaknesses and unreliability of implements attached to the tractor. If one analysed the way in which a tractor driver spent his time, much the greater part was occupied in steering a straight course, the remainder being devoted to overcoming the imperfections of the implement in use.

Better design and better maintenance of static or mobile equipment was frequently a pre-requisite for satisfactory automation.

Mr Smith, in reply, said that before one considered automation, it was desirable to mechanize an enterprise to the hilt first. Until a job had been mechanized to the fullest extent possible, it was no good thinking of integrating the controls together and making it automation.

MR C. J. MOSS (National Institute of Agricultural Engineering) said that the Electricity Council and the Institution of Agricultural Engineers had done a good job in calling the Conference, because although automation had not been discussed as much as some would have liked, the subject had been brought into the open, which was of value.

It would be interesting to know whether it was proposed to have a similar conference at two or three year intervals for the next twenty years, because that was what was needed if one were to keep pace with the progress of automation. At Silsoe there had been developed a moisture controller for grain driers, a ventilation controller for glasshouses, and

at the moment, with the encouragement of the NAAS, the possibilities of automating tractors was being investigated, so that it would be possible to keep rear wheels out of furrows. At two experimental stations there was a controller which measured the incoming sunlight and adjusted the carbon dioxide and temperature of the glasshouse to give the most efficient feeding. An effort was also being made to automate the feeding of calves, and the possibility of tractor operations in the field was being looked at. One did not know whether it was economically worthwhile, so an effort was being made to do a cost benefit study. If a further Conference were held in two years' time, many other workers would be able to come forward and discuss their experience in automation.

The **Chairman** agreed that the Conference had been worthwhile because it had brought automation into the open. He would certainly put forward the suggestion of holding another conference to the Institution's Papers Committee for consideration. A conference might be held on a three year basis or something like that. Towards the end of the year a joint symposium between the Institution of Mechanical Engineers and the Institution of Agricultural Engineers was being held on tractors and allied equipment. It covered a wide range of subjects, but did not include automation. He agreed that automation was a subject which had to be kept in the forefront of the minds of all those concerned.

MR T. S. RABBITTS asked what progress had been made in connection with closed circuit television for the identification of cows, and cows on heat, with the trend to larger herds, also in the matter of automatic feeding of cows and calf feeding.

Secondly, it would be of interest to know what the position was with respect to the use of vacuum for the automatic control of gates. Was it necessary to send a man to open gates when there was a surplus of electricity and vacuum?

He agreed that the Conference had been worthwhile, but felt that electric motors were a little basic for such a Conference, which should be considering what other forms of material were available on the farm for use by electronic control, such as compressed air, etc.

Mr Smith, in reply, said he understood that some work had been done in connection with the use of closed circuit television for cow feeding, using video recognition of cows. As to the use of vacuum for gate controllers, there was a firm which marketed a complete outfit for vacuum controlled yarding.

MR DYKE said there were some 83,000 dairy farms and 40 per cent were not producing more than 25 gallons of milk. When any form of automated equipment went on to those farms, the question of electricity supply was very important.

The point was made about the use of single-phase motors. In many areas in this country the 1 hp single-phase motor was as much as any authority would take on. The cost of supplementing supplies for the small farmer often robbed manufacturers of an order. It was suggested that electricity was cheap and motors were even cheaper. Mr Dyke asked whether electricity could not be made dearer in order that the cost of supplementing supplies to the small farmer could be brought down so that he could buy the equipment which gave him automation.

Mr Taylor, in reply, said that in fact the chief sales of single-phase motors to farmers were in the 3 to 5 hp rating range. Probably what Mr Dyke meant to say was that the individual small farms were probably not in locations where they could have more than 1 hp accepted. It was rather surprising, but there was the question of starting performance and starting requirements. It was stated in the regulations in the majority of Boards that starting current should not exceed one and a half times the full load current of the motor, and the problem facing manufacturers had been to know what was one and a half times the full load current of what motor. There must be a restricted load in amperes which would allow one to put in a larger horsepower motor, but with the correct type of starter to restrict the starting current.

