arise. In the main, however, Inspectors are recruited from the ranks of the great civil engineering contractors, and these contractors might perhaps arrange training for such of their employees as cared to accept it, without regard to the ultimate source of employment of the men concerned.

The Author hopes that this Paper may serve to outline some of the difficulties surrounding the training of Inspectors for civil engineering work, and may stimulate a fruitful discussion wherein the views of other branches of the civil engineering profession may be added to those which he has attempted to set forth.

Discussion.

Mr. Holbein, in presenting his Paper observed that one object of the Works Construction Division was to enable the consulting and resident engineering side of the profession to discuss matters of common interest with the contracting side. In the discussion¹ on Report No. VI of the Post-War National Development Committee at the inaugural meeting of the Division, on 2 January, 1945, the necessity for such co-operation had been emphasized.

Mr. Holbein wished to repeat his statement, made on that occasion, that it was very important that the standard of the inspector should be high. Everyone had met the inspector who suffered from a sense of injustice because the men he was watching were earning more than himself. Owing to the fact that from a financial point of view his job was not a very attractive one, an inspector was often a foreman whom the contractor had sacked as inefficient, and who then took a lower-paid job to watch the man who had replaced him. That was an unhealthy and ridiculous position. An inspector should be of equal standing to the foreman and should receive equal pay. If he did not know his job, he would largely, in self-defence, just take the "book of words" and apply it absolutely, letter for letter. As a result, work might be held up and considerable irritation caused by his insistence on some unimportant detail.

It was necessary to abolish the idea that the inspector was watching a villain—the contractor—and that the contractor had to outwit attempts by the inspector to upset his plans. If it were possible to evolve some better system of training of both inspectors and foremen, that would be all for the good of the industry.

Mr. Symington emphasized certain aspects of the subject of his Paper which he regarded as of fundamental importance. The course of training arranged by the Federation of Civil Engineering Contractors and the Ministry of Labour and National Service, to which Mr. Holbein had

¹ Instn Civ. Engrs, Works Construction Division (1945).

referred, appeared to cover the ground equally well for inspectors as for foremen, and some such training might well be arranged by the Federation for men in the employ of member firms without regard to whether they actually became foremen in the employment of those firms or inspectors in the employ of others. Perhaps that suggestion might appear to have the flavour of asking the burglar to train policemen, but there was a saying that there was no better gamekeeper than the reformed poacher, and on an enlightened view of the responsibilities of the industry as a whole such an arrangement should not be impossible.

He agreed with Mr. Holbein as to the desirability of co-operation between the staffs of the two sides on the job. It was impossible to place too much emphasis on that. He also agreed that the inspector should not be a rejected foreman. He was a man of authority who should be looked up to as such and remunerated as such. The remuneration offered to inspectors should make it worth their while to improve their technical knowledge for their work in that capacity.

The Chairman observed that if any inspectors and foremen were present he hoped that they would not take umbrage at anything that might be said in the discussion, and that their presence would not deter members from saying exactly what they thought.

He also expressed the hope that in the discussion reference would be made to the question of the draft Regulations under the new Factory Act, and some idea given of the extra work which would fall upon foremen and inspectors in carrying out those new Regulations, which had the object of ensuring greater safety in the execution of civil engineering works. It would also be of interest if an engineer whose inspectors were in continuous employment, as in the case of certain public authorities, would describe his experiences in recruiting and maintaining his inspection staff.

Mr. R. M. Wynne-Edwards observed that Mr. Holbein had tended to evade the issue at the beginning of the Paper, or had at least tried to run before he could walk, by dealing with the training of general foremen. Mr. Wynne-Edwards doubted whether it was possible to train a general foreman; a good deal could be done towards training foremen, but he was doubtful whether it was possible to train a man to become a commander, in the sense that a general foreman was a commander, he believed that the qualities, where they existed, were inherent and not the result of training. That, however, did not affect the value of the Paper, because the Author had actually dealt with the training of foremen.

The system described was a very good one, but it needed to be supplemented in some way or other. It necessitated a succession of contracts, if foremen were to be trained within the firm, with no serious fluctuation of labour and so on. That was a very desirable state of affairs, but it was far from being general; moreover, no firm, however clever, knew all the answers, and the wider a man's experience the better he would be.

Mr. Wynne-Edwards did not know the answer, but he believed that

the industry should take every possible step to find out how best to train foremen. The Ministry of Labour course referred to in the Paper was very interesting and formed an excellent start, but he considered that it was trying to do far too much at once. In training, two quite separate things had to be taken into account. Firstly, the training in a trade, such as timbering, trench excavation, or concrete, could very well be given by a series of courses, each lasting for perhaps a couple of weeks. There might be junior courses and senior courses, but no man should take the second course immediately after the first. He should take the course and then come back and obtain practical experience on the job ; later, if he wished to increase his knowledge, he could take the other course.

Secondly, there was training in such qualities as leadership, organization, and the handling of plant, which was much more difficult, much more complicated, and much more important. The handling of plant might perhaps be regarded as part of organization. As to leadership, a great deal had been learnt during the recent war and the Forces had done a great deal of work along those lines. It entailed, among other things, the ability to impart one's knowledge to subordinates, so that they might understand what they were doing, and why. That was a difficult thing to learn, and the need for it was especially great when working abroad.

