

the inequality in the inclination of the moon's orbit, and in the motion of her nodes. He determined with new accuracy the astronomical refraction from an altitude of 27° down to the horizon, where he found it to be $34'$; and he made a vast collection of observations on the planets, which formed the groundwork of Kepler's discoveries, and the basis of the Rudolphine Tables.

MINIATURE PHYSICAL GEOLOGY

THERE have appeared from time to time in the columns of *NATURE*, interesting and instructive letters on the subject of Miniature Physical Geology. May I be allowed to continue this subject, by pointing out a few streams which may be learnt during spare half-hours on Hampden Heath.

Not far to the east of this heath, there bubbles up a little stream, which, when the tide is low, flows for a considerable distance down the main before it reaches the sea. Small as it is, this offers an excellent miniature example of a large river, and from it several things may be learnt. In the first place the stream, when carefully watched, is seen repeatedly, and with more or less rapidity, to change its course. This is effected by the collection from some cause or other, of the main course of the stream against one bank; the result of which is that the bank is forced to recede, and, as it does so, it causes to be a shifting stage, and becomes a tiny cliff of greater or less relative height. This bank next seems to be rapidly undermined by the action of the stream, and the upper portions, now and again, topple over, with a little splash, into the water, in a manner which shows those who have travelled on the Mississippi are well acquainted. In this way a bold curve is formed, which increases in length down-stream.

In the meanwhile, on the opposite shore of the stream, sand is deposited, and, in the river, runs its way downwards, this position is left high and dry.

But, ere long, the deep water channel shifts, when rapidly, and without apparent cause—and the miniature river tends to resume its straight course; it recedes from its bank shifts, and soon a tract of comparatively level dry land separates these banks from the stream. After advancing, however, for a while in this direction, still it then forms a curve similar to the one described above, in some cases savings in the direction of its former course, until, by a continuation of the same process, a broad valley is formed, with beautifully marked river terraces on either side, showing the length of stages of the river on each occasion that it facilitates its bed.

In the middle of the stream sand islands are from time to time formed, partly by the depositing of the main channel on one side or the other; but, as nature has the sand of which they are composed become dry, then the treacherous stream commences the destruction of that which itself had produced.

This is exactly what is continually taking place in the Delta areas of most great rivers. In the Ford branch of the Amazon a large island (Parapetun Island) has, within the last quarter of a century, completely disappeared. The Rio Negro has advanced, and is now covered with a luxuriant vegetation.

During the repeated changes in the course of our miniature river, it is possible to watch the deposition of a layer of coarse sand on the partially-eroded surface of a bed of finer material, and it is interesting and instructive to notice how great a body of the coarse material is dragged along the bottom. Even in the most sluggish of my miniature streams the sand-grains might be seen rolling over and over each other as they travelled seawards.

In the next muddy flats of Pagwell Bay, I, on one occasion, had an opportunity of witnessing the formation

of that which is known on the Mississippi as a "sand-belt." The miniature stream here rushed in a great leap, and the flow of the water caused the coarse bodies to rush, the leap was gradually converted into a steady flow, and, the main stream flowing through the channel course, left a "sand-belt" later, which was in time almost completely shut off from the miniature river.

Perhaps one of the most interesting of these spare half-hours may be spent in watching the formation of deltas. Numbers of these miniature rivers form low ponds, which are miniature seas or lakes. I have seen one of the streams in the course of an hour or so a considerable bay, and push its delta far out to sea. The grains of sand, when they come to rest in the pond, form a slope of very constant angle, which, by a number of measurements, I found to be 40° for coarse sand, and 37° for fine sand, the average angle being 38° . By watching the advance of the delta, the formation of lake-beds may be seen in actual progress. But these ponds or miniature seas, which lie in dependence on the delta, offer a field for the study of marine deposition. The very sea, for instance, the waves advancing over a newly-formed delta, plunging off the upper portion, and forming the cliffs of delta material, but leaving the deeper part of the slope of the deposit bare.

Again, during gales and stormy weather one may see the formation of salt-currents. I remember watching with interest such a current, which flowed between the chalk cliffs through the straits which separated my miniature seas; the most interesting point being that the finer grains of sand at the bottom of the straits, when the water was gone; in other words, were rolling over and over in such a manner as to permit the entrance of a surface-current setting in the opposite direction to that in which the surface-current was flowing.

