NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MAY 6, 1897.

SCIENTIFIC WORTHIES.

XXX.—STANISLAO CANNIZZARO.

IN the autumn of last year there occurred in Rome an event which attracted the attention of the whole scientific world, and more especially of that portion of it which is concerned with chemistry. The occasion was the celebration of the seventieth anniversary of the birth of Prof. Stanislao Cannizzaro, Senator of the Kingdom of Italy, and Professor of Chemistry in the University of Rome. The pages of this journal have already borne witness to the feelings of esteem and gratitude which that event evoked. At the public meeting called to do him honour, all the learned bodies in the world which have any concern with science, or have any regard for its welfare, combined to offer their felicitations, and vied with each in the warmth of their expressions of appreciation and good will, and a multitude of letters and telegrams were received from chemists in all parts of Europe and America. The place of honour in the list of the addresses, as enumerated in the interesting account of the ceremony since published, is given to that from the Royal Society, which repeated the terms in which the Council had previously made known to Prof. Cannizzaro its reason for awarding him the highest distinction in its power. Next comes that from the Chemical Society, which recalls with pride that the name of Cannizzaro has given lustre to the roll of its foreign members for more than half the period of his life-time.

In what follows we desire to give an account of the life and labours of one whom men of all nations have thus shown themselves eager to honour.

Stanislao Cannizzaro, the fourth and youngest son of Mariano Cannizzaro and Anna Dibenedetto, was born on July 13, 1826, at Palermo, where his father was a magistrate, Director-General of the Sicilian Police, and subsequently President of the High Court of Chancery. The future chemist was educated partly at home and partly at the normal school of his native city, and on the death of his father in 1836, he was placed in the Carolino Calasanzio College. The cholera epidemic of 1837 ravaged Palermo, the young Cannizzaro lost two of his brothers, he himself was attacked by the terrible scourge, and it was only after a tedious convalescence that he was able to resume his studies. Elementary education in Sicily at that time was wholly under the control and direction of the priests: grammar, rhetoric, poetry and philosophy, with a very small modicum of mathematics and geography, constituted the pabulum on which the youth of the period was fed. The physical sciences, of course, had no place in a system which was essentially mediæval. The boy soon gave evidence of his power, and after a school career of distinction he entered, in 1841, the University of Palermo with the intention of devoting himself to medicine.

The subject, however, proved uncongenial, and the youth tried in vain to pass the necessary examinations. Stimulated, however, by Foderà, who at that time taught physiology in Palermo, and with whom the young student became intimately acquainted, he was led to take up experimental work in connection with chemical physiology. It is needless to say that at this period Palermo possessed no laboratory accommodation, and all the manipulative essays that the young experimentalist could venture upon had to be done at his home, and with such improvised appliances as he could command. In the autumn of 1845 he went to Naples, where he came in contact with Melloni, the most eminent Italian physicist of his time, with whom he contracted a warm friendship. Mainly through the recommendation of Melloni, who quickly learned to appreciate the character and power of his young friend, Piria, who is honourably known to chemists by his researches on plant products, was led to offer the young Sicilian the post of *preparateur* in the chemical laboratory of the University of Pisa. To Pisa accordingly he went, and the step decided his career. What Melloni was to physics in Italy at that period, Piria was to chemistry. The young assistant could have had no better master. Raffaele Piria, then in the full tide of his vigour, was an admirable, albeit a most exacting teacher. A distinguished pupil of Dumas, and a remarkable expositor, his lectures were distinguished by the same love of method, of orderly arrangement, of