The Ministry of Labour had access to all that had been learnt in the Forces, and it had evolved a very interesting scheme of training within industry, from which much might be hoped. The Ministry of Labour was the only body capable of conducting courses of the kind which were required, and therefore deserved every support.

Job organization was one thing about which engineers could help. They knew the kind of things that happened on their works and what foremen should be expected to know. The lay-out of the work, planning ahead, the supply and arrangement of materials as they went in ; the appreciation of unproductive time ; costs ; and so on, were items that came to mind.

So far as plant was concerned, the ordinary foreman did not have to know why the wheels went round. If he could learn that, well and good, but he did not have to know it. The foreman should know, however, how to locate his plant so that it would work satisfactorily, and how to feed it so as to keep it going. He should think of his plant as being three men, ten men, or fifty men, and should ensure that its time was not wasted ; he should learn that the time-keeping of plant was as important as the time-keeping of men. It was very hard to get that into people's heads, but a good deal could be done by a course.

With regard to Mr. Symington's Paper, Mr. Wynne-Edwards felt himself on dangerous ground, because he disagreed with it from start to finish. Inspection was essential, because the kind of mind which aimed at rapid progress was often not the kind of mind that looked at quality, and it was necessary to have those two kinds of mind on the job. He did not

believe, however, that the necessary inspection could be carried out with the old system of inspectors.

Civil engineering was a highly technical job nowadays, and might even be called a highly scientific job. The supervision of highly scientific jobs could not be entrusted to people with no scientific training. He considered that much more inspecting ought to be done : (a) by putting the onus on the contractor, and (b) by having more engineers on the Resident Engineer's staff ; and that inspectors, as they existed at present, should be confined to the inspection of minor matters.

All who had worked on the contracting side had doubtless suffered from inspectors who did not know why the specification said this, that, or the other, but only knew that it did say it. Lacking knowledge to understand the spirit of the specification, they had to go by the letter, frequently causing unnecessary delays.

Young graduate engineers should be very useful as inspectors. They did not know much, but they were very keen. They would learn a great deal from the contractor's men, and they would be much more intelligent than people who were merely hidebound. Probably Mr. Symington had had that idea at the back of his mind, because his specification for an inspector would tax a number of resident engineers. The Paper was an excellent apology for an out-moded system.

Sir Reginald Stradling observed that he wished to put two questions which had arisen in connexion with his work as Chairman of the Education Committee of The Institution. Firstly, could The Institution do anything to improve the conditions for the type of man under discussion—perhaps in the form of association with The Institution—in order to obtain what Mr. Holbein had described as a better understanding between the engineering side and the foremen ? Secondly, was it of any use to consider some type of semi-qualification in association with The Institution ?

Brigadier J. L. French observed that he agreed in substance with Mr. Holbein. So far the foreman's course had not been a great success, and the reasons had some bearing on the whole subject of the Paper. Firstly, so far as the material available for the course was concerned, when the Federation of Civil Engineering Contractors had suggested the course in the first place they had had in mind that it should be particularly for young men in the industry who had served for two, three, or four years either as labourers or as timbermen, or as assistants to timbermen, and who therefore would have had some background which had been interrupted by the war years, so that, on returning after gaining experience in leadership during the war, they could be brushed up, groomed, and improved for the position of foremen. The other source of supply was from the ordinary applicants under the Ministry of Labour scheme ; because, being a joint scheme, the course had to be open to any young man whose career had been interrupted by service in the Forces and who felt an inclination to take up civil engineering.

With regard to the first source of supply, from industry, what happened was that, owing to the priority which had to be given to building and to the need for apprentices for building, the Ministry of Labour had had to devote attention first of all, in the provision of equipment, accommodation, and instructors, to the building industry, and therefore the civil engineering construction course was very late in starting, and had begun only about six months ago. As a result, many young men who were particularly fitted for it by their previous experience in industry had returned to their firms, settled down, were getting good money, and were no longer so inclined to take the course. Equally their employers, suffering from a very grave shortage of manpower, were glad to be able to put them to work, and were disinclined to send them away for three or four months on a course; so that that source of material was sadly depleted.

On the other hand, the applicants who presented themselves to the interviewing boards were many and of varying types. An interviewing board which saw a dozen applicants during a morning, might write off eight as useless and consider that, of the remaining four, two would hardly do, but in a weak moment might let them through. The result was that the men attending the course were not those who had been in mind originally when the course was framed. The arrangements for the course at Hounslow were good, and the instructors were competent and enthusiastic. The men were also enthusiastic; but it was obvious that many of them had the impression that they were being trained, not as foremen but rather as agents or even as civil engineers. To some extent that might be due to the name of the course. The original suggestion, that it should be called a foreman's course had been abandoned for two reasons. That name would have involved an implied promise that anybody who passed through it would be fitted to be a foreman, which would not be the case; moreover, the Ministry wanted a rather wider title for the course.