There are many other lessons which may be learnt—such as the formation of fan-deposits (similar to those so plentiful in the Rhine valley and elsewhere in Northern Italy), which are formed at the foot of the miniature chalk mountains that stand out from the sand; and the collapse of the sand ripples, or miniature sand dunes, by the strong current, consisting as it is of the way in which the tide has pressed Egypt from total obliteration by the material; but I have already occupied enough of your space.

My object in drawing attention to such matters of ordinary observation is to induce students of physical geology to go out and observe these things for themselves. It, after a thorough study of Lyell's "Principles," the young geologist will devote an hour's careful observation to miniature physical geology, with strict and test-bed in hand, he will find that his conceptions have a reality and a solidity which could not have been evolved in the study at home, while at the same time he will find it more easy to follow, when he shall have the opportunity, the workings of nature on a grander scale.

C. LEWIS MORRIS

TESTIMONIAL TO MR. DARWIN.—EVOLUTION IN THE NETHERLANDS

WE have great pleasure in printing the following correspondence:—

To the Editor of *NATURE*.

Sheets, February 20, 1877.

On the sixtieth birthday of your great countryman, Mr. Charles Darwin, in allusion with fifty photographs of his activities in the Netherlands, among whom are right-reverend Doctors and twenty-one University Professors, are presented to him. The album was joined a letter, of which you will find a copy here enclosed, with the names of Mr. Darwin.

I suppose you will like to give to both issues a place in your very estimable journal, and therefore I leave the honour to forward them to you.

F. HARTING,
Professor, University, Utrecht.

Utrecht, 6th February, 1877

SIR,—In the early part of the present century there existed in Amsterdam a physician, Dr. J. L. ERASMUS, who, in 1810, took his departure for Java, and passed the remainder of his life in the quiet part of India. His name, though little known outside this in the Netherlands, yet will deserve to be held in remembrance, those to consider an honourable place among the pioneers of the theory of development. Among his numerous publications on natural philosophy, with a view to this, are the following: "A popular and accessible account of the development of the vertebrate animals, as far as comparative anatomy can demand guidance." ("Philosophie der Organen des Thiers.") "On the Origin of the Species," and his treatise, "Over het nageen van kinship, of the kinship of the species." ("On the Origin of the Species.") The last of these appeared in 1810. The first, though written about the same time, was published in 1818, together with other papers more or less similar in tendency, under the title of "Wetenschappelijke en medische verhandelingen." ("Scientific and medical treatises.") "On the Origin of the Species," in these publications, we recognise Erasmus as a devoted adherent of the theory that the various modifications in which life manifested its successive lines originated each from the other. He deeply occupies the point of passage on which, shortly afterwards, Lamarck, with reference to the animal kingdom, and in its wide, broad, and fertile, with respect to the geological history of our globe, have taken their stand.

Yet the world owed to Dr. Erasmus little that was to be held as his. It is true that his philosophical, if I may so say, exhibited a great knowledge of his age, and, regarding the origin of life, it attacked but little public attention, and they did not find it difficult.

Erasmus had passed away ere the theory of evolution began to attract more attention in the Netherlands. The impulse was given by the appearance of the well-known work, "Principles of the Natural History of Creation," of which a Dutch translation was published in 1844 by Dr. V. H. van der Boek, Professor of Chemistry at the Military Medical College in Utrecht, with an introductory preface by the celebrated chemist, Prof. H. T. Molay, a well-known name in England as elsewhere. This work excited a lively controversy, but its appearance was more common than its purchase. Remarkably enough, it found more favour with the general public, and especially with some theologians of liberal principles, than with the representatives of the natural sciences. The majority of celebrated biographies of any celebrity in the Netherlands looked upon the writer's position as a dilemma, and speculated on the reader's belief that on the matter of the work. Nevertheless, this position was already in a comparative sense, and in 1844, from a solid position of the translation was published, edited by the translator with numerous additions.

