release a flint-lock at a determined period after it was set in motion. The machine was partly encased in cork, so that when charged with powder it was a little heavier than sea-water, and it was attached by a line to a box float, whereby it could be kept suspended at any particular depth. These torpedoes were carried in harpoon-boats, and connected by long lines with harpoons fired from small guns at the ship to be attacked. If the harpoon was successfully planted in the ship's side, the torpedo was drawn into the water by the line, and this, as it ran out, released a pin from the torpedo, setting the clock-work in motion. The submerged torpedo was then supposed to drift into close proximity with the ship by the time the flint-lock caused ignition. Several French ships were attacked by means of these explosive machines—which, by the way, Fulton was the first to term *torpedoes*—but although they were in some instances successfully exploded, the enemy's vessels sustained no material injury, from the fact that the charges were immersed in too great a depth of water. Fulton's drifting torpedoes were employed in a more simple form in an experiment made in October 1805, in the presence of the principal officers of the fleet commanded by Lord Keith, on which occasion a 200-ton brig, the *Dorothea*, anchored for the experiment off Walmer Castle, was destroyed at one operation. The torpedo employed contained 180lb. of powder, and was suspended at a depth of fifteen feet; it was simply allowed to drift with the tide against the hulk, the clockwork which regulated the explosion being timed to run eighteen minutes before the machine was cast adrift.

The torpedoes made use of by the Russians in the Baltic in 1855, were mechanical self-acting machines, containing charges of from 8lb. to 10lb. of powder; they were constructed with some care and ingenuity, and if they had been but of larger size, their existence would have greatly jeopardised the safety of our ships. The machines were conical in form, and were so arranged as to explode on being struck by a passing vessel, the blow causing the fracture of a glass tube containing sulphuric acid, which, falling upon a tuft of cotton wool saturated with chlorate of potash, sulphur, and sugar, at once ignited the charge.

But it was not, as previously stated, until the subject of torpedoes was seriously taken in hand by the Americans during the recent war, that torpedo-warfare assumed a grave and wide-spread importance. In the hands of the Confederates especially, the applications of submarine mines to warlike purposes were very carefully studied, and with such marked success, that, according even to the official despatches of the Federals themselves, twenty-five ships are admitted to have been destroyed. In the first instance *mechanical* torpedoes only were used, such, viz., as exploded by means of percussion arrangements fitted on the outside, or by a drifting line attached to a trigger, but these were afterwards succeeded to some extent by machines ignited at will from the shore by electricity. The latter were, in the opinion of Admiral Porter, of inferior value, from the fact of their ignition not being effected at the proper time; and the gallant officer reports, that on one occasion he safely ran the gauntlet through a channel bristling with these machines, by simply sending forward as pioneer a sham *Monitor* built of logs, and furnished with an imitation turret, which passed without damage over several torpedoes exploded at her, and was afterwards followed by the fleet unharmed.

Consequent upon the successful employment of torpedoes by the Confederates, the Federals turned their attention more closely to the matter, building a torpedo-boat especially for this kind of warfare, and reconstructing six *Monitors* for the same purpose.

The perfection to which submarine mines have been brought up to the present time, and the various methods adopted for applying electricity to their ignition, will form the subject of the second part of this paper.

THE DEEP-SEA SOUNDINGS AND GEOLOGY

SOME little time ago an eminent geologist, Professor Gümbel of Munich, applied to Sir Roderick Murchison for specimens of the Deep-sea Soundings which have lately been the subject of so much discussion. Sir Roderick mentioned Dr. Gümbel's wish to me, and I immediately sent him a small quantity of North Atlantic mud from 2,350 fathoms, which had been preserved in spirit. The following translation of a letter, dated April 18th, 1870, with which Dr. Gümbel has favoured me, and which embodies the result of his researches hitherto, will, I am sure, be read with the greatest interest by geologists and biologists. I may mention that I long since found coccoliths in the nummulitic limestone of Egypt. T. H. HUXLEY

