

provide machines to do this work in one-hundredth of the time and so would save the world many hours of valuable labour and enable the worker to spend his time more profitably than on handle-turning.

At least one attempt to provide a service in Great Britain on these lines has been established, on a business footing, and within its limitations has proved to be highly valuable. But such privately owned concerns may not be able to obtain all the more expensive and more specialized machines, which are at present mainly scattered throughout the laboratories of industrial companies, universities and similar institutions, where their use is practically restricted to members of the institution concerned. It would appear that the great possibilities of mathematical machines can be fully realized only through an organization supported by public funds, concentrating all types of machines under its care and using them to solve the problems of scientific workers wherever they may happen to be working. This must stand as not the least of the problems of social re-organization which confront the world to-day.

Future Trends

At present machine mathematics is widely regarded as being not quite respectable, not quite mathematics. This is especially the opinion of that school who see the chief justification of mathematics in what they interpret as its uselessness, combined with its "intrinsic beauty". Such mathematicians should take a warning from history. For theirs was the attitude adopted by English mathematicians of the eighteenth and three-quarters of the nineteenth century, with the result that, while Continental mathematics forged ahead, the English mathematician toyed with his "beautiful" problems of the Newtonian era, ignoring the fact that these had by then lost all relation to social usefulness and that the conditions of the Industrial Revolution were calling for new techniques. Thus it came about that Great Britain dropped far behind and had to be modernized with a jerk, when at last the scientific representative of the industrial capitalist burst into the universities, besides setting up his own research institutions.

There seems not to be a danger of this happening again. The real problems of to-day need machines,

and machines have come to stay. If mathematics is to advance, it must recognize this fact and re-organize itself appropriately. This implies re-orientation in the light of the possibilities and the limitations of machines. To give one trivial example, in all machines so far in existence, the multiplication of two varying functions is an extremely awkward matter, while integration is comparatively simple. This suggests that our analysis should be 're-worded' so as to substitute integration for multiplication wherever possible. This, of course, may mean the loss of some formal elegance, but formal elegance must and will give way to the needs of practice.

SELECT BIBLIOGRAPHY

Miscellaneous :

- ¹ Stevin, English translation by Robert Norton: "Disime: the Art of Tenths; or Decimall Arithmetick" (1608).
- ² Hessen, B., "The Social and Economic Roots of Newton's Principia", in "Science at the Cross Roads", N.I. Bukharin *et al.* (1931).

General Surveys :

- ³ "Handbook of the Napier Tercentenary Exhibition", ed. E. M. Horsburgh (1914). Contains an account of the life and work of Napier, detailed descriptions of many mathematical machines and instruments and various other matters up to 1914.
- ⁴ Wolf, A., "A History of Science, Technology and Philosophy in the 16th and 17th Centuries" (1935), 560-63.
- Wolf, A., "A History of Science, Technology and Philosophy in the 18th Century" (1938), 654-60.
- ⁵ Comrie, L. J., "Calculating Machines", being Appendix III to L. R. Connor's "Statistics in Theory and Practice" (1938) (published separately). The best concise account of modern calculating machines.
- ⁶ "Encyclopædia Britannica", article on calculating machines.
- ⁷ Thomson and Tait, "Natural Philosophy" (2nd edn.), Appendix B, Gives an account of all Kelvin's machines.
- ⁸ Bush, V., "Recent Progress in Analysing Machines", Proc. 4th International Congress of Applied Mechanics (1934). An excellent review of progress to 1934; contains descriptions of some of the machines discussed in the text and several others.

Particular Machines :

- ⁹ Babbage, H. P., "Charles Babbage's Calculating Engines" (1889).
- ¹⁰ "Encyclopædia Britannica", article on Charles Babbage.
- ¹¹ Comrie, L. J., Supplement to *J. Roy. Stat. Soc.*, **3**, 87 (1936).
- ¹² Comrie, L. J., *J. Roy. Stat. Soc.*, **4**, 210 (1937).
- ¹³ Bush, V., *J. Franklin Inst.*, **212**, 447 (1931), on the first differential analyser.
- ¹⁴ Hartree, D. R., *Math. Gaz.*, **22**, 342 (1938), gives the best simple account of the differential analyser.
- ¹⁵ Kranz, F. W., *J. Franklin Inst.*, **204**, 245 (1927).
- ¹⁶ Brown, S. L., *J. Franklin Inst.*, **223**, 245 (1939).
- ¹⁷ Montgomery, H. C., *Bell System Tech. J.*, **17** (1938).
- ¹⁸ Mallock, R. R. M., *Proc. Roy. Soc. A*, **140**, 457 (1932).
- ¹⁹ Wilbur, J., *J. Franklin Inst.*, **222**, 715 (1936).
- ²⁰ Gray, T. S., *J. Franklin Inst.*, **212**, 77 (1931).
- ²¹ Hazen, H. L., and Brown, G. S., *J. Franklin Inst.*, **230**, 183 (1940)

NEWS and VIEWS

Manuscripts of Charles Darwin

WE understand that the trustees of Charles Darwin are considering disposing of original MSS. of Darwin's which are in their care. These include the manuscript journal kept by Darwin during the voyage of the *Beagle* (1831-36) on which was based his "Journal of Researches into the Natural History and Geology of the various countries visited by H.M.S. *Beagle* . . .", Darwin's autobiography in his own handwriting with alterations made or suggested by Mrs. Darwin, the manuscript of "The Effects of Cross- and Self-Fertilization in the Vegetable Kingdom", the 1844 sketch of "The Origin of Species", and a large number of letters and miscellaneous material most of which has been published. Although this material may contain little of strictly scientific value, it has

an obvious interest to the historian of science as revealing the workings of Darwin's mind at different periods of his life, and it would be unfortunate if the material should be dispersed. Such documents should be preserved in a library where access to them can be had by students, and it is to be hoped that some benefactor of science, aided perhaps by the Friends of the National Libraries, or some similar body, may be able to secure them for that purpose.

Future of Radio Communication

CAPTAIN P. P. ECKERSLEY addressed the British Institute of Radio Engineers at its meeting on April 18 on "The Future of Radio Communication". He dealt at some length with the limitation of communication channels available, for the whole of