metallurgical science. In such cases as this we think it would be wise to read the paper and then postpone discussion until the next meeting; or, by preference, to have the paper printed in the Journal of Proceedings, and at a meeting subsequent to its appearance call for discussion. It would appear evident that the interior of the pieces of scrap had a lower melting-point than the exterior parts which formed the shells obtained, and the explanation of the variation in melting-point was the point requiring consideration. Liquation of the elements is naturally the first suggestion, but this only shifts the uncertainty, for liquation is itself an obscure matter. Mr. Snelus would explain the matter by decarbonization at the surface, which would render the interior parts more easily fusible. He had, in raking out a furnace, found pigs of which only the outer skin remained as metal, the case thus formed being filled with graphitic carbon. Mr. Galbraith attributed the phenomenon to the surface of the metal pieces having absorbed an infusible oxide when at a high temperature. There was, however, more in the circumstances described than the meeting was prepared to explain off hand, and it would be well if the discussion could be reopened at the spring meeting or brought on again by another paper.

The contribution of Mr. Massenez was in many respects the most valuable of the meeting. It is a pleasing thing to see a foreign steelmaker putting his experience so unreservedly at the disposal of his English fellow-workers, and the thanks of the Institute are doubly due to the author for his valuable and practical paper. There is also an economic lesson in this matter, for the apparatus described owed its introduction to the German colliers' great strike of two years ago. Since then there has not only been a diminution in the amount of coal wrought, but the quality has also fallen off, so that the proportion of sulphur in the coal has much increased. This necessitated a desulphurization process, the method of which forms the subject of the paper. Manganiferous molten pig, poor in sulphur, is added to sulphuretted pig iron, poor in manganese; the result being that the metal is desulphurized, and a manganese sulphide slag is formed. The mixer in which the process is carried on is a large vessel in appearance, to judge by the drawings shown, like a converter. The apparatus in use at Hoerde will hold seventy tons of molten pig, but it has been shown that a vessel of about twice the size would be advisable. Details of the working are given by the author, and will be of great use to steelmakers working with phosphoric pig. In the discussion which followed several speakers bore testimony to the value of the invention, Sir Lowthian Bell intimating that a saving of 2*s*. 4*d*. per ton could be made by this method over the process of re-melting pig in the cupola; a step which has to be taken when it is desirable to combine the product of different blast furnaces. In the large mixer, metal from two or more furnaces can be brought together.

The only remaining paper was a contribution by Mr. B. Thwaite, in which particulars were given of the metallurgical department of the Sheffield Technical School, which was read in brief abstract by one of the clerical staff; after which the meeting was brought to a conclusion by the usual votes of thanks.

CARL WILHELM VON NÄGELI.

THE death of Carl Wilhelm von Nägeli, on May 10, 1891, removes the last survivor of that distinguished group of botanists who, side by side with zoologists such as Schwann and Kölliker, laid, half a century ago, the foundations of modern histology. The career of Nägeli is of special interest for the history of botany. During a period of fifty years he held a leading position in the advance of the science; and, while his activity began in the early days of Schleiden's predominance, his most recent work is in touch with those latest developments of biology which are connected with the name of Weismann. His work reached every side of the science. Systematic botany, morphology, anatomy, chemical and physical physiology, the theory of heredity and descent, as well as histology, all bear lasting traces of his influence.

Nägeli was born on March 27, 1817, at Kilchberg, near Zürich, and was the son of a country doctor. As a child he was devoted to books, but he soon showed a taste for natural history, which appears to have been in some degree inspired by his sister. His education as a boy was begun at a private school, of which his father was one of the founders, and was completed at the Zürich Gymnasium, where he did well. He then matriculated at the recently-established University of Zürich, with the view of studying medicine. As a student, he is said to have been strongly influenced by the "Naturphilosophie," as taught by Oken. He soon lost his taste for medical studies, and, owing to his mother's influence, was allowed to migrate to Geneva, where he devoted himself to the study of botany under De Candolle.

Nägeli took his doctor's degree at Zürich in 1840; his dissertation on the Swiss species of *Cirsium* was dedicated to Oswald Heer, and was his first contribution to that minute investigation of species which formed so characteristic a part of his life's work.

