while, at the point of growth in the root, only leucoplastides are to be seen. Moreover, in following the plastides farther back, he found them present in the seed itself; and this he conjoins with the well-known fact, that chlorophyll-granules are to be found ready formed in certain seeds.

The destiny of the plastide depends upon the tissue which is to be developed from the meristem. Some of them remain colorless, that is, as leucoplastides, and serve to produce starch-grains at the expense of assimilated matters; others become chloroplastides to produce assimilated matter; while still others are to furnish colors to flowers and fruits. This simplest of all organs is therefore capable of wide metamorphosis, by which it becomes fitted for its diverse functions.

Nor is this all. The same plastide can become at different stages of its life a leuco-, a chloro-, and a chromo-plastide. But which of these is the primal form? To this the author answers unequivocally, the chloroplastide; and he believes that the others have all been derived therefrom. Reserving some of the other features of this suggestive paper for another notice, it may be said that the terms proposed by Schimper are quite equivalent to those given by Van Tieghem in his Botany, now in course of publication, as *leucites* and *chloroleucites*, and, in part, to his *xantho-leucites;* but, so far as their development is concerned, the latter author follows the accepted view of Gris. G. L. GOODALE.

LETTERS TO THE EDITOR.

Molluscan rock-boring.

IN giving lectures upon building-stones my attention has been often called to the action upon them of boring mollusks, echini, annelids, sponges, etc., when used in submarine constructions.

In Albany Hancock's paper on the above subject (*Ann. mag. nat. hist.*, (2), ii. 225, pl. viii.), are figured numerous siliceous grains, found about the foot and mantel, which he regarded as secreted by the mollusk, and employed in excavating the burrow. While Hancock's conclusions are generally denied, I have not seen any explanation of the observed particles. The forms figured by him, especially in fig. 6, resemble the grains (principally quartz) observed in the microscopic study of mud and other earthy deposits. Such grains would naturally be the result and not the cause of the rock excavation; and it is difficult to see how the animal could be in the position in which it is found, without their presence about it.

Perhaps some zoölogist can state if this explanation has been given before, and whether it be correct or not. M. E. WADSWORTH.

Cambridge, Mass., April 30, 1883.

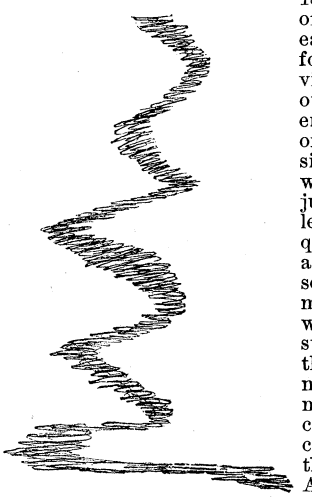
The Lake Superior rocks.

Prof. N. H. Winchell is evidently right in saying, in SCIENCE, No. 12, that, in my letter in No. 5, I misrepresented his position on the unconformity in the St. Croix valley. I had said that he had strenuously denied this unconformity, because my recollection of a conversation on the subject, held with him in 1880, was to that effect. But, on turning to the reference he gives in his First annual report of the geological survey of Minnesota, I see that he had announced such an unconformity as long ago as 1872, which, of course, I should have known before; so that I must have misunderstood him.

As to the other matter, — viz., the relation of the 'St. Croix' or Potsdam sandstone of the Mississippi valley to the 'eastern sandstone' of Lake Superior, — I certainly have understood from his various reports, that he regarded them as distinct. But I am very glad to be set right on these points, though regretting very much having misunderstood Professor Winchell; for it narrows down the question at issue between us very materially. R. D. IRVING.

Track of meteor.

In your first number, Feb. 9, 1883, I saw an account of a meteor witnessed by Capt. Belknap of the U. S. S. Alaska, Dec. 15, 1882, and reference to a similar phenomenon seen at Lake Winnipeg June 29, 1860. On the evening of June 17, 1873, in early twilight, and before any stars were visible, upon coming out of my hotel in Vienna, I found a crowd of persons watching a similar phenomenon, which appeared to be just north of the Kahlenberg. Upon inquiry, I learned that a meteor had been seen to fall a few moments before, but without noise; and a subsequent watch of the daily papers gave no account of any meteorite, which could hardly have escaped observation in this settled section of Austria. It would appear, therefore, that this meteor must have been entirely dissipated in vapor before reaching the earth.