Among the few Dutch authors to recognize the light which the theory of development opened, we mention, most of all, Erasmus van Swinderen, viz., F. C. Zoonder, and F. Harting. The former, in his inaugural address pronounced in 1847, "On the History of the Earth," in speaking of the origin of life, expressed his opinion that, in the gradual change of the successive stages of development, may be the cause of the origin of the various kinds of animals, and in the course of the history of the earth, he delivered a series of lectures before a miscellaneous audience, on "The History of Creation." He published the following year under the title of "Wetenschappelijke en medische verhandelingen." ("Scientific and medical treatises.") "On the History of the Earth," in which, in a popular and accessible manner, he treated the theory of development. Though hardly the cause in a stand, it did not, however, yet in general, he decided that there existed, though it is the progress in the course of a theory which would pass into the mind and become a conviction. I was, for instance, Professor at Leyden, making a well-known French writer's work his own, was accompanied by a sign of an explanation, "de l'origine des espèces." ("On the Origin of the Species.")

In 1849, just at national congresses, Dr. Charles Lyell, was staying for a few days in Utrecht. In the course of conversation

with this distinguished man on the theory of development, in which Lyell himself, at least in his writings, had shown himself as a pleader, the learned of this country were first made acquainted with him had been and what was being done in the direction of England. His attention attracted towards the history of the origin of the animal kingdom, and related to his friend Darwin had been completed the year in an exact study of this subject, and that as long a work would appear from his pen, which, in his opinion, would make a considerable impression. From these conversations it was evident that Lyell himself was working. In the following edition of his "Principles of Geology," he dedicated himself, as we know, a portion of the hypothesis of development, and Prof. Harting, especially interested in the same work. In his "Algemeen Handboek der Natuurkunde," published in 1850, he was able to dedicate himself with his own views on the hypothesis of development. Also another famous name, Miguel, Professor of Botany at Utrecht, who had previously declared himself an opponent of the theory of development, became a convert to it in his last years, for although this is not expressed in his published writings, it was clearly manifested in his private conversation and in his lectures. To what was this conversion to be ascribed? With Harting and Miguel, as well as with Lyell and as many others in every country of Europe, this was the first produced by the study of your "Origin of Species," published in 1859, which first furnished me with the key to the theory of development. That work, translated into Dutch by Dr. F. C. Winkler, now Professor of the Geographical, Mineralogical, and Palaeontological collections in Leyden's Foundation, in Haarlem, excited great and general interest. It is true that a theory, striking as hardly and to deep at the roots of existing opinions and prejudices, could not be regarded at once as more with general approbation. Many even among scientific circles offered violent opposition. Prof. J. van der Horst, head up as he was in the school of Cuvier, endeavored to diminish its value by what he regarded as a hostile position by bringing into his language (Lyell's) well-known facts in the history of the earth. However, neither this position nor the professor's influence over his students could withstand the current, especially when, after his death, the German geologist, Prof. Karl Schimper, now Professor of Zoology at Erlangen, was appointed at Leyden. A decided adherent of your theory, he presented in the younger scientific a lively enthusiasm, and founded a school in which the conviction prevailed that the theory of development is the key to the explanation of the history of Creation.

In Utrecht, Prof. Harting, with reservations more and more decided, was kept in the same direction; and Schimper's success in Leyden, Prof. C. K. Hoffmann, did not remain in the rear. Other names, among which are Groningen and Amsterdam, persons, might have been cited. By the translation of your "Lectures on Man" and "The Expression of the Emotions in Man and Animals," with copious explanatory notes and by various original papers and translations translated in your honor, Dr. Harting kept on his course, but also largely contributed to the more general spread of your opinions in the Netherlands.

To fully have generally they are held in esteem among the younger geologists and botanists, and more and more obtain among professors of zoological branches in this country, amongst others in a multitude of less important papers and articles in the periodicals.

This, however, we deem important, than by offering for your acceptance an office, containing the portraits of a number of professional and amateur naturalists in the Netherlands, we offer a convincing proof of our estimation of your valuable contributions to the promotion of science and our admiration of you, the, as the opposite in this wonderful path. We recognize with pleasure Dr. Harting's great and generous as the primary source of such a demonstration of our feelings. The committee, however, devoted upon the direction of the "Nederlandsche Wetenschappelijke Society," who resumed that, with the presentation of this appreciative mark of esteem, a few words on the history of the theory of development in the Netherlands would not be entirely unimportant, though many so, since this history itself clearly shows that, about most of the in this direction had already been suggested here, yet in your alone, reveals the history of having formed by your writings, a school of natural and zoological professors of the theory of development.

Among the names in the accompanying list you will observe several professors of Natural History, Zoology, and Botany at the three Dutch Universities, the "Algemeen Handboek" of Amsterdam, and the Polytechnical Academy of Delft, the Com-