Subsequently Nägeli spent a short time at Berlin, studying, among other things, the philosophy of Hegel. A metaphysical tendency marks his writings all through life, and indeed favourably distinguishes his work from that of many less cultivated scientific writers; but Nägeli, in one of his later papers, expressly denies that he was ever himself an Hegelian.

Nägeli's next migration was to Jena, and here he came under the influence of Schleiden, by whom he was initiated into microscopic work. It was not long before the association of these two great men bore fruit. In 1844 appeared the first number of the *Zeitschrift für Wissenschaftliche Botanik* under the editorship of Schleiden and Nägeli. The connection of the former with the new venture was only a nominal one, and, indeed, all the papers but two are the work of Nägeli himself. The influence of Schleiden however, is manifest throughout, sometimes in an injurious degree, though the independence of Nägeli gradually asserted itself. To this brilliant, though short-lived publication we shall return presently. In 1845 Nägeli married, and on his wedding tour he spent a long time on the south-west coast of England, and there collected much material for his important work on "Die neueren Algen-systeme," published in 1847.

On his return to the Continent he became a *Privatdocent* at Zürich and lecturer at the veterinary school, and soon afterwards he was appointed Professor Extraordinarius. In 1850 his association with Cramer, so fruitful of good work, began. His colleague says of this time: "Es war eine schöne zeit! da wurden nicht bloss Staubfäden gezählt und Blattformen beschrieben; es ging in die Tiefe, ans Mark des Lebens!" It was the microscopic practical work with Nägeli which made the deepest impression on his distinguished pupil; his lectures, though clear and full of matter, do not appear to have been specially brilliant, but he possessed the highest qualification of a teacher in being himself a great maker of knowledge.

After declining a "call" to Giessen, Nägeli in 1852 became Professor at Freiburg im Breisgau, where most of the work was done for the "Pflanzenphysiologische Untersuchungen," published in conjunction with Cramer in 1855–58. In 1855 Nägeli accepted the post of Professor of General Botany in the new Polytechnic at Zürich; his work at this time was hindered by the temporary failure of his eyesight, owing to too much microscopic work.

In 1857 Nägeli was summoned to the Professorship of Botany at Münich, where King Maximilian II. was striving to render his capital as distinguished in science as it already was in art. This post Nägeli continued to hold to the time of his death. At first somewhat distracted from his original work by practical duties in connection with the organization of the institute and gardens, Nägeli soon resumed his proper activity, and continued for thirty years more to produce a magnificent series of researches on the most varied subjects. Unfortunately, Nägeli's work was excessive, and from the age of sixty onwards, his health began to suffer, so that he was ultimately compelled to give up teaching. An attack of influenza during the epidemic of 1889-90 seriously shattered his already failing strength, and from the effects of this he never completely recovered. He lived long enough to celebrate in great honour the jubilee of his doctor's degree, and thus to look back on half a century of continuous work for the advancement of science, a retrospect such as few savants can have enjoyed.[1]

Without attempting to give an adequate account of Nägeli's scientific work, a task which would far exceed both the limits of this article and the powers of the writer, some idea may be given of the salient points in his career as an investigator.

Nägeli's first histological paper, so far as we are aware, is on the development of pollen (1841). This already marks a de-

[1] The details of Nägeli's life are taken from the funeral address delivered by his colleague, Prof. Cramer, and published in the *Neue Zürcher Zeitung* for May 16, 1891.

cided advance on Schleiden's theory of free-cell formation, for Nägeli maintains that the special mother-cells are not formed directly around a cytoblast (nucleus) but around the whole granular contents, in the middle of which a free cytoblast lies. It was long, however, before Nägeli completely freed himself from the influence of Schleiden's histological theories. It is interesting that in this paper he described and clearly figured the two nuclei in the pollen-grain of an Œnothera, though he did not know that this was a constant phenomenon. The importance of this observation was not appreciated until Elfving, Strasburger, and Guignard, investigated the subject in our own day.

Nägeli's "Botanische Beiträge" contributed to the volume of *Linnæa* for 1842, include some important papers. In those on the development of stomata and on cell-formation in the root-apex, he endeavoured to reconcile his own accurate observations with Schleidenian theories, and was thus led to oppose Unger, who had already recognized that vegetative cell-formation is a process of division. A paper on Fungi in the interior of cells is interesting, because the existence of such endophytic forms was at that time regarded as establishing a presumption in favour of spontaneous generation.