The syllabus was possibly too exhaustive, but it should be borne in mind that the men taking the course were expected to have a good background in the industry beforehand. The syllabus would have to be revised before the next course began, and suggestions for its improvement would be welcome to the Director of the Federation of Civil Engineering Contractors. The courses would be continued. Of the men attending the last course, a few had some knowledge of the industry. One had done some railway transportation work in India, and would, he thought, prove an asset to the industry, though probably more as a sub-agent than as a foreman. Given better material and an amended syllabus, it should be possible to turn out men who would make good foremen. It had never been considered that the course would produce a perfect foreman.

He could not agree with Mr. Wynne-Edward's suggestion that leadership consisted partly in passing knowledge to others. Leadership was a very difficult attribute to define, and it turned up in the most unexpected quarters. If a young man coming out of the Services, who had shown

considerable aptitude for leadership, were given a good technical training his spirit of leadership might be worn out before he reached a position which he would otherwise be entitled to occupy. That was one difficulty in an occupation such as civil engineering, which required a considerable technical background; in the slow and tedious process of acquiring such a background a man might lose his spirit of leadership.

That was another reason why it had been thought that the course was worth trying. Sixty or seventy years ago, if a leading contractor had been asked in what proportions he wanted leadership and experience, he would probably have replied that he wanted 10 per cent. leadership and 90 per cent. experience. In the period between the wars a contractor who was asked a similar question would probably have replied that he wanted 60 per cent. leadership and 40 per cent. experience. Now the situation had so largely changed, owing partly to mechanization and partly to the present labour difficulties, that the requirement might well be 70 per cent. leadership and 30 per cent. experience.

There was only one way to put that to the test. A firm might be prepared to take a petty officer or a leading seaman from the Navy—Brigadier French suggested the Navy, because there a man had to do his job with intuition, ability, and speed or else he might be drowned—give him perhaps six months in going round the firm and seeing what things were like, and then put him in charge of a job. That might sound fantastic, but it might succeed, because the man's spirit of leadership would not have been impaired, he would still be young and full of enthusiasm, and he would know something about what was going on; the rest would depend on the extent to which he could take advantage of other people's knowledge. If anybody cared to make that experiment, Brigadier French would be very glad to know of the results.

Mr. S. C. Doughty observed that Mr. Symington had given a list of the things that an inspector should know, but had not stated what he should be expected to do in order to inspect. The items enumerated for the purposes of training were exactly those applicable to the training of foremen, given by Mr. Holbein, and in fact almost the whole of Mr. Symington's remarks seemed to apply to foremen rather than inspectors. That view was strengthened by his continual reference to inspectors as those who had previously been foremen.

Mr. Doughty regarded that as a mistake. Few things could be farther apart than the outlook of the foreman and that of the inspector, if each did his duty; they were, in effect, the same as the outlook of the contractor and of the engineer respectively. Failure to recognize that undermined both the authority and the efficiency of the inspector. Mr. Doughty's experience had been that ex-foremen often failed seriously as inspectors, whether they came from contractors or from direct labour organizations. The duty of the foreman was essentially to execute the work, to get things done, and to understand and handle labour towards that end. The fore-

man who had become an inspector, unless specially trained in that capacity, was prone to let things go ahead until questions were raised from some other quarter—too often from his superiors—whereas it should be the other way round.

Mr. Symington had correctly stated what the inspector should know, but had covered inadequately the question of what he should do. The inspector should understand what to look out for, what steps to take to satisfy himself that everything was in place according to requirements, and what to do to correct failures to meet those requirements. His duties were principally technical and not so much human, except that he needed tact and persuasion in dealing with foremen and gangers. He was not required to carry out work, and it was not essential for him to have the qualifications to carry it out; his duty was to watch the work of others and assess its conformity with specified requirements. It was by no means advisable that he should be devoid of education; Mr. Doughty had known young college graduates who had made first-class inspectors.

Nothing had been said in the Paper of the most important document of all, namely, the specification. Each inspector should have a copy of it, and should know its contents thoroughly, and should be trained to recognize at once the implications of every clause in terms of what he would have to do about it himself. In fact, it was not too much to say that the specification should be written with the inspector's duties in mind, for he was largely the instrument for putting it into effect. It was depressing to come across requirements in a specification which the inspector had not the remotest chance of being able to enforce. Only when care was taken in that respect would the inspector be able properly to carry out the responsibilities entrusted to him. He was the eyes and ears of the engineer, and to a very large extent the more unpopular he made himself the better would he be devoting himself to the interests of his employer. But that did not imply that he should make a nuisance of himself or stir up friction for the sake of doing so; that would lower his authority and defeat its own ends.

Mr. Doughty would strongly oppose item (7) of the list of qualifications given by Mr. Symington in so far as it referred to a knowledge of time-keeping methods and keeping a proper record of the time of labour and plant and of the quantities of materials used. Whether that was meant to apply to price contracts or to day-work, it was not part of an inspector's duties; he should not be allowed to become a *maid-of-all-work* on the job, to feed information of all kinds to the office. His duty was to inspect.

