chain or branched-chain type. These may be separated by use of the urea compounds, because the straight chains fit into the honeycomb whereas the branched isomers cannot; but the separation of chains of different length is not a structural necessity. In clathrates, as these compounds are termed, the cage is of restricted size and, if suitable structures can be found, molecules of different lengths should be separable.

Benzene which is already of reasonable purity may be further rid of impurities, probably *cyclo*hexane, by formation of its nickel cyanide ammonia complex, which is later decomposed. A single crystallization of this kind gave a large yield of benzene, which contained 99·992 ± 0·004 molecules per cent. The ideal in this type of chemical work should be to 'tailor a suit' for any desired molecule, which could then be obtained as a molecular compound; this compound could then be removed as unwanted or used as a source of the required material.

The purification process is further illustrated by some experiments in the separation of the inert gases. No ordinary chemical componds of these elements are available for a separation, and the usual method takes advantage of their different boiling points in a fractional distillation process. Argon may be separated from neon by adjusting the pressure conditions such that the argon forms the compound with quinol but neon does not. The gases krypton and xenon, which both form compounds with quinol, may be separated in a different manner. Since the solubility is higher for xenon, there is a greater chance for xenon to become enclosed. A mixture containing krypton and xenon in the proportions of 3 : 1 was used in the standard method of preparation; the gas liberated from the crystals contained about one part by volume of krypton to three parts of xenon.

ENGINEERING EDUCATION AND TRAINING

THERE has been much controversy in recent years on the education of the engineer. An unusual feature of the discussions is that engineers have taken relatively little part. That this is not due to lack of interest in the subject is shown by the fact that during the Joint Engineering Conference held during June 4–15 in London, a whole day was devoted to papers dealing with the education and training of the engineer.

During the morning of June 13, at the Institution of Civil Engineers, Prof. J. F. Baker read a paper on "The Development and Trend of University Education in Engineering", and this was followed by "The Contribution of the British Technical Colleges to Engineering Education", by Dr. H. L. Haslegrave. As was to be expected at a Conference having as one of its objectives the recording of the contributions made during the past century by engineers to the advancement of civilization, both authors devoted considerable attention to the history of technical education in Great Britain.

While the origins of the technical colleges in Great Britain go farther back than a hundred years, to a welfare movement for working men and neglected youths and to the founding of the Society of Arts in 1754, the universities, in all but one of which there are now flourishing engineering schools, came into the field much later. It was not until a third of the nineteenth century had passed that courses of lectures, described as "Civil Engineering", were given in the University of Durham and in University College and King's College, London, and not until 1840 was any real attempt made to establish a balanced course of fundamental science and practical application.

In 1851 there existed only five university schools of engineering in Britain, chairs having been established at Glasgow, Dublin and Belfast, while the courses at Durham had been wound up. In the next twenty-five years four more were added, Owens College, Manchester, and Armstrong College, Newcastle upon Tyne, being founded, while the Universities of Edinburgh and Cambridge established chairs of engineering. It was shortly after this, between 1878 and 1890, that the most striking blossoming of advanced educational facilities occurred; no less than nine chairs of engineering being established in this period. In almost all cases the colleges owed these foundations to the generosity and ideals of local men; but they all had financial difficulties. More serious was the dual part all but Cambridge were called upon to play; the Government Department of Science and Arts instituted in 1858 having provided by means of grants a great stimulus for skilled craftsmen to attend evening classes, all other schools were centres of evening as well as day work. While the evening class students undoubtedly brought in that enthusiasm which is still so marked in the technical colleges, the dual responsibilities inevitably had repercussions on research and scholarship in the universities. Only gradually were the two activities separated and, in fact, in several cases this separation has still to be effected.

During 1900–14 the story of engineering in the universities is one of continuous and steady development, although hampered by lack of funds in spite of State aid. As in other fields, the First World War had appreciable repercussions. Apart from the sharp rise in numbers, the main effect seems to have been indirectly through changes in industry, which at last realized the advantages to be gained from the application of science to production and design problems. More universities stiffened their courses to three years post-intermediate and delayed specialization until the final year; but only Oxford and Cambridge persisted in giving an all-embracing course to a high level in the firm belief that their products possess a versatility and balance of mind which enable them to strike out with equal facility along any line they may be called upon to pursue.

The most striking change brought about by the Second World War was the doubling of the number of students, an expansion which must at least be maintained if the universities are to shoulder the responsibility of supplying the 'engineer-scientists' and development engineers needed by industry. There is evidence that the universities are alive to their responsibilities and are responding to them with a flexibility which a study of the last thirty years would scarcely lead one to expect. A number of universities are questioning the value of the formal experiments in the laboratory courses and are introducing small investigations and projects in the final year as a means of encouraging initiative and a methodical approach to new problems. Alarm at the inability of students to think and write logically has led in some colleges to formal instruction in the presentation of technical information, and in others to the use of discussion-groups; and there are other healthy signs of encouragement to undergraduates to achieve a better general education.