The *Zeitschrift für Wissenschaftliche Botanik*, 1844–46, is a very remarkable publication. It never got beyond its first volume, but it may be doubted whether any book of its size has been more important for the progress of the science. Nägeli's introductory paper, "Ueber die gegenwärtige Aufgabe der Naturgeschichte, insbesondere der Botanik," is very metaphysical in tone, and is not free from a certain youthful pedantry. Great stress is laid on the absolute difference of species—a conception which, as Nägeli tells us in one of his later works, did not prevent his believing even then in the origin of species by descent. The study of development is treated as a philosophical necessity, and anatomy, or the study of *mature* structure, is denied to be a science. This is perfectly just; no one did more for anatomy than Nägeli himself, but he recognized that it only becomes scientific in union with development and physiology. He further insists that the knowledge of development as a whole is the only sound basis for classification—a principle which still remains to be carried out. The highest importance is attached to the cell theory, which was expected to do as much for botany and zoology as mathematics had done for physics, or atomic formulæ for chemistry—an expectation which cannot be regarded as unjustified. Nägeli severely criticized the theories then current, according to which cell-formation is a process of crystallization. Some of the most doubtful of his own later generalizations, however, were affected by the same source of error—namely, too great eagerness to find a simple physical explanation for biological phenomena.

Nägeli, in this paper, devotes much space to the distinctions between animals and plants. He decisively rejects the idea of a transition between the two kingdoms, on the ground that this would contradict the "Absolutheit der Begriffe"—an argument which now seems strangely out of place in natural science.

The whole paper is of great interest as showing the point of view from which biological questions were regarded at that time by a brilliant and philosophical naturalist just entering on his life's work.

The two papers in the *Zeitschrift*, on the nuclei, formation and growth of vegetable cells (1844 and 1846), are of the greatest importance to histology, finally establishing the constant occurrence of cell-division as the one mode of vegetative cell-formation. This conclusion was only reached in its completeness in the second of the two papers. Although Unger's and Mohl's views of the details of the process were in some respects the more correct, still Nägeli established the main facts of the division of the nucleus and of the cell on a broad basis of observation. These papers, as well as one on the utricular structures in the contents of cells (nuclei, nucleoli, chlorophyll granules, &c.) were translated by Henfrey for the Ray Society, to the great benefit of English students, as the writer of this article can testify.

In the same journal there are several algological papers, the most important of which is the complete and admirable account of *Caulerpa prolifera*, the extraordinary histological structure of which and its relationship to the other Siphoneæ Nägeli already thoroughly understood. It is interesting that in this paper he describes both the cell-wall and the cellulose rods as growing by apposition, a view to which we have now returned, owing to the observations of Strasburger and Noll, in opposition to Nägeli's own later theory of intussusception propounded in 1858.

The paper on *Delesseria hypoglossum* contains an elaborate account of the cell-divisions by which the thallus is built up. Nägeli here characteristically attributes great importance to the introduction of ideas of absolute mathematical form into physiology and systematic botany.

The discovery of spermatozoids in the Ferns is one of the most important recorded in this volume. The essential points in the structure and development of the antheridia are described rightly, and the movements of the spermatozoids very accurately traced. Nägeli calls attention to the nuclear reactions of the substance of the spermatozoids. He demonstrates the homology of these bodies with those of the mosses and Chara and of animals. Nägeli was at that time necessarily completely in the dark as to the relation of the spermatozoids to spore formation, for the archegonia and the process of fertilization were first discovered by Suminski four years later.

Among other papers of fundamental importance may be mentioned that on the growth of mosses, in which the apical cell-divisions and the development of the protonema are clearly made out; that on the growth of the stem in vascular plants, a work which laid the foundation of our knowledge of the distribution of vascular bundles, and that on the reproduction of the Rhizocarps. This last is especially interesting. It is directed, though very cautiously, against the Schleidenian theory of fertilization as applied to these plants. It is singular how this theory, according to which the end of the pollen-tube, after penetrating the embryo-sac, itself became the embryo, took possession of the minds of botanists at that time, and led sometimes to the strangest confusions, sometimes to a chance recognition of homologies, which could only be legitimately proved at a later period of research. In the case of the Rhizocarps, the Schleidenian theory assumed that these plants were really Phanerogams. Hence we find that he and Nägeli agree in calling their microspores pollen-grains, their microsporangia anthers, their macrospores embryo-sacs, and their macrosporangia ovules, a terminology which very nearly expresses out present view of their homologies as established by Hofmeister. Nägeli discovered the spermatozoids of these plants as well as the prothallus and archegonia, but he shows the greatest reserve in correcting Schleiden's extraordinary mistakes.