Finally, Mr. Doughty considered that training should always be given to inspectors, and at as young an age as possible. The more education they had the better. Their work should be regarded as a career or profession for which they should be encouraged to prepare themselves and to devote themselves throughout their active life. He could not agree that outside training would not be successful, and he regarded the practical

experience emphasized by Mr. Symington as only the beginning—the foundation on which would be laid the real instruction for their duties. Foremen turned inspectors were but a makeshift for the real article.

Mr. Charles Brand observed that many years ago his father had visited a job in Ireland where a concrete quay wall had to be demolished. The concrete was not very good, his father had mentioned that fact to the Irish ganger, who replied: “Concrete? Concrete, yer honour, sure, what’s not displacers is holes.” Mr. Brand did not know how much training that navy ganger had had, but at all events a wealth of experience lay behind his apt description.

That was the crux of the matter. Both Authors had stated that an essential characteristic of an inspector or a foreman was that he should be a man of experience. That being so, training could only be ancillary—something to help a man to make use of his experience; mere training without experience would not make a foreman or an inspector.

Mr. Brand agreed that an inspector should be a man of mature age. One should beware of the brisk young inspector who thought that he knew everything and wanted to teach everybody. Inspection was not a job for a virile young man, but for an older man, of wisdom, maturity, experience, and tolerance.

On the other hand, for foremen it was desirable to have younger men, trained in the way which had been suggested, and Mr. Brand had been impressed by Mr. Holbein’s remark that “Good men between the ages of 30 and 40 years should be capable of handling fair-sized jobs, and the best of them will probably reach their zenith in the early forties.” The qualities required of foremen were energy, virility, courage and—especially in the present days of frustration and difficulty—resilience. Many older foremen were apt to look back to the “good old days” when labour was easy and the main thing to be done in carrying out a job was to overcome the physical difficulties. Such men, when they experienced difficulty in getting men to do the work and in making them work when they obtained them, were apt to get the stuffing knocked out of them. Perhaps, therefore, that the time had come for a younger type of foreman.

Mr. Holbein had also raised the question of the need for a higher standard of education. There could be no doubt that, with the improvement in education over the past generation or so, educated foremen were now coming along. One no longer got the old type of very decent foreman who always said: “Well, I’m no scholar.” There was now a more educated type, and that would be particularly important in the future in view of a number of new duties and responsibilities which would come to the general foreman.

The Chairman had referred to the question of the draft factory regulations. Hitherto civil engineering works had been almost outside the scope of the Factories Act; the Building Regulations applied only to buildings. But a draft set of Regulations for works of engineering construction had

now been prepared. They were still in draft at the moment, but would probably be put into force towards the end of 1947. Those Regulations placed considerable responsibility on the employer, stipulating a number of periodical inspections and tests of plant, temporary works, timbering, etc., to be made by a "competent person." It was obvious that in most cases the only competent person to carry out such inspections and tests would be either the general foreman or the foreman fitter.

The results of the inspections would have to be entered in registers kept on the job and available to the factory inspector. A contractor would have to keep on the job a register of scaffolds, with the results of the weekly inspection by the competent person; a register of lifting appliances, with the result of the weekly inspection by the driver or other competent person; a register of the anchorage of derrick cranes, with the result of the examination by the competent person, and a test load each time the crane was erected; a register of lifting gear, such as block and tackle—with the result of examination by a competent person; a register of hoists, and a register of timbering, containing the results of examination by a competent person on completion of erection, after any substantial alteration, since the use of explosives, since any substantial damage, since any material interruption of the work, after any substantial fall of earth or rock, and in any case every seven days. Much the same thing applied in case of cofferdams and caissons.

Apart from the question of inspection and of logging the results in registers, the Regulations laid down, for instance, when dealing with excavations, that any timbering or plant used to retain any portion of an excavation, shaft, earthwork, or tunnel might not be erected, substantially added to, altered, or dismantled except under the direction of a competent person, and the same applied to cofferdams and caissons. Mr. Brand would not discuss the rights or wrongs of the Regulations, but there could be no doubt that something on those lines would come into force, and would impose added duties on the foremen. Such inspection, apart from the actual logging of it in registers, was done instinctively by a good foreman; but it would now become a specific responsibility of foremen, and therefore it was important that the standard of education of foremen should be kept high.

One difference between the younger foremen and the older men was that the former were susceptible of some form of training. But training was not a substitute for experience, and therefore he agreed entirely with the views of the Authors.

Mr. G. P. Manning observed that whilst he was in favour of any scheme for training or assisting foremen or embryo foremen, he considered that one main difficulty so far as the course of instruction was concerned, would be the choice of a suitable lecturer. The normal university lecturer learnt his theory first and his practice later—if indeed he learnt anything at all about practice; whereas the foreman learnt his practice first and his theory

(if any) later. Therefore the two men approached engineering problems from entirely different points of view. One university lecturer could understand another university lecturer, and one foreman could understand another foreman ; but Mr. Manning had found that the lecturer could not understand the foreman and the foreman could not understand the lecturer. He had experienced that difficulty himself in his early days when attempting to discuss technical problems with foremen, because they spoke different languages. He considered, therefore, that a lecturer could not successfully conduct such a course unless he had had several years' experience either as a contractor's engineer or as an agent.

