

who had passed through the Department knew what a haphazard system prevailed there in the past. The system adopted by the Victorian Roads Board, where the assistant engineer was put in charge of a job and had his junior or pupil with him from start to finish, was also a good one. In surveying, not much more could be taught in practical work in the Engineering Course than was taught at present in the school. Apprenticeship was necessary in the surveying profession, the surveyor in practice being called upon to do much more than measuring lines and angles. For a similar reason, even such a subject as Bridge Designing could never be taught absolutely in a school. In University training no distinction was made between exceptional men and average men, and assuming that the course should fulfil the needs of the average man, this was where the training required moulding to meet prevailing conditions.

Mr. A. D. FORSTER, B.E. (Metropolitan Railway Construction), stated that the system in vogue in Germany, and since the war adopted in Great Britain, was in the direction of a short apprenticeship. On some machinery, an operator would serve a period of training ranging from one month, during which he was paid half wages, and when classed as proficient on the particular work, was given full wage.

Libraries comprising the principal technical periodicals of England, America, Germany, and other countries, besides all standard works, were also provided there, and made use of to a large extent. In most cases copies of technical periodicals are circulated among the officers, but one copy is retained by the librarian, and cannot be issued till bound with others into a complete volume. He thought there should be an Engineering Library here, and that greater facilities should be given students to visit engineering works. Where six months' practical training was stipulated, the actual time efficiently spent probably amounted to about one per cent.

Mr. WILLAN thought the Engineering Course at the University should include a section dealing with business principles, and that it would be better to arrange to do the practical work during vacations. He pointed out that the practice of holding honours examinations in March discouraged students in doing practical work during vacations. The engineer must be a man amongst men, as in all engineering work an engineer comes in contact with men, and to succeed he must have a knowledge of men.

Mr. DONALD CLARK, M.M.E. (Chief Inspector of Technical Schools, Victoria), wrote: He was exceedingly pleased that Mr. Poole had opened the important subject of Technical Education for discussion, and was wholly in accord

with Mr. Poole in dealing with the subject from the point of view of the man engaged in industry, and not from that of the pure academician.

In Germany the Professor is the outside expert, who delivers a special course of lectures—the Lecturer or the other man who teaches what other men have discovered corresponds to the Professor in our own Universities.

The danger to any system of technical, industrial, or specialised training lies in allowing people whose knowledge of outside work is limited to dictate to students what they should do. The schoolmaster does not know his limitations.

He was perfectly in accord with Mr. Poole on the freedom which should exist in the development of the higher schools of Technology, and the facilities which should exist for the passage of the brilliant student from there into a University.

There is a fairly satisfactory system in South Australia, more liberal than in his own State of Victoria. The University of Melbourne grants two years' exemption to a student who has obtained a diploma from a recognised technical school. He is not required to pass the Matriculation Examination, but he may be required to pass in Senior English and a Second Language only.

He was strongly adverse to the subordination of any of the Technical Schools' work to that of the Universities, as there was the danger of academical courses being introduced. At the same time, the road should be open to the really brilliant student who would profit by University training.

He considered that there was a tendency to over-Germanise some of these institutions which already exist. The baker's boy in Australia, even if he started delivering loaves for his father's bakery, may become a medical doctor, barrister, clergyman, or University graduate in engineering, yet unless he were apprenticed by the time he is 16 years of age he apparently could not, in New South Wales, become a tradesman of any kind, e.g., plumber, carpenter, mechanical engineer, etc.

The fact is, too many restrictions of a foreign bureaucratic nature, non-British in spirit, are growing up in our midst. Many of these restrictions were "made in Germany," and have been fetishly followed. What is needed is a virile body of men actively interested in the training of those actively required for industrial and technical pursuits. These should comprise fully trained employees who have been foremen and professional technical men. The ordinary schoolmaster should be left out, while only the University Professor or Lecturer who had had much outside practice should be included. Such men could lay down a policy which should revolutionise our present pettifogging method of dealing with this great national problem.