Mr Owen, in reply, said that Mr Culpin had referred to solid-state control as being complicated. It was not really complicated.

In reply to Mr Gray, hay was mentioned in Chapter II in the handbook on Automation. If one were to automate the use of hay it must be chopped, to promote easy flow of the material.

MR B. C. STENNING (National College of Agricultural Engineering), in summing-up, said it would be generally agreed that automation in agriculture was still in its infancy. True there had been examples of automatic control, with the exclusion of human intervention, for a long time. The ballcock controlled cattle trough mentioned by Mr Gray was well known, as was the voltage regulator on cars and tractors. Automatic draft control had been present for some time and thermostatically controlled heaters were not new.

But the degree of automation that had come about in many industrial processes in the last ten years as the result of developments in electronics, fluidics and other fields (for example, engine block manufacture) was a long way from being generally found on farms or in farming practices. Indeed, some people would suggest—mistakenly in his view—that it would be a bad day when and if complete automation came to the land. (How often did one hear the old maxims 'a farmer's boot is the best manure', or 'it's the farmer's eye that fattens the beast'?) It was surely clear that the utmost advantage must be taken of the technical advances that were being made, and which the Conference had heard about. Mr Smith and Mr Owen had shown some striking examples.

Automatic control in varying degrees had a great deal to offer in most departments of the agricultural world—in the barn, in the stockbuilding and in the field. Auto-control could be almost as elegant, comprehensive and sophisticated

as one liked, provided that tnose concerned were prepared to pay for it. Mr Taylor made that point. Indeed, it was often said that the engineer had outstripped the plant or animal producer because almost any environmental condition could be achieved reasonably easily. What one did not know in detail was what conditions were required for optimum production.

That was not to suggest, however, that there were not still problems, for example, in monitoring variables such as hay moisture content or uniformity of ventilation patterns. No doubt improvements were still to come in reliability, too, but those concerned were in a position now at least to provide quick location and indication of faulty components so that rapid replacement might be effected, thus partially overcoming the inherent perversity of inanimate objects, referred to by Mr May. Of course, almost complete reliability could be achieved. It was necessary to look only at the American Space Programme to see that; but the cost could be high.

On another tack, the auto-control of field components and tractors was beginning to come about, albeit slowly; but one could understand the caution of the industry in accepting that development. Investigations into the auto-control of tractors were being made by several workers, and only recently it became possible for a farmer to buy a tractor which would perform a number of field operations without the aid of a driver. What was the next step from that, assuming that some form of automatic field operation would eventually be widely accepted?

If a little crystal gazing were permissible, perhaps ultimately one would see a considerable increase in the amount of protected cultivation. Cheap plastic greenhouses were already well known in the horticultural industry. If very capital intensive cultivation systems were to be used, it might be that efforts should be made to intensify production by protecting crops from the adverse elements.

As a matter of interest, 500 gauge polythene at present cost somewhere about half as much per acre as land.

Still looking forward, Dr E. R. Walsh in the recent issue of the IEE Journal looked at the future of overseas agriculture, and talked of a possible agro-industrial complex to be developed in Puerto Rico, or some other arid coastal region, maybe in the latter years of this century. Nuclear power was to be used to desalinate water for use on a farm or food factory, from which two crops per year could be taken. There would be a heaven-sent opportunity for field and barn automation, with fields set out geometrically in any way the designer might wish. Again the use of sheet plastic was mooted, largely for the promotion of high relative humidity environment for plants.

