DISCUSSION.

Mr. J. S. Fitzmaurice, in opening the discussion, said the Author was to be commended by the members for his highly interesting contribution to the Society's Transactions. He had undoubtedly made a complete study of the Slide Rule, and other calculating instruments, and in such hands these instruments were invaluable.

The use of the Slide Rule had not received the amount of attention amongst engineers that it deserved.

In the hands of competent men, Calculating Machines or Instruments were to the engineer, chemist, accountant, etc., what modern machinery was to a manufacturer—"a Labour Saver."

In opening his paper, the Author rightly stated: "That there are dangers, as well as disadvantages in the use of such instruments in unpracticed hands." This was only a confirmation of the truth of the old adage, "A little knowledge is a dangerous thing," and applied not only to calculating instruments, but to all professions, and it was, no doubt, due to this fact that so little headway had been made in the Colony in the introduction of mechanical calculators; however, with so skilful and able a tutor as the Author had proved to be, and with the advantages and conveniences afforded by a generous Government in the establishment of Technical Colleges throughout the Colony, it was to be hoped that engineers and mechanics, especially the younger members, would give this most important subject their serious attention in the near future.

It might be urged that the text-books of the present day afforded so much information, in a compact form, to expedite scientific calculation, as to render the use of the Slide Rule, in a measure, valueless. This might, or might not, be true. But it was certain that if such were the case, the Slide Rule would not be so much in evidence among the English engineers as it was in the

present day; and it was satisfactory to learn that the City and Guild's Institute of London had recognised its worth by according extra marks to questions answered by students in the engineering section.

By the courtesy of the Author, the speaker had an opportunity of examining a Fuller's Special Slide Rule, and, although it would take some time to master the use of this wonderful instrument, yet no difficulty was experienced in working out the examples published in the book of instruction. With regard to the example given on page 37 of the paper, there is a clerical error. The weight of the 6.5' x 3.25' x $\frac{3}{4}$" wrought iron plate should read 683.75, not 638.75.

The Author had shown the many uses to which the ordinary Slide Rule might be put, in working out problems, but he (the speaker) favoured the use of Special Slide Rules, or rules constructed for the working out of special formulæ, as being productive of more accurate results, and easier to manipulate. For instance, the "Morse Lightning Calculator" for electric light circuits. This simple instrument gave, at once, the correct size of wire for any group of 16 c.p. incandescent lamps (or their equivalent), at from 100 to 115 volts, 0.65 to 0.50 amperes up to 250,000 lamp feet for 1, 2, 3, 4, 5, 6, 8, and 10 per cent. drop, or loss.

To find the size of wire required for any circuit, all that was required was to multiply the number of 16 c.p. lamps (or their equivalent) by the distances in feet from the source of energy to centre of distribution, turn the dics until the product thus obtained is included in the figures appearing in the ribbon at top of disc, and the correct size wire for the different per centages would be found below. For example:—Required the size of wire to feed 150 100 volt 16 c.p. incandescent lamps, at a distance of 280 feet from generator, with a drop in potential not exceeding 3 per cent.

In this case, the lamp feet—150 x 280—42,000. Now turn disc round until the figures 36,001 to 44,000 appear, then read off the size of wire opposite the loss of percentage line, when it would be found that the size of wire required to transmit current for the 42,000 lamp feet, with a 3 per cent. drop, was size "00."

On the bottom of the Morse Calculator are also given the Resistance per 1000 feet, and safe carrying capacity of wires from "0000" to No. 14.

Messrs. Crompton & Co. publish a Slide Rule, designed by "Trotter," which enables the size and length of cables, and their sectional area in square inches, carrying capacity, current density, resistance in ohms, and the maximum current allowed for Board of Trade Rules, to be calculated with very great ease.

There is also a handy calculator on the market, which is largely used by English electrical engineers. It is in the form and size of a keyless watch, and has two dials, upon which are engraved (in some cases printed) the scales used for calculations. The back dial is fixed, the front dial is made to revolve by turning the milled head under the ring. Attached to the case, in front of the movable dial, is a fixed pointer, or index. There are two other indexes (one for each dial), which can be moved simultaneously by a milled head projecting from the side. The scale on the front dial, beginning from the outside are:—

1. Scale of Logarithm Sines ... S.
2. „ „ „ Numbers ... p.
3. } „ „ „ (Numbers)^2... p^2.
4. }

On the back dial:—

1. Scale divided into equal parts ... E.
2. }
3. } „ of Logarithm (Numbers)^2 ... p^2
4. }

With this little pocket calculator (Boucher's), all the calculations which can be made by the ordinary straight Slide Rule, may be worked out.