When I first saw the luminous track, I at once supposed it, from appearance and color, to be the flame from a distant zinc-furnace; but it was gradually changed from its straight course to a curved line closely resembling fig. 3 in SCIENCE, No. 1, p. 5, and appeared to be borne to and fro by the gentle currents of air. It extended fully 30° from the horizon, and was distinctly visible for half an hour after my attention was first called to it. From a letter sent by me the next day to a friend in this country, the above facts are taken, in which letter I roughly sketched the appearance of the luminous cloud, after a few minutes from the fall of the meteor, as shown by the accompanying cut. PETER COLLIER.

AUGUSTUS DE MORGAN.

Memoir of Augustus de Morgan; with selections from his letters. By his wife, SOPHIA ELIZABETH DE MORGAN. London, *Longmans, Green, & Co.*, 1882. 10, 422 p., portr. 8°.

IF the degree of interest which attaches to the life of a hard-working mathematician is, from the nature of the case, less than strong; if the biography of De Morgan is in this respect in marked contrast to that of a man whose life is a picture of his time, and who has had himself a distinct effect upon his time, — to the life, say, of Harriet Martineau, which was included within nearly the same years as the life before us, — it is none the less true

that the record of an eminent scientific man, his nature and his nurture, and his way of regarding the important questions of his day, is material which one would not willingly have lost. The present memoir disclaims being written from a scientific point of view; and it does not, in fact, furnish ground for modifying the very just estimate of De Morgan which is given by Mr. Jevons in the Encyclopaedia britannica. Nor is it, on the other hand, a very personal memoir. The letters are nearly all addressed to scientific friends, and are on questions of general interest. His correspondence with his wife and children, from whom he was seldom separated, was fragmentary, and not suited for publication; and, with respect to domestic details, his biographer has done what she knew her husband himself would have wished. He was always averse to making known what nearly concerned his family.

De Morgan was born in the year 1806, at Madura, in the Madras presidency. His father, Col. John De Morgan, was in the service of the East India Company; and both his grandfather and his great-grandfather had served under Warren Hastings. His mathematical powers, as well as his taste for music, he derived from his mother, who was the granddaughter of James Dodson, author of the *antilogarithmic canon*, a friend of De Moivre, and an early fellow of the Royal society. Soon after De Morgan's birth, the family returned to England, and settled first at Worcester. The young Augustus was indoctrinated in various branches of 'general knowledge' in many different private schools, after having learned reading and numeration from his father at the age of four years. His estimate of the character of the instruction which he received appears, from his belief in after years, that, of exceptional children, those who are least taught have the best chance of a healthy development. One element of his early teaching — the formal observances and the rigid religious doctrines in which he was trained — strongly tinged his character in after life. He was made to learn by heart long passages of Scripture, which, from frequent repetition, had become meaningless to him; he was taken to church twice in the week and three times on Sundays, and required to give an abstract of every sermon he heard, until church became a place of penance to him, and Sunday the one wretched day of the week. In after years he was unable to listen for any length of time to speaking or preaching: to get rid of memories of dreary sermons, he had to think of something different from what was being said.

Until after the age of fourteen, he had shown rather less than the usual aptitude for mathematics. He said one day to an old gentleman, a friend of the family, who saw him making with great care a figure with ruler and compasses, that he was 'drawing mathematics.' From him the future mathematician learned, greatly to his surprise, that he had hitherto missed the aim of Euclid, and that geometry does not consist in drawing accurate figures; and he was soon intent upon the first demonstration of which he ever understood the meaning. From that time his progress was rapid. At the age of sixteen he entered Trinity college, Cambridge; and in his second year his tutor writes, "He is not only in our first class, but far, very far, the first in it." Airy, Peacock, and Whewell were among the teachers whose instruction he particularly prized, and with whom he kept up a life-long friendship and correspondence. In 1827 he took the degree of fourth wrangler only, his wide mathematical reading having led him too often far away from the courses prescribed for examination; and to the bitter disappointment of his mother, who had hoped to see her oldest surviving son in the church, he came up to London soon afterwards, and entered at Lincoln's Inn. In London he made the acquaintance of William Frend, whom he describes as a man of singular directness and clearness of mind, a clergyman of the church of England, and a member of the old Mathematical society, who rejected negative quantities and the doctrine of the Trinity. In his house he became a frequent guest; and his children were surprised to find that this brilliant young man, of whom great things were expected in science, rivalled them in love of fun and fairy-tales and ghost-stories, and that he could even show them a new figure in cat's-cradle. It does not appear why so auspicious a beginning did not result in his marriage to Sophia Elizabeth Frend until ten years later.