Coming back to the 'seventies, however, what was quite clear was that automatic control—automation—was here to stay, and to grow. It was up to the agricultural industry to make as much use of it as it possibly could, and largely to make use of existing equipment and techniques since probably the agricultural industry could not often justify custom built equipment. That could not be done in isolation and it would therefore become more and more necessary for designers, engineers, farmers, growers, plant and animal breeders all to work closely hand in hand. It was also worth remembering that although mains electricity plays an important part in many control systems as had been shown during the day, the consumption of kilowatts of power is not an essential rider to the use of automation, or a condition governing its application.

The challenge was to make use of electronics, fluidics, shared time on computers and every available aid, as soon as it could be provided reliably and economically.

One must agree with Dr Slight who said at the Power Farming Conference that 'complete automation of the basic food materials on a world wide scale is perhaps too far into the future to be of any real interest to us at the present time. What we are really interested in is the evolutionary process which will lead us in that direction, and provide us with increasing commercial benefits as we move forward'.

Perhaps the first step was to review the various individual operations and activities which occurred in the farming processes, be they loading and unloading, feeding, mucking out or whatever, and ask whether, in those processes the best use was being made of labour. Where was the inherent intelligence of man actually being used? Which operations involved intelligent decisions? Having decided that, the remainder of farm operations were probably those which, sooner or later, would lend themselves to a degree of automation. Then the intelligent man could get on with doing jobs which required his intelligence.

In conclusion, Mr Stenning said he believed the Conference had done a good deal to help all concerned to realize that automation was not the black magic that it was sometimes made out to be. It was a useful tool which, with the good offices of the electricity supply authorities, could be used by all. The attendance at the Conference indicated the interest which was being taken in a fascinating subject. Thanks were due to the organizers for making the day's events possible.

On the motion of **Mr Bayetto**, a vote of thanks to the Chairman was carried by acclamation, and the Conference then terminated. □

admissions and transfers

At a meeting of the Council of the Institution on 16 April 1970 the following candidates were admitted to the Institution or were transferred from one grade to another, as stated below.

ADMISSIONS

Fellow

Shiach, J. G.	*Aberdeens*

Member

Barbora, D. N.	*India*
Swanson, J. M.	*Essex*

Associate

Bertrand, A. J.	*Bucks*
Calvert, P. N.	*Beds*
Elston, B. A.	*Essex*
Felstead, C. W.	*Hants*
Forknall, J. P.	*Beds*
Gravely, A. H.	*Northants*
Hemmant, H. J.	*Liberia*
McNaughtan, A. J.	*South Africa*
Morgan, D.	*Glos*
Pettigrew, I. R.	*Cambs*
Richards, G. H. E.	*Herts*
Robertson, L. N.	*Ethiopia*
Spiller, R. G.	*Devon*
Stamp, J. T.	*Sussex*
Stokes, R.	*Devon*
Willn, G. R. O.	*Beds*

Graduate

Coleman, S. A.	*Ghana*
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Foreman, L. S.	*Canada*
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Edghill, G.	*Essex*
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Heath, R. P.	*Staffs*
Hopkins, A. G.	*Ayr*
Ilori, I.	*Beds*
Jeevunjee, S. H.	*Beds*
Jones, G. O. S.	*Mon*
Lewis, B. C.	*Sussex*
Myatt, D. C. W.	*Beds*
Ouvry, P. G. D.	*Hants*
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Schiele, M. A.	*Beds*
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Yeboah, E.	*Ghana*

