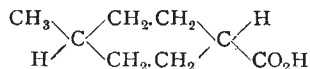destroys the symmetry on either side of the plane of the ring, whilst the dissimilarity of the —H and —$CO_2H$ groups destroys the symmetry about the perpendicular plane. The compound therefore fulfils the fundamental condition for enantiomorphism, namely, that no plane of symmetry shall exist. By way of contrast it may be noted that the compound

$$CH_3 \diagdown \quad \diagup CH_2 \cdot CH_2 \diagdown \quad \diagup H$$
$$\phantom{CH_3}C\phantom{----}C$$
$$H \diagup \quad \diagdown CH_2 \cdot CH_2 \diagup \quad \diagdown CO_2H$$

could not exist in enantiomorphous forms or exhibit optical activity, because the four radicles are all situated in a plane (perpendicular to that of the ring) which would thus form a plane of symmetry of the molecule.

Extraordinary difficulties were encountered in effecting the resolution of the acid. Owing to its weak basicity the salts were very ill-defined, and the brucine salt by means of which the resolution was finally accomplished separated from its solutions as an oil which only slowly became crystalline. Again, the brucine salts of the enantiomorphous acids were so similar that an exceedingly tedious process of re-crystallisation was required before they could be obtained with a constant rotatory power, and even then the acids separated from them were not homogeneous, but proved to be capable of further resolution. Evidently the salts are not only similar, but partially isomorphous. Finally, however, both acids were obtained in a pure state, the l-acid giving $[a]_D - 81 \cdot 1°$ and the d-acid $[a]_D + 81 \cdot 4°$ in absolute alcohol (0·145 gr. in 20 c.c.).

## TECHNICAL EDUCATION IN MANCHESTER.

THE sixth annual report of the Manchester Education Committee, dealing with the work of the year 1907–8, has now been published, and provides an excellent example of the way in which an educational authority can build up a complete and duly correlated system of education to meet the precise needs of the area under its charge. The report deals fully with higher, secondary, and elementary education.

The section dealing with higher education is concerned with the year ending in October, 1908, and deals chiefly with technical education. The number of individual day and evening students enrolled at the Municipal School of Technology for the session ending July 31 was 5299, as compared with 5149 for the previous session. The number of individual students enrolled in the day departments was 661, as compared with 651 for the session 1906–7. The class entries for the session were 11,379, against 10,979 for the session 1906–7. These figures do not, however, include the class entries in respect of students in the day departments of the school. Computing the total volume of work of the evening departments in student-hours—that is, by multiplying the number of students enrolled by the total number of hours' instruction given during the session— it was found to be 459,805. The actual volume of work, namely, the total number of hours of instruction multiplied by the actual attendances, was 302,162 student-hours, or 60 per cent. of the total volume of work. Whichever method of computation is adopted, the result obtained shows a marked increase on the previous session.

The imperial grant received year by year increases steadily, amounting during 1906–7 to 9773*l.* The capitation grant paid by the Lancashire County Council in respect of students outside the Manchester area was, for 1907–8, 1226*l.* The Cheshire County Council compounds, so far as its students are concerned, and from this source the school received 400*l.*

It is interesting to notice that a certificate has been instituted this year for students attending the engineering apprentices' course, held on Mondays from 9 a.m. to 6 p.m. throughout the session. To satisfy the conditions of award, students must pass all the prescribed examinations upon completion of the two years' course of study. The certificate has now been awarded to thirty-seven students, who have attended the course during the past four sessions. A similar day course for apprentice painters and decorators has also been inaugurated. The committee of the school has had under consideration the question of extending the facilities to apprentices in other industries for instruction and training during one whole day a week, so as to relieve them from attendance at the evening classes, and at the same time to give additional time and opportunity for homework and study in the evening. After consultation with the Master Plumbers' Association of the Manchester and Salford district, a scheme has been drawn up for apprentice plumbers on the same lines as the course for apprentice engineers.

During the past year opportunity has been taken to improve and develop the organised courses of instruction in several of the evening departments in order more thoroughly to systematise the training given, and to bring the various subjects of the respective evening courses into closer organic relation. The courses in the departments of mechanical engineering, electrical engineering, architecture and builders' work, municipal and sanitary engineering, and textile manufacture, are thus graduated and organised to cover a period of three or five years, leading up to the evening certificate or diploma of the school, as the case may be.

A large number of tests has been carried out during the year for various firms in Manchester and district, and the facilities which the school offers for mechanical and electrical tests, and tests and analyses of a chemical nature, are taken advantage of increasingly, as shown by the fees received, which have increased from 119*l.* in 1904–5 to 319*l.* in 1906–7, and 352*l.* in 1907–8. The members of the staff have been responsible during the session for a considerable amount of original research, a large portion of which has been embodied in papers read before various scientific societies, and published in the journals of the scientific and technical Press.

Not only does the committee govern the Municipal School of Technology, but aids higher education in other ways. It recommended to the City Council the grant of 4000*l.* received by the Victoria University of Manchester, and is responsible for the grants received from the council by the secondary schools of the district.

## ON THE INVENTION OF THE SLIDE RULE.[1]

SOME modern writers attribute the invention of the rectilinear slide rule to Edmund Gunter, others to William Oughtred, but most of them to Edmund Wingate. This disagreement is due mainly to lack of opportunity to consult original sources. It is the purpose of this paper to demonstrate that Wingate never wrote on the slide rule, and that Oughtred is the inventor of the rectilinear as well as the circular type.

It was pointed out by Prof. De Morgan that Gunter invented Gunter's line or scale, but that he did not invent the slide rule. As Gunter's works are found in most large libraries, the correctness of this statement can be readily verified. This scale was not a slide rule, for it had no sliding parts.

No one denies that William Forster published in London in 1632 a book entitled "The Circles of Proportion," which described the circular slide rule invented by William Oughtred. In the dedication it is said that Oughtred invented also the straight-edge type; but this was not described until 1633, when Forster brought out an "Addition unto the Use of the Instrument," with an appendix entitled "The Declaration of the Two Rulers for Calculation," which described the rectilinear slide rule.[2]

The question remains, Did Wingate invent the straight-edge slide rule, and is he entitled to priority over Oughtred? De Morgan maintained that Wingate never wrote on the slide rule,[3] but he had not seen all of Wingate's books. Thus he admits[4] he had not examined Wingate's "Of Naturall and Artificiall Arithmetique," 1630, yet this very book is quoted by several recent writers as describing the slide rule[5]; but these and all writers who name Wingate as the inventor invariably fail to give

1 Abstract of a paper, by Prof. F. Cajori, read before the Section of Mathematical and Physical Science of the British Association, Winnipeg, August 27.
2 For extracts see Cajori, "History of the Logarithmic Slide Rule." (New York: *Engineering News* Publishing Co., 1909.)
3 "Penny Cyclop.," Art. "Slide Rule," and Wingate, Edmund, "Arithm. Books." Pp. 38, 42. (London, 1847.)
4 "Arithm. Books," p. 48.
5 A. Favaro in "Veneto Istituto Atti" (5), 5, 1878–9, p. 500 ; Mehmke in "Encyklop. d. Math. Wiss.," vol. i., p. 1054. (Leipzig, 1898–1904.)