precision, neatness, and even elegance that characterised his laboratory work; and Cannizzaro and his fellow-assistant Bertagnini must at times have been sorely exercised to satisfy the rigorous ideal of exactitude and of manipulative skill required by the Professor in the experimental illustration of his lectures. When not employed in the class-room, his duty was to wait on Piria in the laboratory. Piria during that period was engaged upon those inquiries on salicin, populin, asparagin, and their derivatives, by which he is best known to the chemists of this time. The greater part of the experimental labour connected with these investigations was done by Piria himself during the eight hours that he daily spent in his laboratory, Cannizzaro being for the most part, as he says, a simple looker-on, observing attentively and in silence the rare skill and manipulative ability with which the work was executed. Occasionally, however, the assistant would be called upon to continue some experiment or analysis which Piria had begun, or to prepare some material he needed; all of which he was required to perform in literal compliance with the instructions he received from the master. Most of the work of preparation in connection with the lectures had to be done in the early morning, before Piria descended from his apartments to the laboratory. These preparations were carefully scrutinised by the Professor, who would tolerate no slovenliness or negligence, and whose æsthetic sense demanded that the apparatus should not only work well but look well. Although a silent worker during the day-time, and a most severe judge of his assistant's duty whether in the laboratory or in the lecture-room, Piria could unbend in his hours of ease, and many an evening was spent by Cannizzaro with his master, who would then freely discuss chemical subjects with his young assistant, and explain the object and meaning of the work on which he had been engaged during the day.

This severe discipline, to which Cannizzaro frankly confesses he owes much of the success of his after-career as a chemist, was interrupted by events, which, as they have turned out, had no small share in determining also his success in his career as a politician. Returning to Sicily at the end of July 1847, presumably to spend his vacation at home, the ardent young Liberal of twenty-one, mindful of the events of 1836, naturally found himself in active sympathy with the movement of the time, and when the revolution broke out in January 1848, he became an officer of artillery at Messina. Having been elected deputy for Francavilla in the Sicilian Parliament, he went to Palermo at the end of March, and, as the youngest member of the Assembly, he was required to act as its Secretary. After the bombardment and fall of Messina on September 7, 1848, he was sent to Taormina to organise resistance to the advance of the royal troops. The armistice of September 13, extorted by the combined fleets of England and France to put a stop to the atrocities of Ferdinand's army, stayed for the moment further hostilities, but Cannizzaro was ordered to remain at his post as Commissioner of the provisional Government. The armistice ended in the following March, and after the disaster of Novara, and with it the abdication of Charles Albert, the Sicilian movement utterly collapsed. The royal troops were everywhere victorious, the insurgents retreated first to Catania and thence by Castrogiovanni to Palermo, and, in May 1849, Cannizzaro, with a number of his compatriots, succeeded in escaping for Marseilles on board the Sicilian frigate *Indipendente*. He was now in exile, and led for a while a somewhat wandering and aimless existence. After a short stay in Marseilles, he passed on to Arles, and visited in turn Avignon, Lyons, Nîmes and Montpellier. In time, however, he again betook himself to his chemical studies, although his means were very limited and his opportunities few. He had, of course, no laboratory, but he read such books as he could obtain, and visited such chemical factories as would admit him. When the body of the unfortunate and broken-hearted Charles Albert was brought back from Oporto, to be buried in the land for whose liberty he had sacrificed his kingship, Cannizzaro joined his fellow-refugees in Turin in order that they might testify by their presence at the obsequies of the dead monarch their grateful memory of his services, and their resolution that his tomb on the Superga should be to them the symbol of an undying aspiration.

Towards the end of October, Cannizzaro found himself in Paris. Thanks to a letter from Piria, he became acquainted with Cahours, who introduced him into the little laboratory of Chevreul attached to the theatre in the Jardin des Plantes, where he found Cloëz installed as assistant. He had now abundant opportunities for work, and with the characteristic ardour of his Southern blood he embraced them all. The excitement of political disquietude in Paris has never seemed to react disastrously on the progress of science there. Curiously enough, for some inscrutable reason, it would appear to stimulate it. Indeed, some of the darkest and most unsettled periods of the political history of France have been among the brightest and most glorious epochs in the annals of science. The stir of 1848, and the unrest which followed it, were contemporaneous with an extraordinary activity in chemical and physical inquiry in Paris, and Cannizzaro participated to the full in the busy movement going on around him. Dumas, it is true, had been swept by his political convictions into the Legislative Assembly, to become Minister of Agriculture and Commerce; and his laboratory in the Rue Cuvier, in spite of the seductive offer of Jecker, was closed.