To be really helpful, the course should be supported by good textbooks. No man could absorb all the different subjects in sixteen weeks, and good textbooks would be very useful for reference. In Great Britain few textbooks on construction were available, and some of those were either copied from or inspired by American practice. Thus they did not represent British practice.

Mr. Manning believed that the paucity of good practical textbooks was due to the traditional outlook of the British contractor, who would not publish details of his methods of construction or of his costs, but regarded such information as his personal property. Taking, for an example, a subject put down for the seventh week of the course, item A, the design of shuttering, in the offices of Mr. Manning's firm there were dozens of drawings of shuttering fit-ups, with the calculations showing how they were designed and how the sections were arrived at, photographs of the work in progress, and complete analyses of the costs—in fact, all the material for a complete book on shuttering. He and the other members of his firm, however, were forbidden to publish any of that material. In America, on the other hand, contractors would publish their methods of construction and details of their costs, and would even acknowledge their failures.

While American contractors shared their knowledge, and British contractors kept their knowledge to themselves, the Americans would go ahead and the British fall behind. It was high time to make an effort to break that traditional English spirit, and until that was done the training of practical men and of foremen would always be very seriously hampered by lack of suitable works of reference.

Mr. Symington and Mr. Manning seemed to live in different worlds of contracting. Mr. Symington regarded the inspector as a man called upon to show a large degree of initiative, stating that one of the duties of an inspector was "To take such immediate action in conjunction with the contractors as may be required to safeguard the works in the event of any unforeseen happening." If anything went wrong on a contract, the only two people to whom Mr. Manning would refer would be the agent and the foreman. As Mr. Manning understood the present legal situation, the contractor was responsible for everything—the design, construction and

everything else—and if anything went wrong it was the contractor's responsibility to put it right. If the inspector dashed in and began taking action, he would thereby incur responsibility either on the part of the consulting engineer or on the part of the client. That was not the duty of an inspector, and Mr. Manning had never known it to happen.

The Chairman suggested that in America a contractor might perhaps make money so quickly that he could retire after a few years, and so might not mind what information he gave away, whereas in Great Britain a contractor had to work with greatly restricted rewards.

Mr. L. E. Hawkins observed that he welcomed the Papers because he felt that the constructional side of engineering was lagging behind manufacturing engineering, in training what might be termed the "warrant officer" and "N.C.O." ranks of the industry. Many engineers would have seen in the Army the great benefits of trade courses and refresher courses at intervals for young men in the engineering and building trades. It had been surprising to see how some of those young men had taken charge of large working parties and had carried out successfully, and in very short periods of time, quite large works of a kind very different from anything of which they had had experience in civilian life. He believed that something on similar lines would be of benefit in civilian life—something rather different from what was at present covered by apprenticeships and technical schools.

His experience had been that carpenters had a definite advantage over others, both as foremen and as inspectors; and on very heavy work that applied also to timbermen. The carpenter in his apprenticeship became used to setting out his work and obtained a good idea of the geometry of setting out. He was able to shape under his own hands a material which in its smaller sections he could see deflect and even break, and from that he acquired a very good idea of bending moments and the action of forces, which people in other trades did not pick up so readily.

Mr. Hawkins had often experienced trouble in explaining to foremen or inspectors such points as the continuity of beams. He had found that men from other trades than that of the carpenter had no idea of the reverse bending moment over a support, and so on, whereas carpenters could understand it at once. Small points of that kind were often important. A foreman or inspector might have to decide, without the help of an engineer, on the position of a temporary joint in reinforced-concrete work, and he would require some knowledge of forces to decide upon the best place for the joint.

Mr. Hawkins agreed long experience was required to train both inspectors and foremen with regard to matters of workmanship, and that nothing could replace that experience; but on reinforced-concrete work experience alone would never really teach a man the principles which lay behind what he was doing. For instance, it would not show him why reinforcing-bars were placed in the positions which they occupied. The

bars were shown exactly in position in the drawings, but they would have to be altered if a pipe or other obstruction came in the way, and the inspector and foreman might have to agree between themselves where the bar was to go. Both would be prejudiced in favour of putting it in deeper into the work, probably into the neutral axis, because if they made a mistake in that direction it would not be seen afterwards. They would not know where else to place it so that it would be equally effective. Therefore some kind of practical training in reinforced-concrete work was needed for foremen and inspectors in the civil engineering industry—not lectures, but practical training which would give the men the opportunity of learning by doing things themselves. That need not be very expensive. In a yard somewhere they could themselves make structural members of small sections using different techniques, making some with intentional faults, different arrangements of bars, different water/cement ratios, and so on. They could then break those members themselves, not in a laboratory under laboratory conditions but by loading bags of sand on them, or with jacks, and read the pressure required, with somebody to explain to them what they were doing and to show them what the results were. That would give them a real understanding of reinforced concrete and would provide really useful training.

Sir Reginald Stradling had inquired whether some form of association could be provided for the type of men under discussion. The Permanent Way Institution had grades for technical assistants on the railways and for permanent way inspectors and gangers. The permanent way inspector was called an inspector, but was more or less equivalent to a foreman in so far as the matter under discussion was concerned. Mr. Hawkins was convinced that that association had quite a considerable educative effect on those inspectors, and he wondered whether any such association could be provided for general civil engineering inspectors and foremen. Such an association, where they could meet and exchange ideas, might have a great educative value and be a good thing for the industry as a whole.