It is worth remarking that at this early period the homology of pollen-grains with spores was generally admitted, and at first we wonder how this true result could have been arrived at so prematurely. Here again the Schleidenian theory affords the explanation. The pollen-grain was regarded as a spore, which on germination produced the embryo-plant, not as do the spores of Cryptogams in the open air, but within the embryo-sac of the ovule. This conclusion was of course strengthened by a more legitimate argument drawn from a comparison of the mode of origin of pollen-grains and spores.

A less fortunate result of the same theory appears in a paper in the *Zeitschrift*, "Ueber das Wachstum und den Begriff des Blattes." Nägeli here erroneously attributes to the stem and its branches an endogenous origin. That this holds good for the *primary* axis, he proves by stating that it is derived from the pollen-grain, which itself arises endogenously within the anther.

We have dwelt long on this *Zeitschrift*, as it affords a remarkable insight into the state of botanical questions during the earlier part of the most brilliant period of progress which the science has known. The very name, *Journal for "Scientific" Botany*, is characteristic, expressing the somewhat arrogant claims of the enthusiastic naturalists of the new school of that day.

The next period in Nägeli's career is marked by the publication of two important algological works: "Die neueren Algensysteme und Versuch zur Begründung eines eigenen Systems der Algen und Florideen," 1847, and "Gattungen einzelliger Algen," 1849. It cannot be said that Nägeli was altogether happy in his generalizations on algological subjects, though his special work was often of the greatest value. At that time he included the Lichens among the Algæ and excluded the Florideæ. The Algæ in his sense were distinguished from the Fungi, not only by the presence of chlorophyll and starch, but also by the absence of spontaneous generation, while they differed from the Florideæ and all the higher plants in being destitute of sex. The Florideæ, on the other hand, he regarded as sexual and as closely allied to the Mosses. He recognized their antheridia as the male organs, but regarded the tetraspores as the product of a female organ.

on account of their superficial resemblance to the spore-tetrads of the higher Cryptogams. The carpospores, which are the real sexual products, he regarded as gemmæ like those of *Marchantia*, with the *cups* of which he compared the cystocarps. Such views were excusable at that time, but Nägeli, as we shall see, adhered to them later on with excessive pertinacity.

Nägeli was perfectly acquainted with the conjugation of Desmids and Zygnemaceæ and imperfectly with the fertilization of Vaucheria, but he imagined that these processes were too inconstant to be regarded as sexual.

Nägeli was at that time much more successful in dealing with the vegetative organs of the Algæ, and he rightly protested against the generalization current down to our own day, that all Algae are destitute of leaves.

His conviction that the Algæ are without exception sexless led him in 1849 to reject Decaisne and Thuret's discovery of the spermatozoids of Fucus, which he regarded as spores. Of his later algological papers, the most important is that on the Ceramiaceæ, published in 1861. In this the procarpia and trichogynes, the true female organs, are described and accurately figured; but Nägeli failed to recognize their true nature, and still maintained his old view of the sexuality of the tetraspores. The whole credit of the discovery of the real state of the case thus belongs to the French botanists Thuret and Bornet.

The "Pflanzenphysiologische Untersuchungen" of Nägeli and Cramer (1855–8) contain among other papers of importance Nägeli's huge work on starch grains (about 600 quarto pages!), which is of great general value as embodying his views on the growth of starch and cell-wall by intussusception and on the molecular structure of organized bodies. For many years this micellar theory, as it was afterwards called, was regarded as Nägeli's greatest achievement. Sachs, in 1875, said in his "History of Botany": "Nägeli's molecular theory is the first successful attempt to apply mechanico-physical considerations to the explanation of the phenomena of organic life." More recent research has shown that this attempt, like its predecessors, was premature, and though Nägeli's ingenious and carefully elaborated hypotheses must still arouse our admiration, we can scarcely now regard them as having added much to our knowledge either of the growth or structure of organized bodies. The book on "Starch Grains," however, quite apart from theoretical considerations, will always remain a marvellous monument of research. It contains a vast mass of systematic and descriptive matter in addition to the speculations which have made it famous. The micellar theory was further developed in subsequent papers "on the behaviour of polarized light towards vegetable organisms" (1862); "on crystalloid protein bodies" (1862); and "on the internal structure of vegetable cell-membranes" (1864). It is presented in its perfected form in the important work on the microscope, published by Nägeli and Schwendener in 1877.

