SOME SCIENTIFIC CENTRES.

I.—THE LEIPZIG CHEMICAL LABORATORY.

LEIPZIG is a city which boasts many traditions; it is associated with some of the most distinguished names in nearly every department of intellectual life; and its University justly takes a place among the leading schools of Europe. To us there is a sense of fitness in the thought that the school which produced a Wagner and a Goethe should have numbered among its teachers two men who have left a mark in the history of the development of organic chemistry. These men are Hermann Kolbe and Johannes Wislicenus; both of them famous as teachers and experimenters, and each of them associated with a theory the importance of the effect of which on the growth of their science it would be difficult to overestimate.

Wislicenus succeeded Kolbe in the chair at the University of Leipzig, and Wislicenus still works in the laboratory which was made famous by his predecessor; he is the oldest survivor of that generation of workers who laid the foundations of organic chemistry, and as such and as a mark of esteem by one of his old pupils, his laboratory has been chosen as the first of the present series.

The laboratory in Liebig Strasse, which has been the scene of so many classical researches, was built by Kolbe, who commenced to work there in the autumn of 1868.

His name was already famous in connection with his earlier work on the determination of the nature and chemical constitution of organic radicles, in which he was materially assisted by the researches of Frankland. But it was in Leipzig that his most brilliant experimental work was carried out; it was there that, in conjunction with Drechsel, he synthesised oxalic acid from carbon dioxide and potassium, and, assisted by Basaroff, obtained carbamide by the interaction of carbon dioxide and ammonia. Among the early achievements which have invested the present laboratory with such historic interest, and entitle Kolbe to a place among the "wahre Bearbeiter," of Berzelius—to whom, indeed, as well as to Liebig, Wöhler and Bunsen, he used to ascribe his inspiration—must be mentioned the synthesis of isosuccinic acid, the production of nitromethane from chloracetic acid, and the famous reaction for obtaining salicylic acid by the action of carbon dioxide upon sodium phenate, in which he disclosed the singular fact that the use of potassium phenate resulted in the formation of the isomeric para-hydroxybenzoate.

Kolbe died on November 24, 1884. He was not mourned by all who knew him, for his pen had made him not a few enemies; his violent attacks on the "Structurchemiker," and his description of Kekulé's theory of the benzene ring as "wilde Phantasien ohne reelle Basis," have become part of the history of chemistry; while his allusion to the since illustrious van 't Hoff in the words "Ein Dr. J. H. van't Hoff, findet wie es scheint, an exakter chemischer Forschung keinen Geschmack. Er hat es bequemer erachtet, den Pegasus zu besteigen, und in seiner 'La Chimie dans l'espace' zu verkünden, wie ihm auf dem durch kühnen Flug erklommenen chemischen Parnass die Atome im Weltraume gelagert erschienen sind," was almost worthy of Swift himself.

Wislicenus was appointed director of the laboratory in October, 1885, and effected several alterations in its interior to increase the facilities for work. The number of students rapidly increased till it reached the maximum that the building could accommodate; and in spite of the counter attractions of the Physical Chemistry Institute, which was opened in 1871, the popularity of the first laboratory never waned. At the present time there are 174 students working there, of whom 50 are engaged in carrying on research under the direction of Prof. Wislicenus and his assistants.

Before going on to describe the researches which have maintained the traditions of the laboratory, a brief glance at the career of Johannes Wislicenus will assist us in forming some idea of the nature and variety of his experience.

Born in 1835 in Saxony, the son of a pastor, he received his education first at a school in Halle, and then in 1853 at the University of the same town, where he commenced to study science. But those were the years of revolutions, and in the following autumn his father was forced, on account of his political opinions, to fly to America; there the young Johannes obtained an appointment as assistant to Prof. Horsford at Harvard University, and one year later was made lecturer at the Mechanics' Institute, New York, with a laboratory at his disposal.

In 1856 he returned with his family to Europe, resumed his interrupted studies at the University of Zurich, and later on at Halle; in 1860, he "promovirte, and was appointed 'Privat-docent' at the Zurich Polytechnic." In 1865 he was called to the chair of chemistry at Zurich University, and six years later became director of the Polytechnic. The years 1872-1885 were spent as professor at Wurzburg, where he succeeded Ad. Strecker. On the death of Kolbe the vacant chair at Leipzig was offered him and accepted; and there is a curious irony in the thought that his first work there should have been directed towards the extension of the theory of that van 't Hoff whom his predecessor had regarded with such contempt.