Mr. D. A. G. Reid considered that the problem under discussion formed part of the fundamental problem of recruitment to the industry. Both Authors had emphasized the haphazard nature of the recruitment of foremen and inspectors in the past. Of the operatives coming into the industry only a small proportion had ever been suitable for supervisory duties, and he believed that the position in that respect was likely to become worse unless some active steps were taken to make the work of the civil engineering operative more attractive to intelligent boys.

Means existed by which that might be done, including a wider recognition of the skill of certain trades, possibly the full recognition of concreting and of all work associated with concreting as a skilled trade, the provision of proper apprenticeships, and possibly indentures. There could be no doubt that the industry required a certain number of highly skilled operatives, and if it became understood that a boy who was apprenticed to one

of those trades would have an excellent chance of obtaining a supervisory appointment later, the industry would have gone some distance to meet the principal difficulties in connexion with the provision of inspectors and foremen.

Mr. Reid believed that if that were done the solution of the technical training problem would follow almost automatically. Technical training would be recognized as a necessary adjunct to apprenticeship. Evidently both Authors recognized the need for technical training, and Mr. Symington had correctly placed it at the normal learning time, namely, concurrently with experience. Mr. Reid differed profoundly from Mr. Symington's view that the technical colleges could not do much in that respect, as he believed that they could give the most help in the matter of technical training for the younger operatives. He agreed that at present no ready-made courses were available in the technical colleges; but that was a result of past neglect, and showed the need for work which he considered that The Institution might undertake. He was sure that the colleges would co-operate with contractors and with The Institution to provide suitable courses.

The City and Guilds Institute had already, he believed, an exploratory committee considering the possibility of courses for structural engineering operatives, by which presumably they meant concretors, platers, and young employees of that type. It was not a long step from there to the more general requirements of the civil engineering operatives. Moreover, in that respect, time was very important. In three years' time it would become obligatory for every employer to release all his employees under 18 years of age for one day per week, so that they could continue their education. If the best use was to be made of that time from the point of view of the civil engineering employers, they should start at once to consider the kind of course those youngsters should undertake.

Possibly he had been paying attention to people who were much too young to be foremen or inspectors, but he considered that no training of foremen or inspectors would be satisfactory unless it were founded upon some fundamental training which was taken at a younger age. He was dubious about the alternative suggestions for training within industry, whereby the training would be given by the agent or contractor. The agent would not often have the time or the inclination, or perhaps even the ability, to arrange satisfactory systematic instruction for men under his control, varying in age, presumably, from 16 to 30.

With regard to training for management—for foremanship proper—he considered that formal instruction would have a certain value. He agreed that experience was essential, but experience by itself was not enough. Formal instruction could be effective if it were founded upon more fundamental technical study at an earlier age and regarded principally as a guide to the man in gaining his experience; it should also be supplemented, possibly by subsequent discussion or other arrangements

for foremen to meet and consider the common difficulties with which they were faced.

Mr. H. J. B. Harding observed that he agreed with Mr. Brand that inspectors should be both mature and tolerant. They could learn tolerance by working with a contractor. If graduates were to be employed as inspectors, where would young engineers be obtained and what would become of the good workman who on reaching middle age lost a little of his physical endurance? Such a man made a very good inspector, because his mental activities would continue although his physical activities might be waning. Inspectors' work had always provided a field of employment for such men.

He agreed with Mr. Holbein that it was necessary to beware of trying to train foremen by courses which the men themselves might think were intended to make them into engineers. He knew a foreman of whom it was once said: "George was a very good foreman until he bought himself a set of drawing instruments." The point to which Mr. Symington's Paper led was that the inspector's duty was to agree as to facts. A good deal of bickering took place on contracts when inspectors and the lower orders of engineers on both sides wrangled as to who should pay for what. That kind of thing should be kept for the higher members. If the contractor felt any sense of injustice, the inspector should at once agree as to facts, and the question of who was to pay should be agreed between the agent and the resident engineer, out of sight of their underlings; very often, as in politics and statesmanship, it was the riots created by the people lower down which prevented those higher up from agreeing, because if they agreed they seemed not to be supporting their underlings.

It had been said that the best specifications were seen and not read. Mr. Harding's first job had been on a contract on tunnels under the late Sir Harley Dalrymple Hay, who knew exactly what he wanted. Nobody seemed to look at his specifications, because both sides knew exactly what was wanted next and did it. Mr. Harding had been concerned with a small but difficult job where the previous contractor had gone bankrupt. The work was being carried out for a public authority, and it had to be finished on a cost-plus basis, so that anything that was done affected the authority. He had been struck by the unimaginative rigour with which everybody, from the inspector upwards, tried to enforce the specification, thus penalizing themselves. It became perfectly obvious why the contractor had gone bankrupt.

Wherever possible, the inspector should be trained to prevent anything going wrong before it happened, and not wait until something had been wrongly done and then have it put right.