While all this development was taking place in Great Britain in the universities, where students get their education in the relatively easy way, the determination of the workers in industry to improve their knowledge of their work brought about an even more striking increase in the number of technical colleges. These were created from the earlier mechanics institutes from 1870 onwards, first by means of voluntary effort and later with government financial help. Evening classes were not the only activity; by 1914 there was a considerable volume of part-time day release of engineering apprentices throughout Great Britain, and this was increased after the First World War when the National Certificate scheme was born. One of the values of this scheme is its flexibility, and the syllabuses, subjects and standards have since been kept constantly under review by the Ministry of Education, the professional engineering institutions and the staffs of the colleges. Teaching of a high order has been assured for part-time students, resulting in the securing of recognized qualifications and through them of membership of the professional institutions. When the output of engineering graduates in Britain is compared unfavourably with those of other countries, the products of our senior technical colleges, which have no parallel abroad, are too often forgotten.

Since 1931 many new colleges have been erected; but this expansion has always lagged well behind the needs of industry. Since the War, two of the Percy Committee recommendations have been adopted, namely, the formation of national colleges, four of which are now in existence, and the setting up of regional advisory councils for further education. These councils have had little time to make any impression other than the production of the controversial scheme for the creation of a Royal College of Technologists. What is likely to have a greater effect upon the progress of technical colleges is the revision of salary scales which came into effect on April 1 last. Up to now the staffs of the colleges have worked with a surprising devotion and resourcefulness for woefully inadequate salaries.

In introducing his paper, Prof. Baker directed attention to a most important recent development in university education, namely, the establishment of postgraduate courses of instruction which generous help from the University Grants Committee has made possible at Birmingham, Cambridge, Edinburgh, Glasgow, the Imperial College of Science and Technology, Leeds and Sheffield. These courses have been designed for engineers whose experience in industry has concentrated their attention on relatively narrow fields. The student will choose that university which has organized a course in the particular field of his interest, and there he will return, not to do research but to attend advanced lectures, to read under supervision and to engage in laboratory work under conditions not generally available in industry and, above all, to learn how to apply science. This scheme should have far-reaching effects, integrating as it does teaching and research activities. Primarily in the interests of the undergraduate courses, the teachers engage in research or consulting work. When that makes them leaders in their particular field, they obtain extra facilities to enable them to organize postgraduate courses of instruction. The students attending these will be mature men coming straight from industry. They will contribute quite as much as they receive, so that the departments' research and undergraduate teaching will both benefit; neither will become too academic and a healthy balanced state will develop.

In the discussion that followed, in which engineers from Holland, Belgium, Australia and New Zealand joined, this scheme was applauded. Its economy over the possible alternative of extending the undergraduate course for a fourth year was stressed, and it was welcomed for its encouragement to make the undergraduate course more general. The opinion of the Conference, expressed particularly by Colonel B. H. Leeson, who opened the discussion, and Dr. Livingstone Smith, was solidly in favour of the universities making their undergraduate courses general and fundamental on the present Cambridge pattern. Prof. R. L. Lickley, while in favour of the postgraduate courses, gave the serious warning that, judging from the experience of the National College of Aeronautics, industry would not avail itself of the new opportunities. Others taking part in the discussion urged the need for a study of teaching methods, for more attention to the education of those destined to become managers, for more places in university engineering departments for the good all-round man who is in danger of extinction, and finally a strong plea was made for the granting of greater academic freedom for technical colleges.

The teaching of engineering presents peculiar difficulties compared with other subjects, because it is essentially an applied science, and practice can never be ignored. This side of the problem was dealt with in two more papers, "Practical Training of Civil Engineers" by Mr. H. J. B. Harding, and "Practical Training of Mechanical and Electrical Engineers" by Sir Arthur Fleming. Both authors gave interesting accounts of the evolution of practical training and of the schemes which are now available. Because engineering employment is diverse, no one single scheme can cover adequately the general needs of the whole profession, nor can a single scheme cover the individual needs because the entrance levels to the profession are different. It was interesting that both authors advocated an increase in the facilities for 'sandwich' courses based on works training. Certain institutions, notably the University of Glasgow, so arrange their courses that the students can spend five months at a stretch in or on works. Mr. Harding has had such men working for him. At the end of the five-months period, they leave an unexpected vacuum behind them in the organization. Mr. Harding suggested that selected colleges should establish double-sandwich courses of, say, five and a half months each. The employer could then engage students in pairs, and as each half-year's course ends they could change places so that one is always available. He then somewhat ingenuously stated that, as the total number of students would not increase, no great increase in teaching staff would be required. No university teacher could go on indefinitely teaching for eleven months in the year; but there is something in the scheme where an institution wishes to double the number of students turned out. It would mean doubling the teaching staff—no easy task to-day—but would entail no addition to its buildings, equipment or appreciably to its laboratory staff.

Though Capt. A. M. Holbein, in opening the discussion, was able to say that he detected an awakening of interest among industrial companies as well as among individuals, and a sense of responsibility for giving an all-round training as was done by the ancient trade guilds, this was not supported by the other contributors to a somewhat disappointing discussion.