Unfortunately, so long as it is called education, it will suffer through being looked at from the academician's standpoint, and not from that of the industry or profession.

It is proposed to appoint a Board in the United States of America to deal with the administration of funds granted by the Central Government for vocational education. One out of the five members is to be an educationist, the others represent the industries concerned.

The main aims of any form of preliminary training for the engineer should be:—

1. To fit him to be of service to his employer.
2. To give him such a knowledge of basic principles underlying his purely engineering subjects as to reduce to a minimum the danger of making mistakes.
3. To encourage and develop a spirit of confidence, resourcefulness, and initiative.
4. To enable him to deal with practical problems, including their relationship to financial matters, such as commonly occur in engineering.

There are many necessary subordinate matters involved in these qualifications. They pre-suppose an exact knowledge of English, mathematics, and science.

It may unhesitatingly be stated that boys who spend about half their time studying languages and history, and for the rest of their time mathematics and science, until they are 18 years of age, will never, in engineering subjects, be able to compete with boys of similar attainments who have done their drawing and manual work, and who have gained more practical information than can be given in a secondary school.

As time goes on, the tendency of University teaching is to become more and more technical, and to deal with matters which fit the young graduate for his post. His training, however, is far from complete; he should not make mistakes in scientific principles, nor in carrying out simple engineering work entrusted to him; but one very important section of his training has been neglected. He knows very little about the laws regulating employment, contracts, agreements, and his knowledge of framing specifications and of estimating costs is largely academic.

There is no doubt that the Civil Engineer receives as full and as adequate a training as it is possible to crowd into a four years' University course, but I am not sure whether the same can be said of the Mechanical Engineer. At present, I am not certain what position he is to ultimately hold, but I do not consider that, in the University course, the student can gain an adequate knowledge of workshop materials and pro-

cesses. If two years were spent in a workshop, and if facilities were given for acquiring practical knowledge in the various departments before the student went to the University, he would understand and appreciate his work very much better. As an alternative, six months' workshop practice and six months' University work, spread over a five years' course, would make a better Mechanical Engineer of him.

Apart from the University, there are large classes of men who have risen, and will continue to rise from the ranks. These men have become qualified for their posts on account of their innate ability, their experience, and their sound judgment in dealing with men and materials. It must be confessed that in the past our educational scheme neglected this class.

CHARLES FENNER, D.Sc. (Supt. of Technical Education, South Australia): He had read with much pleasure the reprint of Mr. Poole's presidential address, which he had the good fortune to hear when in Sydney last November.

His own attention has lately been chiefly directed to the question of pre-vocational and apprentice training. With what Mr. Poole said on this matter, he agreed generally. He thought, however, that in a State where there is an up-to-date primary system of education, the lads who wish to pass through the junior technical schools should be in those schools by the age of 13. The whole question of specialised education at these ages leads naturally on to the necessity for the raising of the compulsory school age to 15—the age at which most boys and girls really enter on their life work.

The special characteristics of the type of junior technical school that is found in Victoria are:—A separate school and school building, with a distinct curriculum and a special staff of men teachers, associated more closely with the senior technical school than with the primary school. Such schools are preferable to the junior technical schools of Sydney, which are in close association with the primary school, and appear to be no more than the ordinary higher grades of the primary school, with some alterations and additions in the curriculum.

In connection with the school attendance in Australia, he had lately compared the results achieved in the various States of the Commonwealth. The general fact brought out was that in all the States the children come to school in their thousands at the ages of 5 to 7, and leave in their thousands at the ages of 13 to 15.