With regard to the intermittent employment of inspectors, would it not be possible to form a kind of corps of inspectors, rather like the Corps of Commissionaires, with perhaps a levy of 1 per cent. on all contracts, to be collected by the consulting engineers' union, and in that way organize

a body of reputable inspectors who could be drawn upon to deal with different contracts and then returned to their central depot if work was scarce ?

* * **Mr. J. W. H. Turner** observed that **Mr. Holbein's** opinion that "the first selection of a man from the rut must, in general, be made by a ganger," might be correct to-day ; but would that rather haphazard method be adequate for the conditions of the future ? Prominent amongst those conditions would be competition between the various industries for a share of the diminishing labour-supply. It had been authoritatively stated that owing to the drop in the birth-rate in the 1920's and 1930's, and to the raising of the school-leaving age, only half the pre-war number of juveniles would be available for industry in 10 years' time. Thus haphazard promotion was unlikely to attract the right type of youth into public works. Could anything be done to supplement the ganger's choice ?

First, the implications of the 1944 Education Act were worthy of consideration. It was intended that from 1950 onwards all adolescents should remain at school until the age of sixteen. Thereafter, for those entering industry, there would be compulsory part-time education, amounting to one day per week, until the age of eighteen. The points to note in that context were, primarily, that the new entrants to industry should be of higher intellectual capacity than hitherto, and, secondarily, that a new tradition favouring adult education would be possible.

Secondly, compulsory military service would have an important influence in stimulating any latent capacity for leadership. The youth of eighteen would continue training and learning in the Services for a further eighteen months or two years and therefore, it was from the age of twenty that he would become available as a potential foreman. That was admittedly too young for him to be entrusted with any degree of responsibility : but it was not too young to preserve that continuity of training in which he had so far been reared. There, in fact, was a critical point in a young man's career. If he broke away from the habit of learning, he might never take it up again. Therefore that was the point where vocational training should be made freely available to those who had the "guts" to take it.

Thirdly, the syllabus set out in **Mr. Holbein's Paper** formed an excellent basis for public works training. But at present it was designed to meet different needs, and was meant to be taken over a period of sixteen consecutive weeks. To fit in with the present argument, it would be better to break it up into eight annual periods of two weeks. That would mean that the trainee would be alternating theory and practice, and, more important, would be of an age at its completion when any capacity for foremanship should be clearly emerging.

Those considerations added up to two conclusions of vital importance

* * This contribution was submitted in writing.—**SEC. I.C.E.**

for the calibre of the future public works foreman. In the first place, the industry should be sufficiently attractive to compete successfully with other industries for good recruits : otherwise, all the training in the world would be ineffective. In the second place, voluntary vocational training should be geared into the new experiences which the " under-twenties " would receive. With a scheme of that type, a trainee would be under observation by others as well as a ganger, and any capacity for foremanship would be quickened and fostered more efficiently.

Mr. Symington, in reply, observed that he was in the happy position of having had Mr. Wynne-Edwards and Mr. Doughty very nicely answered by Mr. Brand and Mr. Harding. He need only say that he agreed with Mr. Brand and Mr. Harding as much as he disagreed with Mr. Wynne-Edwards and Mr. Doughty. Unfortunately, Civil Engineering was not an exact science ; it fell into the two broad categories of theory and practice. The theory was provided by the engineering graduate or young engineer and could be taught in lectures and in colleges and learnt over a comparatively short period of years. The practice could be learnt only by doing the work over a long period of years. That was why inspectors, generally speaking, would have to come from the great civil engineering contractors, because that was the only school in which they could practise the work itself with their own hands and learn by experience all that they needed to know as inspectors.

Mr. Symington had had experience of Mr. Brand's " brisk young men " with some technical training but no experience as inspectors and when they arrived they were of little value as engineers, and of no value as inspectors, because they did not know enough. Therefore, he deprecated any proposal to train young men as inspectors over a short period of years. They would not become inspectors until they were men of mature age and had gone through the mill ; they could become suitable only by actually doing the work.

He was afraid that he and Mr. Manning would not see eye to eye on a contract. He had tried to make it clear that he had attempted to cover the possible duties of inspectors in all the different circumstances which might arise. He did not suggest that every inspector would have to do all those duties every day, but he had known inspectors to carry out all of them in different circumstances. In the case of a measured contract, the inspector would not take the initiative as he would in the case of a cost-plus or daywork contract, where the promotor was paying the bill and would wish to call the tune—and in many cases would call it through the inspector, who would approximate in many ways to the general foreman.

On the question of the inspector taking the initiative in preventing a collapse, Mr. Symington could speak with experience of tube tunnelling construction in London, where it was open to the inspector (and was indeed his duty) if he thought fit, to order the timbering in the tunnel face

or trench-work to be altered. The list given in the Paper covered what an inspector might have to do in some circumstances. Some of his inspectors had told him, since reading it, that they had been surprised to find that they knew so much !

What he had said applied also to Mr. Reid's remarks about apprenticeship. It was not possible to take a young man and apprentice him with a view to his becoming an inspector. A man needed 20 years' experience in public works before he could be an inspector, and while he was obtaining that experience he would probably have had no idea of becoming an inspector ; but later, when no longer physically able to work so hard, he might prove to be the right man for the job, and of the greatest possible value, because of his long experience.