The work of Wislicenus has been confined almost entirely to the domain of organic chemistry. He entered the field when the "Radical Theory" of Kolbe and Frankland had taken a firm hold on the minds of the newer school of chemists.

One of the first problems he attacked was the constitution of lactic acid; while still at Zurich he effected its preparation artificially from propionic acid as well as from aldehyde (*Liebig's Ann.* 1863, cxxviii, 11; cxxxiii, 257; and cxlvi, 145). Later on he succeeded in establishing the identity of structure for the two different substances fermentation- and para-lactic acids (*Liebig's Ann. Chem.* 1872, clxvi, 3; and clxvii, 302). The structural theory alone was thus insufficient to explain such cases of metamerism. He was impelled, therefore, even as early as 1873, to the conclusion that the cause of the difference between the two acids must be looked for in the spacial relations of the atoms in the molecule.

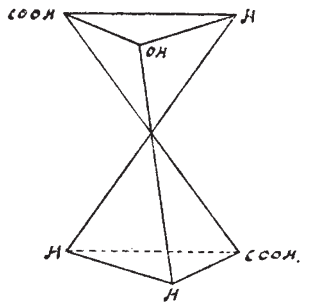
But his attention was for a time diverted from this topic by the classical researches which he was carrying out on acetoacetic ether; his chief papers on the subject appeared in 1877 (*Ann. Chem. Liebig*, clxxxvi, 163; cxc, 257; 1881, ccvi, 308). He studied in detail its reactions, mode of preparation and decomposition, and showed it to be the most valuable synthetic agent then known. His work was of the utmost value in throwing light on the still debated constitution of the substance; in it he was assisted by several English students who have since attained eminence.

Wislicenus was now the occupant of the Leipzig chair; after several papers of lesser importance had appeared, he challenged the attention of the world by the publication, in 1887, of the famous memoir: "Über die raümliche Anordnung der Atome in organischen Moleculen." In this he put forward an explanation of what he termed geometrical isomerism, which was an extension of the hypothesis formulated independently by Le Bel and van 't Hoff in 1874. According to this hypothesis "the centre of gravity of a carbon atom was regarded as situated in the centre of a tetrahedron, and its four affinities at the four corners." When two atoms were linked together, van 't Hoff, and after him Wislicenus, assumed that both were capable of rotating in opposite directions about a common axis; this possibility ceased, however, with a double or treble linking of the carbon atoms. Wislicenus further called into play the action of certain "specially directed forces, the affinity energies," which

determine the relative positions of the atoms to one another in the molecule.

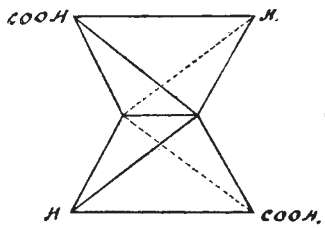
Space will not permit of any detailed discussion of this theory; a single example must suffice to illustrate the manner in which it was applied by Wislicenus.

By heating malic acid to 150° on an oil bath, it is converted almost entirely to fumaric acid; this he explained by the diagrams



$= H_2O +$

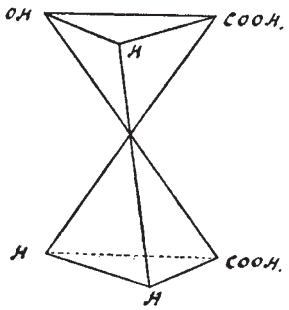
Malic Acid.



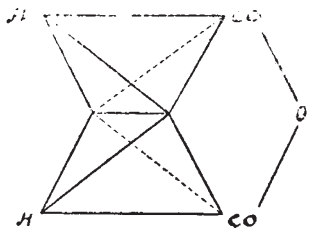
COOH

Fumaric Acid.

If the malic acid be heated from 170—200°, small quantitities of maleic anhydride are formed, though even at this temperature the greater part is converted as before to fumaric acid; this, according to the theory, is due to the existence in the malic acid at the higher temperature of a certain number of molecules in which the atoms have swung round and assumed the positions indicated below; from which the formation of maleic anhydride might be predicted:



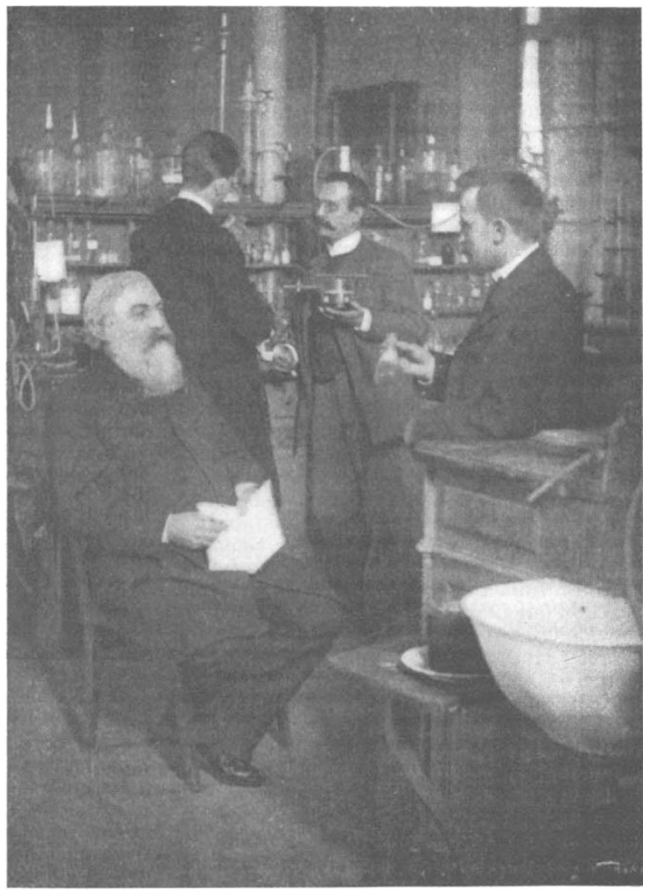
$= 2H_2O +$



Maleic Anhydride.

In the same way Wislicenus applied his theory to all the other reactions of maleic and fumaric acids, to the tolane dichlorides and dibromides, mesaconic and citraconic acids, the crotonic acids, &c; among all the cases he considered, there were only two facts not in consonance with those demanded by the theory; these were (1) the partial conversion of maleic into fumaric acid by the action of bromine, and (2) the production of dibromfumaric acid by the addition of bromine to acetylene-dicarboxylic acid.

In the following year (1888) he published a series of papers (*Liebig's Ann. Chem.* 1888, ccxlvi, 53; ccxlviii, 1; 1889, ccl, 224; cclxxii, 1) containing the results of a large number of experiments (carried out by himself and his pupils) with the object of investigating the nature, constitution and relationships between maleic and fumaric acids, acetylene-dicarboxylic acids, the



Wislicenus in his laboratory.

α-chlorpropylenes, the crotonic acids, the tolane dichlorides, &c.; all of these tended to support the hypothesis he had put forward. In the case of the two apparent exceptions alluded to above, he showed that in the first case the action is far more complicated than at first appears, the conversion of the maleic into fumaric being wholly accounted for by the formation of hydrobromic acid in the course of the reaction, which would suffice to bring about the change. Similarly in the second case, by preventing the formation of hydrobromic acid, the reaction is that demanded by theory, viz., the formation of dibrom maleic acid. Thus the exceptions strengthened rather than weakened the argument.

It is only fair to call attention to the fact that Michael, who has devoted considerable time to the investigation of the subject, has obtained results which in many cases

are not explained by the theory of Wislicenus and van 't Hoff (*Journ. Prac. Chem.* 1895, [2], lii, 365–372); but, as was shown in the celebrated controversy with Fittig (*Liebig's Ann.* 1892, cclxxii, 1-99) over the brom-additive products of angelic and tiglic acids, the conditions of the experiment play such an important part in determining the nature of such reactions that the bearing of the results on the validity of the theory must be accepted with a certain amount of reservation. The matter is still the subject of discussion; for the present we can only quote the words of an illustrious chemist, who said that "unter allen sonst vorgebrachten Erklärungs-versuchen lehrt kein einziger auf gleich einfach und gleich umfassende weise die beobachteten Thatsachen verstehen."

Wislicenus has of late been engaged in the application of the theory of spacial relations to the formation of ring compounds, his synthesis of cyclo-pentanone from the calcium salt of adipic acid serving as a starting point in the preparation of the simplest five-ring compounds. Especial interest attaches to the investigation of suberone, which was shown to be a seven carbon ring; for the theoretical consideration of von Baeyer (*Ber.* 1885, xviii, 2277), in addition to those already referred to, would make us regard a seven carbon ring as unstable as a four.

Wislicenus is one of the forty foreign members of the Royal Society, and was awarded the Davy medal in 1898. Still working with all the vigour of an enthusiast, lecturing both in summer and winter at eight o'clock, making frequent tours through the research laboratories with his note-book and cigar, and listening patiently to the "Ausländer" who bury their unsuccessful experiments in the mysteries of the German language, he attracts students of every nationality, for he has a personality which makes its influence felt; and those who have enjoyed the privilege of working under him have lost none of their respect for a distinguished teacher in their appreciation of his kind hospitality and generous spirit.