The two great universities were closed to De Morgan on account of his strong repugnance to sectarian restraints on freedom of opinion; and hence he welcomed the opening of University college (called at first the London university), not only as meeting a great want of the time, but as offering to himself a prospect of leaving the study of law for a more congenial occupation. Out of thirty-two candidates, he was unanimously elected to the chair of mathematics, in spite of his being only twenty-one years of age. Three years later he handed in his resignation. The professor of anatomy had been removed on account of some complaints preferred against him by his class; and De

Morgan immediately addressed a letter to the council, saying that he considered it discreditable to hold a professorship one moment longer in a college in which a professor might be removed and disgraced without any fault on his part. His resignation was accepted; but, after five years of private teaching and voluminous writing, he returned to his university. The sudden death of his successor at the end of a summer vacation induced him to offer to fill the vacancy until Christmas; and his belief, that, owing to changes in the management, his former objections to holding office would not recur, led him to accede to the request of the council that he should permanently resume his chair.

De Morgan's life is chiefly a record of his labors and his publications. He gave regularly twelve lectures every week, besides occasional extra courses; and for half an hour after each lecture he remained in his place to give personal assistance to those students who needed it. This, with an hour for correcting exercises, made four hours of solid work for each day in the week, without counting the time required for preparation. As a lecturer, he showed unrivalled skill. Mr. Sedley Taylor writes, "His exposition combined excellences of the most varied kinds. It was clear, vivid, and succinct; rich, too, with abundance of illustration, always at the command of enormously wide reading and an astonishingly retentive memory. A voice of sonorous sweetness, a grand forehead, and a profile of classic beauty, intensified the impression of power . . . which he made upon his auditors." He had a great hatred of cram, and no confidence in the power of an examination to determine the true value of a student's knowledge. "The claims which college examinations might be supposed to have on the studies of his pupils were never allowed to influence his programme in the slightest degree." He wrote the following in illustration of a Cambridge examination: —

Q. — What is knowledge?

A. — A thing to be examined in.

Q. — What must those do who would show knowledge?

A. — Get up subjects, and write them out.

Q. — What is getting up a subject?

A. — Learning to write it out.

Q. — What is writing out a subject?

A. — Showing that you have got it up.

The list of De Morgan's publications is a very long one. Much of his writing was of a kind which it is extremely useful to have done at the time and to have well done, but which is not destined to be preserved, and which it is more economical to extract from a man of less than De Morgan's ability. He wrote one-sixth of the Penny cyclopaedia, and he made voluminous contributions to the Journal of education, the British almanac and companion, the Dublin review, Notes and queries, the Athenaeum, the insurance journals, and to the memoirs and obituary notices of the Astronomical society, in whose affairs he took an active part for thirty years. His most important contributions to science are his papers on the Foundations of algebra and on the Syllogism, his text-books on Formal logic and on the Calculus, and his treatises in the Encyclopaedia metropolitana on the Calculus of functions and the Theory of probabilities.

Such an amount of labor left very little time for pleasure or relaxation; and, in fact, De Morgan writes near the end of his life, "I have never been hard working, but I have been very continuously at work. I have never sought relaxation. And why? Because it would have killed me. Amusement is real hard work to me." He had, however, an interesting circle of friends, who came frequently to his house, and in whose society he found great pleasure. Libri (the author of the History of mathematics), Arthur Hugh Clough, Miss Muloch, and Mrs. Follen the abolitionist, were among them. Throughout his life, also, he was an inveterate reader of novels, good and bad. Puzzles, and even puns, were interesting to him. He made a collection of over eight hundred anagrams on his own name; and his fondness for paradox was so well known that the circle-squarers all sent him their most curious investigations. He was a thorough believer in the phenomena called spiritual. After describing some striking occurrences in spirit-rapping, he writes, "I was perfectly satisfied that some thing, or some body, or some spirit, was reading *my thoughts;*" and in regard to mesmerism, "Of the curative powers of this agent I have no more doubt than one has of things which he has constantly seen for years." His feelings on the subject of slavery were very intense, and he sat up the greater part of one night to finish Uncle Tom's cabin.