The papers in the "Physiologische Untersuchungen" bear the name of Nägeli or of Cramer respectively, but it appears that they mutually assisted each other throughout; hence it is not out of place to mention here Cramer's fine researches on the apical growth of Equisetum, which to this day serve as a model (rarely approached) for all such investigations.

No sooner were these investigations with Cramer completed than another great undertaking was commenced in the publication of the "Beiträge zur Wissenschaftlichen Botanik" (1858–68). This began with the great paper "On the Growth of Stem and Root in Vascular Plants and on the Arrangement of the Vascular Bundles." This is the most important of Nägeli's purely anatomical works, and is of the greatest permanent value. It is not too much to say that the bulk of our knowledge of the distribution of vascular tissues in plants still depends on this work. Other valuable papers in the "Beiträge" are those on the use of the polarizing microscope, on the growth in thickness of the Sapindaceæ (another ideal pattern of anatomical research), and on the origin and growth of roots, in which last Leitgeb cooperated. Until the quite recent work of Van Tieghem and Douliot, this was undoubtedly the most important investigation on the subject.

Among Nägeli's later works there are two which have had a lasting influence on our views as to the biology and physiology of the simplest plants. In "Die niederen Pilze" (1877) he treats of moulds, yeasts, and bacteria in relation to infectious diseases and hygiene. In this work an excessive scepticism is displayed as to the existence of definite species among the lowest organisms, such as bacteria. There is no longer any doubt that species are neither more nor less distinct among these simple beings than among the higher plants, but Nägeli did a real service in showing that each of these species may appear in a number of morphologically and physiologically different forms.

Nägeli's "Theorie der Gährung" (1879) demonstrated the relation between the processes of fermentation and respiration, and established the modern view of fermentation, according to which, to use the words of Prof. Vines, "living protoplasm, besides undergoing decomposition itself, can induce decomposition in certain substances which are brought within the sphere of its influence."

It remains to consider briefly an aspect of Nägeli's work, which is from some points of view the most interesting of all—namely, his relation to the theory of descent. The elaborate observations on variable species, especially in the genus *Hieracium*, which Nägeli carried on throughout his whole life, side by side with his histological and physiological work, specially qualified him to take up an independent position with reference to the problems of evolution.

In his paper "Die Entstehung und Begriff der naturhistorischen Art" (1865), Nägeli for the first time discusses this question in the light of Darwin's work. His belief, however, in the origin of species by descent was no new thing, but had been tacitly held by him throughout his whole scientific career, and had been definitely expressed in his paper on individuality in Nature, published in 1856. In his work of 1865 he gave an admirably clear exposition of natural selection, but was unable to accept it as affording a sufficient explanation of evolution. He believed that variation has a definite direction, always tending towards the greater complexity and perfection of the organism (Vervollkommnungstheorie). On this view the development of the race, like that of the individual, has a definite course assigned to it beforehand. He protests that there is nothing supernatural involved in this doctrine, and that it does not necessarily require *sudden* transformations. On this latter question, however, he speaks very uncertainly, and states that transitions between certain morphological types appear to be unthinkable and impossible. One seems to catch here an echo of his older teaching about the "Absolutheit der Begriffe."

The perfecting process, he says, knows no rest; hence all plants would have become Phanerogams by this time were it not that spontaneous generation takes place at all periods. Thus the flowering plants of our own day have, on this view, the longest family history, and trace their descent from the first-formed "Urzellen," while the vascular cryptogams had a somewhat later origin, and have, consequently, not had time to advance so far, the mosses again arose more recently still, and so on with all the groups of plants. According to this singular hypothesis, there is no actual blood relationship between the higher and lower forms of any one epoch. They have had a similar but not a common origin. This remarkable, but, as it seems to us, retrogressive theory was maintained by Nägeli to the close of his career.