Still, if Cannizzaro never came under the spell of Dumas, he could witness Fremy's experiments in the laboratory of Gay Lussac, and could attend Regnault's lectures in the Collège de France. But it was to the chemical work-table he mainly turned, and on this he spent the greater part of his time and energies. He took up the study of the amines, the existence of which had recently been made known by Wurtz, and, with Cloëz, prepared cyanamide by the action of ammonia on cyanogen chloride. An account of the nature and properties of this compound, published in 1851 in conjunction with Cloëz, constitutes Cannizzaro's first contribution to the literature of chemistry. The reaction by which they obtained the substance proved exceedingly fruitful, and, by the substitution of amines for ammonia, Cahours and Cloëz subsequently prepared the alkyl cyanamides. Moreover, cyanamide itself, by the ease with which it suffers polymerisation, gives rise to a number of isomeric

series of homologous amides of considerable theoretic interest. Congenial and inspiriting as the atmosphere of Paris might be, man cannot live on air alone. But there were too many young and eager aspirants, of French nationality, for the few posts which practically only Paris was able to offer, to justify the hope that the young Sicilian could obtain a position, sufficiently lucrative even for his modest requirements, in the land of his exile. Piedmont, of all the Italian States, could alone afford an asylum to him, and accordingly, towards the end of 1851, he accepted the position of Professor of Physical Chemistry and Mechanics in the National College of Alessandria, an institution modelled somewhat on the lines of a German Realschule. Here, thanks to the action of the municipality, he was provided with a small laboratory, together with an assistant, and, although much occupied by his public lectures on chemistry and mechanics given to the townspeople, in addition to his regular class instruction, he began the study of the action of alkylamines on cyanogen chloride, only to find himself forestalled by Cloëz and Cahours. At about the same time he discovered benzyl alcohol, which he obtained by the action of alcoholic potash on bitter almond oil, and the properties and modes of decomposition of which he described in a series of letters to Liebig and Wöhler, published in the *Annalen*. His vacations were usually spent with Piria at Pisa, or at Montignoso, near Massa-Carrara, with his old collaborateur Bertagnini, with whom he worked on anisic alcohol (*Ann. de Chimie*, xlvii. 285).

In October 1855, he was called to the chair of Chemistry at the University of Genoa, and at the same time Piria was moved from Pisa to Turin. Although the new position at Genoa was one of greater dignity and emolument, Cannizzaro found himself, so far as laboratory accommodation was concerned, less favourably situated than at Alessandria; the only place at his disposal was a damp and dimly-lighted room, without the slightest convenience for even the most elementary experiments. For some months he found it impossible to carry on the work he had begun at Alessandria. In the following year he obtained a room on the upper floor of the University building, and this, with the aid of an assistant and a couple of pupils, he turned into a fairly convenient laboratory, where he resumed his work on the aromatic alcohols. At Genoa Cannizzaro began the studies on chemical philosophy, which were to culminate in the great generalisation with which his name will continue to be associated. Admirable as his experimental labours are, his chief claim to the esteem and gratitude of his contemporaries and of posterity rests upon his critical contributions to the philosophy of chemistry. In what this signal service consisted will be shown subsequently.