Technical trade education (pre-vocational and apprentice training) is mainly concerned with young people, aged from 12 to 18 years. The following table gives figures from the 1911 Census:—



*School Attendants, 12 to 18 years.**Stated as Percentages of total No. of individuals of each age.*

Years of Age.	12	13	14	15	16	17	18
N.S W. ... ..	88	79	43	22	11	6	3
Victoria... ..	89	81	41	14	11	6	4
S. Aust.... ..	85	53	30	14	8	5	3
Queensland ...	80	66	37	19	9	4	2
W. Aust. ... ..	90	79	43	21	12	6	3

When we come to compare these results with what is done in the United States of America, as shown by figures for the year 1911, we find that Australia is lagging far behind. The exact figures are:—

Age Groups.	Percentage Enrolled in School.	
	U.S.A.	Australia.
Under 5 years ...	?	2.3
5 years ... ..	18.6	42.3
6 to 10 years ...	80.2	86.8
10 to 15 years ...	96.2	79.8
15 to 18 years ...	55.8	12.0
18 to 24 years ...	9.8	1.6

The figures show that while in the United States the average age of commencing education is about a year later than with us, yet there is a much higher percentage enrolment. Also, while we lose most of our young people at about 14-15 years, they are retained in America to the age of 16-17. When we consider the special educational value of these years, our backwardness in this matter becomes apparent. For the important period of youth, 15-18 years, we have 12 per cent. of our available young people enrolled at schools. America has four and a half times this proportion—55.8 per cent.

An excellent system of vocation schools must be the chief reason for this very fine result.

He did not wish to over-emphasise the value of pure "schooling," nor to detract from the educational value of workshops and offices. But some schooling (vocational training, etc.) is essential for those engaged in acquiring the necessary skill and knowledge for their life-work. The figures show how much farther we in Australia have to advance before we can reach what has already been accomplished in the United States.

F. W. REID, B.Sc., A.S.A.S.M. (Principal of South Australian School of Mines and Industries): The Fellowship Courses at the Adelaide School of Mines are conducted under an agreement entered into in 1903 between the University and the School of Mines, whereby the institutions united in providing courses of instruction in Mining, Metallurgy, Electrical Engineering, and Mechanical Engineering. A Joint Board was appointed to deal with matters arising out of the fulfilment of the agreement, and a Faculty of Applied Science was formed from the staffs of the two institutions to advise the Board. The instructional work is fairly evenly divided, the proportion of subjects allotted to each institution varying somewhat in the different courses.

A student completing one of the courses and submitting evidence of twelve months' practical experience in work appropriate to the course, is granted the Diploma of Applied Science of the University and the Fellowship of the School of Mines. If he has matriculated and conformed with certain regulations, he is also granted the B.E. Degree of the University.

The Associateship Course is of lower standard than the Fellowship, and the entrance qualification is not so high. In the case of Mechanical and Electrical Engineering, the time occupied is the same, viz., four years; but the course for the Associateship is a combined one, whereas for the Fellowship, separate courses are provided. Students completing the Associateship and wishing to proceed to the Fellowship, are granted full recognition of the work done in the former course. Several Associates have proceeded to the higher course and obtained the University Degree.

As Mr. Poole states, there is no Civil Engineering Course at Adelaide. During 1914 a syllabus was prepared, and steps taken for the establishment of such a course, but the scheme was abandoned on the outbreak of war. Doubtless it will be taken up again and brought to fruition when circumstances are more favourable.

Mr. W. POOLE, in reply, stated that he was very gratified that his address had been received with such keen interest, both in this and other States.

As the opinions which he had expressed were not in agreement with many existing practices in connection with the training of engineers, he had anticipated that his remarks would have received much adverse criticism. His address certainly had evoked much serious discussion, but in the main, it had supported his views. The most satisfactory feature of the discussion was that it showed that the subject of the training of engineers in both its trade and professional aspects was being widely and seriously considered, that the views expressed were much less diverse than formerly, and that therefore substantial progress may be expected in putting this important matter on a sounder basis.