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Handbury, J. M.	*W Lothian*
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Powell, R. M.	*Surrey*
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Merryweather, G. T.	*Fellow*
Olivecrona, C. M. B.	*Member*
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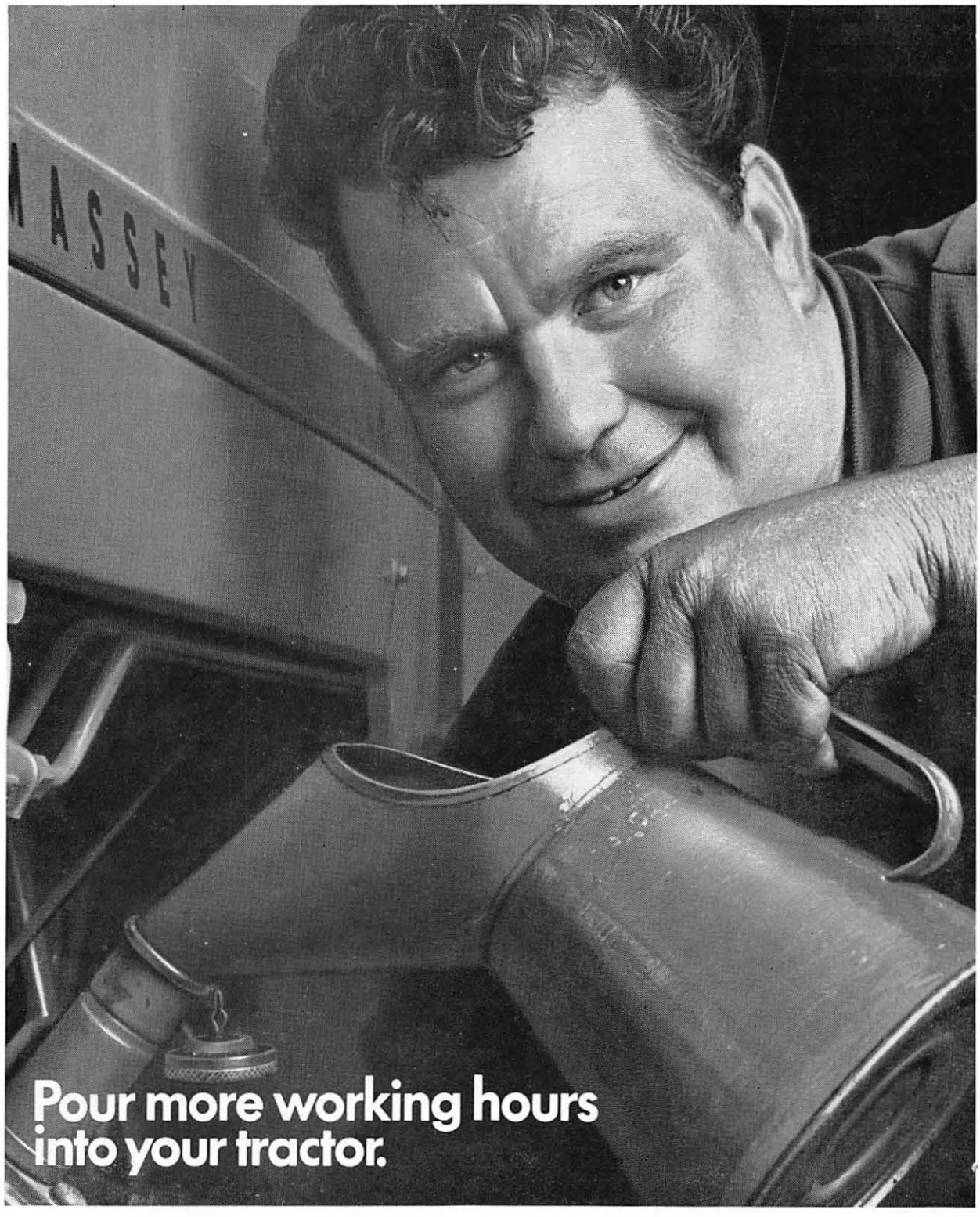

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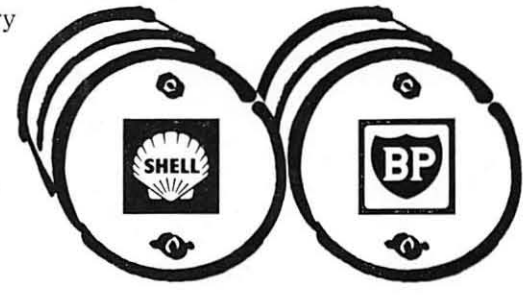

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