Mr. Harding's suggestion for a pool of inspectors was very interesting. Mr. Symington did not know how his inspector friends would react to it, but undoubtedly non-continuity was the fundamental trouble in the training of inspectors. Public bodies, such as railway companies, gas companies, and dock companies, could doubtless take young workmen and give them courses of training, and ultimately such men could become inspectors, but always in the employment of the same employer. On many large public works, however, the inspectors were engaged for the job only. Doubtless that was what Mr. Harding had in mind in suggesting the formation of a pool in order to secure some continuity of employment for them.

Sir Reginald Stradling had raised the question of what The Institution could do to raise the status of foremen and inspectors. They were men of ability and authority, and should be treated as such. It might be of value if they could be more generally invited to attend the Meetings of The Institution, and of the Works Construction Division. The mention by Mr. Hawkins of the special category established by the Permanent Way Institution for inspectors was of considerable interest.

Mr. Holbein, in reply, observed that United States practice in regard to concrete varied as between the East and the West. On one side of America the tendency was to specify in the contract terms the strength of the concrete instead of detailing the mix, and if the contractor could obtain that strength by putting in no cement at all he was at liberty to do so, whilst if he made a very rich mix and it failed under test he was liable. That was worth thinking about. If it were adopted, it imposed a much heavier load on the contractor, which would react on the training and ability of the foreman and place additional responsibility upon him.

With regard to Mr. Wynne-Edwards's suggestion that a continuous course of sixteen weeks was unsuitable, it was necessary to take the practical difficulties into consideration, and it would probably be generally agreed that far too much dislocation would be caused if a man went off for a fortnight's course, came back to work again, went off to another course, and so on. Something might be done in that way, but it would

be difficult. The present course had been arranged with the ready help and guidance of the Ministry of Labour, which was conducting the course, whilst the Federation had merely given help and advice. It was hoped to provide a really good course which would *supplement* the practical experience needed by a good foreman. Mr. Holbein agreed that the training should be ancillary. It was not possible to replace experience.

He also agreed with Mr. Wynne-Edwards as to the desirability of explaining questions of organization and other problems to the foremen. It was essential to take the foremen into one's confidence and give them a full description of everything they needed to know.

Anything that The Institution was prepared to do in helping to raise the standard of both foremen and inspectors would be good for the industry, and Mr. Holbein was sure that the Federation would willingly co-operate in anything that was done in that connexion.

Mr. Reid's observations about training were very helpful. Mr. Holbein was Chairman of the Technology Committee of the City and Guilds Institute, which was engaged, at the request of the industry, in preparing a syllabus and examinations for workers in structural engineering. But that had nothing to do with reinforced concrete; it was entirely confined to steel-work. If the City and Guilds Institute could give any help, in conjunction with the industry, as was their practice, Mr. Holbein was sure that they would be prepared to consider the question of setting standards and arranging syllabuses for the ancillary training of foremen and inspectors. They always worked with the Ministry of Education, and with the various technical colleges, so that any training provided by the colleges fitted men to take the examinations set by The Institute. That was another way in which practical effect might be given to Sir Reginald Stradling's suggestion. It would not be practicable for the whole thing to be done in London: young men who wished to be foremen, and men who were foremen, would receive their instruction at various centres and should be examined at those centres. In the building industry foremen did qualify through the City and Guilds Institute, and there was no reason why, in conjunction with The Institution or with the Federation, that suggestion should not be followed up.

Mr. Holbein could not agree with Mr. Reid that craftsmanship was needed for placing concrete. Certainly a foreman looking after concrete required training, and certainly for reinforced concrete he should know something of the theory, in order to understand the importance of the location of the steel and of the construction joints. Mr. Holbein agreed with Mr. Hawkins that carpenters and timbermen had an advantage over other trades in so far as becoming foremen was concerned, although he had had foremen with all types of previous training, an example being the former granite mason mentioned in the Paper.

Mr. Brand had rightly emphasized the considerable additional responsibilities which would devolve upon foremen owing to the new Regulations

under the Factory Act. That Act would apply to the civil engineering industry for the first time, and the matter would have to be faced. Contractors would have to take a very real interest in it, because if an accident occurred and the Factory Act had not been complied with definite negligence would be imputed; and, although the Government were taking over workmen's compensation insurance, compensation for the results of negligence would fall on the contractor, and if many cases of that kind occurred his insurance premiums would be increased.

Mr. Holbein could not altogether agree with Brigadier French's suggestion for making use of petty officers. He was not clear, in the case of the petty officer, how the 30 per cent. of experience was to be obtained. He would not like such a man to be let loose on what he had referred to as three-dimensional work, where experience and real knowledge of ground and timbering, etc., were required. It would, however, be an interesting experiment on a fairly simple two-dimensional job. He believed that Brigadier French would agree to the necessity for experience, and had intended merely to emphasize the importance of a spirit of leadership; the value of leadership, added to plenty of experience, should be stressed.

He wished to record the thanks of the Federation to the Ministry of Labour for its assistance in providing the course of instruction. He felt certain that in the end it would be made into a very valuable course.