THE CENTENARY OF THE DISCOVERY OF CERES.

A HUNDRED years have passed since Piazzi, at Palermo, opened a new era in observational astronomy by the discovery of the first of the many small planets that circulate between the orbits of Mars and Jupiter. This welcome, but not unexpected, addition to the known members of the solar system gave an increased interest to the routine of observation, supplied fresh reasons for the preparation of accurate star catalogues, and quickened the researches of practical astronomy, a little overshadowed by the brilliancy of the results won on the physical side by the French mathematicians of the last century. It is true that within the space of time which has elapsed since Piazzi used to such good purpose the altazimuth of Ramsden, the history of astronomy has had to record, not only the growth, but also the decrease, of interest which has been a consequence of the rapid discovery of similar objects. Nevertheless, Piazzi's discovery was fortunate and fructiferous, and we willingly associate ourselves with those of his countrymen who have recently sought to do honour to his memory and to demand due recognition for his services. We are reminded, in a recent number of *Memorie della Societa degli Spettroscopisti Italiani*, that though the story of the discovery of Ceres may have been frequently told and is very well known, yet there are features connected with it of which we may well be reminded. For eight years with untiring diligence did Piazzi patiently work, before he made the discovery which has rendered his name a household word and endeared his memory among his countrymen. Doubtless he himself considered his star catalogue a far greater work, and so posterity will esteem it; but the renown that attaches to such a discovery is immediate and, in a sense, abiding. To appreciate fully what it meant at the time, we must recall the confidence and the agitation which were connected with the so-called Bode's law. The evidence such a formula offered of the existence of an undiscovered planet may not appear now very convincing, but the confidence with which it had been received had been strengthened by the comparatively recent discovery of Uranus, and astronomers, among whom may be reckoned Schrœter and De Zach, were banded together with the firm determination to discover the missing link in the chain of planetary distances. Piazzi, according to Grant, stood outside this company of eager astronomers, but the late Admiral Smyth, who had exceptional information from his personal acquaintance with Piazzi, gives him a place in the circle. In any case it was due to systematic work diligently pursued by the Palermo astronomer that the prize was won.

But, as pointed out by Prof. Angelitti and others who have taken part in the centennial celebrations, the indirect results of the discovery have far outweighed the immediate. Among these may be reckoned the earlier publication of the "Theoria Motus" of Gauss, and especially those chapters which deal with the computation of an elliptic orbit from observations that embrace only a short interval of time. This classical work has remained for a century, the model on which all similar calculations have been based. Alterations of detail have been introduced from time to time bearing upon special parts of the work, but practically the method followed to-day is the method that Gauss evolved to rescue and identify the discovered planet of Piazzi from the stars by which it is surrounded and which it so much resembles. It is well known that Ceres, as the small planet was called, was followed by Piazzi only from January 1 to February 11. Oriani and Bode, to whom Piazzi forwarded his observations, do not appear to have seen the planet in the first year of its discovery, and Gauss' researches and the success that attended them rest entirely on the labours of the original discoverer.

It is not out of place to recall how the discovery of small planets and the eagerness with which they were sought in the middle of last century gave a great impetus to the construction of accurate maps of the heavens. The Berlin charts led to the ready recognition of Neptune, while the ecliptic charts of Hind, of Peters, of Chacornac and of a host of others who engaged in the work, added greatly to our knowledge of the configuration of the heavens and the arrangement of the stellar universe. And it must be remembered that one of the first, if not the first, valuable application of photography to astronomy had for its aim the rapid delineation of such charts originally devised for the detection of small planets. To the fruitfulness that has followed this peculiar direction of thought it is not necessary to refer more particularly, but it would not be difficult to show that the discovery of small planets, originating in the small observatory of Palermo, has exercised an enormous influence on the methods of observation now so generally pursued.

We need do no more here than barely refer to the important part that the group of small planets has played in the oldest of old problems, that of the distance of the Sun. Let the bulky volumes that Sir David Gill has sent from the Cape speak of the work that small planets have furnished to the astronomer in this chapter of his science. And now, practically a century after Piazzi taught us how the space between Mars and Jupiter is crowded with cosmical matter, we find astronomers of all nations cooperating on the systematic observation of one of these small bodies, only intent upon bringing the new material to aid more efficiently in the serivce of the old. Small planets have played, and in the future will continue to play, a part in the onward progress of astronomy, and