But, whatever view may be taken of this speculation, it must be admitted that Nägeli saw clearly the great fact—since brought home to us by the works of Weismann and his school—that the causes of variability are internal to the organism. This important doctrine, based on original experiments and observations, is maintained in a paper entitled "Ueber den Einfluss äusserer Verhältnisse auf die Varietätenbildung im Pflanzenreiche" (1865). He shows that "the formation of the more or less constant varieties or races is not the consequence and the expression of external agencies, but is determined by internal causes"; while the modifications directly produced by external influences are inconstant, and do not give rise to varieties. We think it must be allowed that, on this essential point, Nägeli was at that time somewhat in advance of Darwin himself.

Other works of that period deal with the laws affecting the distribution of species, and with the phenomena of hybridization. In the "Theorie der Bastardbildung" (1866) the peculiarities of hybrids are explained as due to the favourable or unfavourable changes produced by crossing, in the internal coadaptation of the organs of the offspring.

A paper on the social origin of new species (1872) results in the conclusion that groups of new forms are likely to arise simultaneously, rather than isolated new species.

Finally, something must be said of the great work published in 1884, "Die mechanisch-physiologische Theorie der Abstammungslehre," which states at great length Nägeli's final conclusions as to evolution and heredity. The fundamental idea of this weighty work is the conception of the Idioplasm, namely, of a definite portion of the general protoplasm, to which alone is committed the transmission of hereditary characters. This idea, as Weismann points out, is a fruitful one, and will live, and is indeed incorporated in all recent theories of heredity. Nägeli's speculations, however, as to the details of the distribution and molecular structure of this idioplasm are of much more doubtful value, and rest on no firm basis of actual observation.

Nägeli rightly argues that the character of the fertilized egg must be determined by a minute amount of idioplasm and not by the cytoplasm generally, because the characters of the male and female parent are on the average equally represented in the offspring in spite of the enormous difference in the bulk of the cytoplasm of spermatozoid and ovum.

It was only, however, after the idioplasm had been identified by Weismann and Strasburger with a definite constituent of the nucleus that the theory acquired a positive basis.

Nägeli in the "Abstammungslehre" points out that fertilization can only consist in the direct union of solid idioplasmic bodies, and thus on theoretical grounds arrives at a conclusion which has been fully confirmed by the observations of Van Beneden, Strasburger, and Guignard. He also shows that while in the higher organisms idioplasm alone is necessarily transmitted from parents to offspring, in the increase of the lower plants and animals by division, the descendants acquire a share of the nutritive protoplasm also. Hence in the latter the conditions of culture may directly affect the descendants, as Nageli found in his observations on bacteria. These views are in essential agreement with those of Prof. Weismann on the continuity of the germ-plasm, as brought forward a year later, though on other points there is a wide divergence of opinion.

Nägeli insists in his preface to this book, that the subject of heredity can only be authoritatively treated by a physiologist, and he no doubt regarded his micellar theories as an important contribution to the question. In this his view is somewhat one-sided, and as a matter of fact all recent advance in our knowledge of the essential points in reproduction has come from the morphological side.

Nägeli's attitude towards the question of spontaneous generation is interesting. In his early days he had no doubts as to the spontaneous origin of many Fungi, and thought that this could be experimentally demonstrated. In 1865 he gave up the experimental evidence, but believed in the origin *de novo* at all epochs of simple vegetable cells. In the "Abstammungslehre" he still maintains that spontaneous generation is constantly in progress, but no longer holds that even the lowest known organisms can arise in this way. His supposed primitive living things (*Probien*) are as much more simple than bacteria, as these are more simple than the highest animals or plants.

As regards the causes of evolution, Nägeli in his great work appears to limit the field of natural selection even more narrowly than in his earlier essays. Its function, according to his later views, consists in the separation and definition of races by the elimination of ill-adapted forms, rather than in determining the origin of the races themselves. In a brilliant illustration he pictures natural selection as pruning the phylogenetic tree, though powerless to cause the putting forth of new branches. He still regards evolution as a necessary progress towards perfection determined by the constitution of the organism itself, and more especially of its idioplasm.