Several of the speakers had related their early experiences, and it might be of interest if he also related his. On leaving school, he (Mr. Poole) joined the service of the Railway Construction Branch of New South Wales as an engineering cadet. In this capacity he had worked in the Engineering and Survey Drawing Office, and also in the field, and during that time decided it would be of advantage to go through the Civil Engineering Course (the only existing extra course) at the University. He found that the work he had done as a cadet was of great assistance to him in taking the fullest advantage of the work at the University. Some six years later he returned to the University, and, after completing the Mining and Metallurgical Course, had the advantage of a period of practical experience in Mining, Milling, and Metallurgical work at Broken Hill and Port Pirie. It was essential that all engineers who are to be intimately engaged in industrial work should, during their early experience, be closely associated with the craftsmen of the industry, as in this way they acquire an invaluable knowledge of the ways, limitations, and outlook of the men, and of the manner of tactfully dealing with them. A knowledge of such affairs becomes of co-ordinate importance with technical knowledge. If they looked round Australia it would be found that general managers of large undertakings were frequently noted more for their administrative ability than their technical knowledge.

He considered it necessary that tradesmen should receive an efficient course of shop and trade class training, but he strongly objected to the present regulations, which practically prevented a young man over 16 or 17 years of age becoming a tradesman. He did not object to the trades qualifications for those going to the trades. He recognised that trades should be protected, but there should be an open but regulated avenue for those who wish to enter a trade after the ordinary age of apprenticeship. As matters stand at present in this State, a young man of 17 may freely enter upon a proper course of in-

struction for one of the professions, but he is practically debarred from entering a trade. The experience in Britain during the war had shown that it was possible to reduce the period of apprenticeship.

The "job card" system of record of students' work gave excellent results where judiciously and moderately carried out, but there is the undoubted danger that too much of the instructor's time may be taken up in recording too many details. This objection was a few years ago strongly urged against the system then in use in some of the classes at the Working Man's College, Melbourne. He (Mr. Poole) had instituted a system of records, some 13 years ago, at the Charters Towers School of Mines for the laboratory class and field work done during the year, also in connection with class examinations in purely lecture subjects. Such records allowed a competent student unavoidably absent from the annual examination to pass at the end of the year in his subject. It has also enabled students to obtain a pass in the face of seeming failure at the Annual Examination. The Annual Examination was not the test, but only a portion of the test of a student's competency to pass in his year's work.

They were indebted to Mr. King-Salter for a description of the admirable system of training adopted in the Admiralty Dockyards. He (Mr. Poole), while Director of the Charters Towers School of Mines, and Principal of the Ballarat School of Mines, had found that concurrent training turned out most efficient and competent men.

The pure and applied science work, usually known as "Associate" or "Diploma" work at Technical Schools, is a very important feature of modern technical educational work. Many portions of this general class of work always have, and probably always will be, better and more efficiently carried out by the better-class Technical School and School of Mines than by the Universities. This class of work should be established in all populous centres, the nature of the courses of instruction being determined by the industrial requirements of the district. Instead of the courses being more restricted, they should be more varied and more fully accessible. An education qualification of entrance is desirable, but the occupation qualification of entrance in New South Wales to all these courses, except those in pure science, is a very grave mistake. More satisfactory results in associate course work have, in past years, been obtained in all the other States of the Commonwealth than in New South Wales, despite the advantage the latter State has had in both equipment and funds. Increasingly important results are being obtained in the other States in this class of work, and it is a matter of grave regret that both the youth and

industries of this State are being handicapped by unnecessary restrictions. He knows of many instances where positions in New South Wales have been filled by diploma graduates of other States. If the reasons which underlie the institution of the occupation qualification to such classes and courses are fundamentally sound, then such restrictions of entrance should also be applied to the professional courses of the University, viz., Engineering in its several branches, Medicine, Law, Veterinary Science and Agriculture. It is universally admitted in practice that such restrictions at Universities and similar higher Institutions are not necessary. It is even less necessary at Technical Colleges, and should be abolished in the only State in Australia where it exists, viz., New South Wales. The youth of the State should be given the widest opportunities of sound instruction, both for their own benefit and that of the State. The increasing number of private institutions in Sydney giving instruction in Applied Science is very largely the result of the Technical College not meeting the public needs in this matter.