De Morgan presents another instance of the fact that a man's views of women in general are seldom dissociated from the result of his observations upon the few women who stand nearest to him. His clever wife had the effect of dispelling the prejudices with which his rather narrow-minded mother had inspired him. She writes, "I must not conceal the fact, that, in the earlier part of his life, he held man-

like and masterful views of women's powers and privileges. Women, he thought, ought to have every thing provided for them, and every trouble taken off their hands: so the less they meddled with business in any form, the better. But these very young notions gave way, as he saw more of life, to wiser and more practical ones. He found that women were not utterly helpless; and his love of justice, combined with his better opinion of their powers, made him quite willing to concede to them as much as he would have desired for himself; namely, full scope and opportunity for the exercise of all their faculties. This was shown by his giving lectures gratuitously in the Ladies' college for the first year after its foundation, and by the interest he felt in the success of those brave women who first attempted the study of medicine."

De Morgan's letters are of a kind which it is very interesting to receive at the natural intervals at which they are written. When taken *en masse*, the logico-mathematical language in which they are couched, amusing in small doses, and their wit, excellent but monotonous, become wearisome. It is too much like sitting down to a continuous reading of the Budget of paradoxes.

In regard to his ideas on religion, De Morgan was always extremely reticent; but in spite of the disastrous effect of his early training, and in spite of his strong aversion to unfounded beliefs, he preserved a deeply religious tone of mind, and a firm faith in the Christian religion. At the same time, nothing could be more frank and uncompromising than the way in which he meets the renewed insistance of his mother, upon the occasion of the death of a sister to whom he was much attached, that he should renounce his freedom of opinion. His letter, if somewhat severe and untender, is still a splendid example of that strong rectitude of mind which was characteristic of him, and which did not permit him to gain any thing, even family harmony, at the cost of concealment.

The last years of De Morgan's life were years of disappointment and grief. The university in which he had labored with untiring energy until the age of sixty became once more impossible to him. The reiterated pledges of its founders and subsequent directors, that the essence of its being should be absolute and complete religious equality in every portion of its organization, were broken; and De Morgan could not lend his countenance to a less liberal or a more worldly line of policy. Upon the refusal of the council to appoint to the chair of mental philosophy and logic the Rev. James Martineau, who had been recommended by the senate on account of his wide reputation as a preacher of an unpopular sect, De Morgan once more handed in his resignation. A year later occurred the death of his second son, George, a young man of great mathematical promise, and one of the two first projectors of the present Mathematical society. From this time De Morgan's health and vigor were not what they had been; and after an attack of congestion of the brain, from which his recovery was slow, he died in 1871 of nervous prostration.

WHITE'S FOSSIL MOLLUSKS OF NORTH AMERICA.

A review of the non-marine fossil Mollusca of North America. By C. A WHITE. Washington, *Government printing-office*, 1883. 1, 144, 3 p., 32 pl. sm. f°. [Annual report U. S. geological survey, 1881–82, *separately paged.*]

No work is more useful to the biologist, whether his studies relate to recent or to fossil forms, than the collection and careful illustration of scattered material. In the book under consideration, Dr. White has produced for the student of mollusks, in either their recent or their paleontological relations, a much-needed and permanently valuable work of reference. Owing to their wide range, fecundity and accessibility, the class of mollusks included under his title are, all over the world, better known, more thoroughly studied, and more easily collected, than those of the sea. Hence it is to be expected that the material for learning what lessons they have to teach will be available for students much sooner with the land and fresh-water mollusks than with the marine species considered as a class. Publications such as this, perhaps more than any other single means, will serve to shorten the time which must elapse before such a condition of the science is reached. Stratigraphical paleontology will not be so much the gainer as biology in a wider sense, since the uniformity of lacustrine and fluviatile conditions interferes with that differentiation which makes of some groups of marine mollusks valuable indices of geological time.

Dr. White has brought together excellent figures of nearly all the species of the groups under consideration belonging to North American paleontology, from the oldest strata in which they are known, to and including the miocene tertiary. One doubtfully pliocene species is mentioned; but the fossils of the later marls, and such deposits as that of the Colorado