This view is only needed if we assume with Nägeli the existence of purely morphological characters—of characters, that is, which are not, and never have been, of the nature of adaptations. It appears to us to have been sufficiently shown by Prof. Weismann and others that the existence of such characters is an unnecessary assumption. As biology advances, we learn every day the function of characters which had before appeared to us to be useless, and the whole tendency of investigation is to prove that all characters whatsoever are either of direct use to their present possessors or have been inherited from ancestors, to whom, at the time when they were acquired, they were equally advantageous. It would be difficult to cite a stronger instance of a "morphological character" than the alternation of generations which so clearly characterizes the higher cryptogams. Yet it has been lately shown by Prof. Bower that this may well have been an adaptive character at its first origin, the sporophyte being adapted for taking possession of the dry land, while the oophyte, owing to the mode of fertilization, was compelled to retain a lowly and semi-aquatic habit.

We have given a very incomplete and imperfect sketch of the life-work of one of the most illustrious of that illustrious band of botanists to whom the chief advances of our science are due. Much of his work has of necessity been left quite unnoticed. But on even a cursory glance through the writings of Nägeli the conviction is forced upon us that he was a man not only of exceptionally wide scientific and philosophical training and of great literary power, but also one of real genius, and as far removed as possible from that narrow specialism which is the besetting sin of so much modern scientific effort. The judgment of Nägeli's colleague, Prof. Cramer, that he was "a truly great man," cannot be dismissed as the exaggerated language of personal affection, but expresses a truth. Though some of his theories may be abandoned, a vast sum of permanent achievement will always remain, and the influence of Nägeli on the future of our science will be powerful and lasting.

D. H. SCOTT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Full term commences on Saturday, October 17. The following lectures in science generally have been advertised:—

The Savilian Professor of Geometry (J. J. Sylvester) will lecture on surfaces of the second order, illustrated by the models with which that department has been supplied at the request of the Professor.

The Professor of Astronomy (Rev. C. Pritchard) proposes to lecture on the methods of determining astronomical constants, and offers practical instruction with the transit circle and solar spectroscope.

Rev. Bartholomew Price (Sedleian Professor of Natural Philosophy) lectures on hydromechanics.

The Professor of Experimental Philosophy (R. B. Clifton) will lecture on electricity; and instruction in practical physics is offered by Mr. Walker and Mr. Hatton at the Clarendon Laboratory. Lectures on mechanics and experimental physics are offered by Rev. F. J. Smith, at the Millard Laboratory.

The Waynflete Professor of Physiology (J. S. Burdon-Sanderson) will lecture on the subjects required for the final examination in the School of Physiology, and Mr. Dixey will lecture on histology. Practical instruction on this latter subject will be given by Mr. Kent.

In the subject of Chemistry, the Waynflete Professor (W. Odling) will lecture on animal products, while the Aldrichian Demonstrator (W. W. Fisher) will give a series of lectures on the non-metallic elements. Mr. J. Watts lectures on organic chemistry, and the instruction in practical work is under the supervision of Mr. Watts, Mr. Veley, and Mr. J. E. Marsh.

The Deputy Linacre Professor of Human and Comparative Anatomy (E. Ray Lankester) offers a course of lectures on comparative anatomy and embryology. This course is intended for seniors. There will also be a junior course for beginners and candidates for the preliminary examination in animal morphology conducted by the Deputy Linacre Professor and Dr. W. B. Benham. This last-named gentleman will also lecture on the Chætopoda.

The Professor of Geology (A. H. Green) offers two courses of lectures, one on physical, the other on stratigraphical geology.

The Reader in Anthropology (E. B. Tylor) will lecture on the origin and development of language and writing.

The Sherardian Professor of Botany (S. H. Vines) lectures, this term, on elementary botany.

The Hope Professor of Zoology (J. O. Westwood) lectures and gives informal information upon some of the orders of Arthropoda.

In the department of medicine, Sir H. W. Acland, Bart., gives informal instruction on modes of medical study. This instruction is given at the Museum, where arrangements will be made for one or more demonstrations in illustration of subjects bearing on public health. Dr. Collier and Mr. Morgan give demonstrations for the Professor on Medical and Surgical Pathology. The Lichfield Lecturer in Clinical Medicine (W. Tyrrell Brooks) will lecture on the physical signs of disease, and the Lecturer in Clinical Surgery (A. Winkfield) offers instruction on the treatment of fractures, &c.

The Lecturer in Human Anatomy (A. Thomson) offers a