During the whole of this time Italy was in a state of political ferment. The astute Cavour had gradually secured his ascendancy in the parliamentary Councils of the little Sardinian kingdom, and with it his position in the Councils of Europe. Slowly, and in spite of many checks, the cause of Italian unity gained ground. Magenta and Solferino secured Lombardy, and although Victor Emmanuel was forced to give up Savoy, the very cradle of his dynasty, as the price of Louis Napoleon's co-operation, Italy gained Tuscany, Modena, Parma and Romagna; and in 1860 the annexation of Central Italy was complete. Bombino still held his grip on the two Sicilies, but the islanders made one more effort to throw off the hateful yoke. The time seemed propitious, and Palermo, Messina and Catania were soon ablaze; and before the middle of May, Garibaldi and his famous "Mille" had accomplished the liberation of the island. Cannizzaro immediately returned to Palermo. He found here his aged mother and sisters, whom he had not seen since 1849, and at once threw himself into the labour of organising and consolidating the work of the revolution, taking an active part in the debates of the States Council convened to define the relation of Sicily to Italian unity. The affair of Spartivento to all intents and purposes decided the fate of Lower Italy, and by the first week of September Garibaldi was in Naples, and with the shutting up of the last and feeblest of the Neapolitan Bourbons in Gaeta, the emancipation of Italy was practically secured. What remained to be done time would effect.

Cannizzaro now returned to Genoa, passing through Naples, where Piria had been called to reorganise the system of public instruction, and resumed his work at the University. In the preceding March he had been offered, but had declined, the Professorship of Organic Chemistry in the University of Pisa. He was now invited to occupy the chair on the same subject in the University of Naples, and this he also refused. He was then claimed by his native town, and in October 1861, he was named Professor of Inorganic and Organic Chemistry, and Director of the Laboratory of the University of Palermo. What he had to "direct" was contained in a few cupboards, in the same class-room that he had sat in as a student in 1842, and was barely sufficient for even the most elementary illustrations. The whole of the following year was spent in organising his courses and in superintending the arrangement and plenishing of the rooms he ultimately acquired on the top-floor of the University building.

Cannizzaro remained at Palermo for about ten years; he took an active share in the management of the University, and for a time was its Rector. Its influence as a school of chemistry may be judged of from the fact that he had as co-workers Adolph Lieben, Wilhelm Koerner, and lastly Paterno, who has succeeded him in the chair. For the most part he occupied himself, as regards his laboratory work, with the study of aromatic compounds, and in extending and completing his researches on the amines.

If Cannizzaro was useful to the world as a chemist, he was so far mindful of Priestley's example as to strive to be equally useful to Palermo as a citizen, and much of his time and ability was freely given in the service of her municipal government, more particularly on subjects relating to elementary and secondary education.

In 1871 Cannizzaro was called to occupy his present position of Professor of Chemistry in the University of Rome, and Director of the Chemical Institute in the Orto di S. Lorenzo in Panisperma, and here, for the last five-and-twenty years, he has annually delivered his two courses, each of three lectures a week, on general and organic chemistry, and has worked out, partly alone and partly in conjunction with his pupils Amato, Blaserna, Carnelutti,

Sestini, Valente, Fabris and Andreocci, the chemistry of santonin. At the same time that he was called to Rome he was made a Senator of the kingdom, and as a moderate Liberal he has taken his share in the consolidation of the constitution of regenerated Italy.

Cannizzaro, when compared with such men as Berthelot and certain of the leaders of the German schools of chemistry, or even with some of the younger generation of Italian chemists, cannot be called a voluminous writer. In all about eighty memoirs have proceeded from his laboratory. It is on the special quality and character of his published work, rather than on its extent, or on the range and variety of its subject-matter, that his fame depends. In this respect he resembles the late August Kekulé. The names of both men will for ever be associated in the history of chemistry with the promulgation of generalisations which mark epochs in the development of chemical science. Cannizzaro's great merit consisted in being the first to clearly point out the bearing on chemical theory of the hypothesis which is commonly associated with the name of his countryman Avogadro, but which Cannizzaro himself, in his well-known lecture delivered before the Fellows of the Chemical Society in 1872, associated also with the names of Ampère, Krönig and Clausius. This, perhaps, is not the time and the place to discuss the question of whatever claims John Dalton may have to be the first to recognise the fundamental truth embodied in the statement that gases, under comparable conditions, contain in equal volumes equal numbers of molecules, whatever may be their nature and their weight. For the moment we are concerned only with the fact that it remained to Cannizzaro to show that the hypothesis afforded the means of placing the most important of all chemical constants—the atomic weights of the elements—on a definable and intelligible basis, and thereby of rendering our conceptions of atoms and molecules, atomic weight and molecular weight, of gaseous volumes and valency, and of all that is associated with or follows from these conceptions, more logical, consistent, and harmonious. What Cannizzaro did, in a word, was to throw light upon what was obscure, to introduce order where all was confused and contradictory. Hence his "Summary of a Course of Chemical Philosophy," published in 1858, will occupy in the history of chemical doctrine a position as a classic, not less honourable than Dalton's ever memorable "New System." There were, of course, difficulties to be overcome, and inconsistencies to be reconciled: certain facts, indeed, appeared to be hopelessly opposed to the hypothesis which Cannizzaro sought to make the corner-stone of the edifice of modern chemistry. But these difficulties have been gradually swept away, and the very facts which at first seemed incapable of being brought into line, are now seen to afford the strongest support to the truth and universality of the theory.