There is little doubt that University life conduces to make better citizens of those who pass through its walls, but this influence is not confined to Universities, but exists at other large educational institutions. If the University recognises in full, as it undoubtedly should do, the work done at Technical Colleges, two years at the University should not be required in order to give the student a full dose of "University life," if one year is sufficient for his educational work.

The present time is ripe for a greater amount of specialisation of Engineering Courses than at present exists. A few years ago a very generalised course was necessary because a graduate, almost irrespective of his inclinations, did not know where he would get a position or what class of work he would have to undertake. In the early days of the Engineering School of the Sydney University, graduates in Civil Engineering (the only existing course) entered into Civil Engineering in its many branches, but also in some cases into Mechanical, Electrical, or Mining Engineering. The Mining, Engineering, and Metallurgical Course should undoubtedly, and with great advantage, be divided into separate courses. The Mechanical and Electrical Course should preferably also be divided, and the Civil Engineering Course could with advantage allow of extra attention being given to portions of its work during the fourth year.

These contentions are amply confirmed by the undoubted success of the more specialised courses given in such Technical Schools as the Schools of Mines of Adelaide, Ballarat, Bendigo, Charters Towers, and Kalgoorlie, and at the Working Man's

College, Melbourne. The graduates from these Institutions undoubtedly in many cases leave with a fuller and more adequate knowledge of their technical work than do the majority of University Engineering graduates. There are now many different and extensive branches of engineering to absorb graduates of a somewhat intensified, instead of a highly generalised engineering training.

It is a matter of great satisfaction to learn from Mr. H. E. Barff, the Warden and Registrar of the Sydney University, that that Institution has now adopted the principle of appointing the best men as Professors or Lecturers, irrespective of whether they had passed the formerly fatal age of 35 or thereabouts. It is also satisfactory to know that a course of instruction on business matters had been instituted for engineering students.

We are greatly indebted to Mr. Bradfield for his efforts in bettering the prospects of University Engineering graduates. The new regulation of the Public Service Board, re salaries of engineering graduates, is in marked and favourable contrast to the unfavourable condition of absence of definite recognition which existed only a few years ago. It is to be hoped that other public bodies will fall into line and grant similar recognition. Such recognition will have the effect of inducing an increasingly greater proportion of young men to obtain an engineering degree before entering the professional service of public bodies, and it is to be hoped that such a degree will eventually become a necessary qualification of entrance. Several speakers have stated that it was impossible to teach surveying at the University. He (Mr. Poole) did not agree with this statement, as from his own personal experience he knows no difficulty beyond reasonable time and trouble in teaching an average student to have sufficient field and office practice of engineering or mining surveying to be an efficient assistant, or even to carry out simple work on his own responsibility. It is absurd to expect a greater average proficiency than this from a graduate in this or any other subject of his course. The practical work in surveying requires at least two to three hours a week during the period of the course of lectures, as at least an equal amount of practical work is required in other subjects of his course; but it is this necessary time that so many instructors in surveying cannot or are unwilling to give. There is a very considerable wealth of engineering literature and magazines in Sydney, but it is housed with so many societies that it is almost inaccessible to engineers as a body. Both in New York and in Melbourne several technical societies house their libraries in a common library under a single control, and while they retain their own property, the great benefit of common use has been

thrown open to the members of all the societies during the day, and also in the evening. In the building of the Royal Society of New South Wales, there are, inter alia, the following bodies which could but have not yet entered upon a similar arrangement, viz., Royal Society, Engineering Association, Institute of Electrical Engineers, Architects, and Surveyors.

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