The impression left by the papers and their reception was that Great Britain can deal successfully with the education and training of the technician and the general run of professional engineer, the classes who form the backbone of industry. There is a strong partnership between the technical colleges and the engineering industry, and, though there is plenty of room for better equipment and more generous treatment of teachers in the colleges, they are doing good work and will continue to do this and even better so long as they have the determination to develop their own methods and do not ape the universities. The problem industry has not solved is how best to treat the product of the university. No one denies the urgent need for a steady supply of these highly educated men, and everyone at the Conference agreed that the universities in their undergraduate courses should concentrate on the fundamentals of general engineering science; but this is less than half-way to making the men engineers able to use all their talents. Something more is needed than a two-year graduate apprenticeship followed by the usual haphazard and extravagant method of obtaining experience. The only certain way a young man now has of being given a real chance to develop fully is to be born the son of an engineering magnate. This is a restricted class, and unless leaders of industry and the professions are prepared to 'adopt' more young men from the universities rather than just to use them, then fewer and fewer of the best products will turn devotedly to engineering, ignoring the easier paths open to other scientific workers and the attractions of other professions where the training is better organized and the rewards and social standing are higher.

OBITUARIES

Mr. László J. Havas

LÁSZLÓ JENŐ HAVAS died on June 9 at Colmar, in Alsace, after an operation. He was born in 1885, of Hungarian nationality, and studied at Budapest and at several other universities; he also worked at Rothamsted Experimental Station. He was a man of wide culture, and an excellent linguist. The problem which primarily interested him was the relationship between plant and animal cancer; and many of his publications testify to his interest in tumours and other plant abnormalities induced by *Bacterium tumefaciens* and chemical agents. It is not widely realized that Havas was the first to apply colchicine in such investigations (*Nature*, 139, 371; 1937); and it was while he was in Brussels in A. P. Dustin's laboratory that he discovered the effect of colchicine on cell-division that has had wide repercussions in genetical work. This was announced at the Congress of Anatomists held at Marseilles in March 1937. (An account of early researches with colchicine has been given by J. M. Krythe and S. J. Wellensiek, *Bibliographia Genetica*, 14, No. 1, 1; 1942).

Havas regarded as his principal paper that on the gradual evolution of polyploidy and other changes in *Pelargonium zonale* (*Bull. Acad. Roy. Belgique*, (5), 28, 318; 1942); but with this also he was unfortunate. Published during the German occupation of Belgium, it attracted little notice except from the Nazis, who destroyed all reprints. Havas suffered under two despotisms, and lost all his belongings in Brussels and Budapest, including his library. After the War he found asylum in France and existed precariously on grants; but his Belgian-born widow is left unprovided for. There were no children.

HUGH NICOL

Dr. I. E. Balaban

ISIDORE ELKANAH BALABAN, head of the Pharmaceutical Research Department of the Geigy Company, Ltd., Manchester, was killed on May 23 when he fell between a train and the platform on alighting at London Road Station, Manchester.

Dr. Balaban showed an early aptitude for scientific work. During the First World War, he served with the Manchester Regiment and later the Special Brigade, Royal Engineers. He then returned to the College of Technology, Manchester, and after graduation, became research assistant to Dr. F. L. Pyman. He worked on glyoxalines and took his M.Sc. and Ph.D. degrees. On Pyman's recommendation he secured a temporary post at the National Institute for Medical Research, Hampstead, where he collaborated with Dr. Harold King in problems of chemotherapy involving the preparation of analogues of Bayer 205 and a study of their substantive properties, glyoxalines containing arsenic and gold compounds.

Balaban then entered on an industrial career, joining first of all the staff of May and Baker, Ltd., under Dr. A. J. Ewins, and ten years later he left to take up a post in the research department of Imperial Chemical Industries, Ltd., at Blackley, thus fulfilling a desire to return to his native city. While in Manchester he was awarded the degree of D.Sc., and he joined the Geigy Company, Ltd., in 1941 to develop the pharmaceutical side of the firm's activities. During these years in commercial firms, Balaban published a number of scientific papers, all having a bearing on chemicals of potential use in pharmacy or medicine.

Balaban was a keen worker in the field of medicinal chemistry and avidly kept in touch with all the latest developments. Of unassuming nature, he surprised his most intimate friends by his love of ornithology and horticulture; thus he thought nothing of paying a visit to St. Kilda to see the sea-birds in their natural surroundings. He will long be remembered by his friends and colleagues for his enthusiasm and honesty of purpose, and many will mourn his untimely end.

WE regret to announce the following deaths:

Prof. R. St. A. Heathcote, formerly professor of pharmacology in the Welsh National School of Medicine, on May 19, aged sixty-two.

Prof. F. Marguet, *correspondant* for the Section of Geography and Navigation of the Paris Academy of Sciences, and formerly professor of astronomy in the Naval School of Brest, at Villeneuve-Loubet, on June 2, aged seventy-six.

Mr. G. Udny Yule, C.B.E., F.R.S., formerly University lecturer and reader in statistics, University of Cambridge, on June 26, aged eighty.