The theory of Avogadro, indeed, has been approached from independent, although converging standpoints, and its position is now secured by the concurrence of independent testimony. Mathematical conceptions of the nature of gases have shown its necessity. Chemical facts, for a time, were seemingly opposed to it, and hence it was neglected and ultimately forgotten by chemists. They were, however, being driven back to it in spite of themselves; and it in no sense detracts from his merit to affirm that even if Cannizzaro had not perceived the truth, the rapidly accumulating mass of evidence would have forced others to recognise it. Indeed the substantial unanimity with which Cannizzaro's doctrine was received, immediately that it became generally known, is a proof that the time was ready for it. It is not too much to say that its effect on the minds of chemical thinkers was as profound as that described by Cannizzaro himself in the memorable lecture before alluded to, when he reminded us of Thomas Thomson's account of the impression produced upon him by Dalton's own verbal explanation of the atomic theory. To paraphrase his words: they were enchanted with the new light which burst upon their minds, and saw at a glance the immense importance of such a theory.

Hence then, when Cannizzaro visited this country in 1872, to deliver the Faraday Lecture to the Fellows of the Chemical Society, of which he has been a Foreign Member since 1862, he spoke to willing and receptive ears, and to a body of men to whom his doctrine was already an established article of their chemical creed.

Cannizzaro is a Foreign Member of many learned Societies; nearly every Academy in Europe, indeed, has delighted to honour him. In 1889 he was elected a Foreign Member of our Royal Society, and two years later he was awarded the Copley Medal for his services to chemical theory. May he long be spared to wear the many honours he has so worthily earned, and to enjoy, in health and increasing prosperity, the respect and esteem of a multitude of friends in both hemispheres!

T. E. THORPE.

EXPERIMENTAL RESEARCHES ON THE PHYSIOLOGY OF REPRODUCTION.

Die Bedingungen der Fortpflanzung bei einigen Algen u. Pilzen. Von Dr. Georg Klebs, Professor in Basel. Mit 3 Tafeln u. 15 Text-figuren. (Jena: Gustav Fischer, 1896.)

IT has long been recognised that in the life cycle of a large number of plants and also of some animals two very distinct modes of reproduction, the sexual and the asexual, recur in a rhythmical fashion.

This fact, crystallised by Steenstrup in his famous doctrine of alternation of generations, has ranked as one of cardinal importance in the treatment of the higher groups of plants ever since Hofmeister showed that the sequence of events in their several life-histories was essentially identical with that obtaining in a moss or in a fern. True it is that in respect of algæ and fungi there existed an uncomfortable *arrière pensée* that all was not quite right, and indeed certain facts seem to be definitely opposed to the general extension of the doctrine to the various members of these classes. Curiously enough it seems not at once to have been clearly apprehended that one has hardly any right to expect to find alternation recurring regularly in these primitive forms; for the very characters which we regard as indicative of primitiveness consist exactly in those negative conditions implied in an, as yet, undeveloped state of division of labour. But it is obvious that, before alternation could possibly have become part of the regular physiological (and