The use of the Slide Rule and other calculating instruments have, no doubt, been the means of firms introducing tables by which calculation may be facilitated.

Messrs. Siemens Bros. & Co., Ltd., of London, in issuing their price lists, have adopted a system by which data of cable capacities may be readily computed. Every size of cable had a special pattern number. The uses of this pattern number were as follows:—

1. It gave the length of single conductor in yards which had a resistance of 1/10th of an ohm.

2. Divided by 4000, it gave the sectional area of the conductor in square inches. Divided by 6, it gave the sectional area in square millimetres.

3. Multiplied by 5, it gave the weight of the conductor in lbs. per Statute Mile.

4. Divided by 4, it gave the number of amperes the conductor would carry at the rate of 1000 amperes per square inch.

Messrs. Glover & Co. also publish a handy form of calculator, by which the size and number of cables, and other information may be found at a glance, for currents up to 1000 amps., and working at densities of 1000, 750, and 500 amps. per square inch. Mr. Stowe referred to the Planimeter. This instrument is now very largely used by engineers, owing to its wonderful accuracy in computing areas of diagrams, plans, etc., and, in passing, the speaker would like to draw the members' attention to a new form of Steam Indicator which had been put on the English market recently. This instrument did not plot out the diagrams, as was done by the ordinary form, which shows the pressures at all parts of the stroke, but it registered at a glance the mean effective pressure in the

cylinders. It was worked on the Planimeter principle, and had been very highly spoken of by the English press.

Mr. Norman Selfe said he hadn't the pleasure of hearing the paper read, and, therefore, had very little to say. For special work, instruments such as the Arithometer were exceedingly useful. There was one instrument in particular for calculating the horse-power of condensing and compound engines, with a double slide. He thought that for calculating purposes, in special branches of engineering, such as electrical or marine work, slide rules were of most undoubted use. They were labour-saving tools, but at the same time, he agreed with the late President of Institution of Civil Engineers, that with a good box of tools, a skilful man might perform very good work, whilst an unskilful man would very likely cut his fingers, and unless they could do the work without the slide rule, they should not use it at all, as its great point was that it enabled them to do the work in one-tenth of the time by the ordinary method of calculation.

Mr. German said the Colonial Sugar Refining Co. had calculating machines, which were used more particularly in the chemical department, where a great number of similar kinds of calculating had to be performed, and in such cases he conceived they must be of very great value indeed. Personally, his calculations varied so much that he felt he would have to set a slide rule to an unlimited extent, for every description of calculation. He concurred with Mr. Selfe, that one should know how to do the work done by the slide rule, before attempting to use the instrument.

Mr. Stowe, in reply, said that with reference to the remarks made by Mr. Fitzmaurice, that the necessity of the use of the slide rule was somewhat obviated by the introduction of tables, it was the instrumental calcula-

tions which, to a large extent, had been the means of the preparation of these tables, and it was indirectly owing to these instruments that the tables were compiled. This proved, too, that these instruments could be relied on to do the work. It had been rightly said that where repetitions in calculation were necessary, these instruments, such as the Arithometer, and the new Comptometer, of the Americans, were of great advantage. But it was said that with regard to the slide rule this did not apply. Mr. Selfe admitted that special instruments were advantageous, but he did not recognise that the ordinary slide rule was as advantageous. To use any slide rule it was first necessary to understand its principles, and without this, either the ordinary slide rule, or failing that, the special instruments could be of very little value to any one. People assumed that they should be able to take up the slide rule and straightway use it. It was his experience that many people who came to him to be taught the use of the slide rule, had had the usual arithmetical training of the Public Schools, yet withal were deficient of a knowledge of the decimal system, for the reason that many teachers never thoroughly understood the system, and made it rather a question of memory than of reason; moreover, the system could not be thoroughly grasped by children lacking, as it did, the practical element—which was supplied to a certain extent in the Abacus, and ultimately the Slide Rule would take its place in all schools, as a thorough exponent of arithmetic and the decimal system. It was a subject of congratulation that the New South Wales Government was the first authority in English-speaking countries to teach the use of the Slide Rule and instrumental calculation.