Many thanks for sending me the specimen of mud obtained by the deep-sea dredge. I have already subjected it to searching investigation, and have obtained results, which have the most important bearing upon my other work. Although my inquiries are, at present, only commenced, it will possibly interest you to receive some information respecting them. I call the new kind of investigations which I have begun to carry out, "Deep-sea investigations on the dry land;" *i.e.*, examinations of the different calcareous rocks, with reference to the share which the smallest organic forms, similar to those at present existing in the deep sea, have had in their formation. When limestone is soft and earthy, traces of the smallest marine animals can be detected by triturating it in water. In chalk, for instance, from Palestine, I have convinced myself, in the most unequivocal manner, of the formation of the calcareous mass, for the greater part from your so-called coccoliths, besides *Foraminifera*, &c., which have long been known. Similar soft calcareous rocks are unfortunately rare in older formations. With these another process must be adopted. I started from the fact that in many of these calcareous rocks, the original calcareous portion of the organic beings is replaced by silica, and that hence in such rocks, by the separation of chert or flint, at least a part of the calcareous portion of the coccoliths and coccospheres might be replaced by silica. It was to be expected that the exterior form might suffer by this replacement, as, in fact, the chalk coccoliths have become materially different in their form from those of the existing deep-sea ooze.

I found, in fact, by treating such a siliceous limestone with very dilute acetic or hydrochloric acid, in the fine mud which is left, an organic residuum corresponding to the coccoliths of the present day. Even in the Trenton limestone, and in a yellow limestone of the Potsdam series, corresponding minute bodies were to be recognised, although sparingly, presenting themselves amongst an incredible multitude of other minute particles of organic origin. The microscope discloses, like the telescope, in the vault of heaven, a new world of the smallest organic beings, respecting which, however, I must say nothing at present, but confine myself to the coccoliths. These casts of coccoliths are found very sparingly. I explain this from the circumstance that the silica is chiefly the result of the decomposition of large masses of organic material, especially of the larger testacea. I obtained, however, important results by subjecting the deep-sea ooze, for which I am indebted to your kindness, to the action of the acids. These with violent development of carbonic acid, dissolve the minute bodies of the coccoliths, of the coccospheres, and perhaps also those of *Bathybius* (although of this I am not quite sure), and there remain only certain peculiarly formed but very much changed portions of the coccoliths as roundish discoidal flakes, the organic portion of the original coccoliths. In single isolated coccoliths this change of form is difficult to follow, but this can easily be done in those which appear to be firmly bound up (enveloped?) with a mass of the granular flakes (*Bathybius*?); and after the operation of the acid, can be again easily recognised in their exact position. Accompanying these coccoliths transformed by the action of acids, are countless little bodies extremely similar to those which can be obtained, in most cases, by dissolving siliceous limestone in acids.

This is the first commencement of researches which I propose following up, with, I hope, important results; since thin sections are of no good in studying these minute forms. I cannot close these notes of the researches with which I am at

present engaged, without adding a further contribution, and I hope not an unimportant one, to what is known respecting the nature of the deep-sea mud.

You speak of the chemical behaviour of these masses. The question whether these minute organisms represent animals or plants is still open. I have exposed the ooze to the action successively of a solution of iodine, of iodine and sulphuric acid, and of zinc chloride with potassium iodide, and have each time obtained in a remarkable manner a distinct blue colour, different shades from violet to green, in the substance of the coccoliths. There must therfore exist in the organism of the coccoliths, besides the calcareous skeleton, a kind of cellulose. Their organic nature is thus established beyond all doubt; but the conclusion might after all be drawn that we are dealing with plants, were it not that in the animal kingdom cellulose has been found in the Ascidians. But it is at all events interesting here on the boundary of organic life, to meet with cellulose. As a confirmatory test, I treated the substance with Millons' test which, as is well known, colours conchiolin red, but leaves the chitin of the *Orthropoda* on the other hand unchanged.

I obtained by this means no red colour in the flakes belonging to the coccoliths after the limestone had been dissolved by the excess of acid. A red colour showed itself, on the other hand, in many other particles, for instance, in the *Polycistinæ* whose siliceous coat was coloured red at the margins; and in irregular patches, which appeared to be derived from broken and crushed mussel-shells. I also noticed much deep brown and yellow colour. Especially by treatment with different chemical reagents, differentiated minute particles make their appearance which can scarcely be recognised by my microscope, and which, before the treatment with the chemical reagents, cannot be by any means detected. I expect that by this method an important extension of our knowledge of the most minute forms of organic life will be effected. I will only mention further that the red of the conchiolin shows itself of a bright red in the smallest particles which are found in such great numbers in the agglomerated flakes (*Bathybius*), and which are smaller than the little elevations on the epidermal structures, which probably belong to *Holothuridæ*, and which frequently occur in the field of the microscope.

I should like to pursue further the chemical side of these investigations; but, unfortunately, the supply sent over to me is almost exhausted. If you consider these researches of sufficient importance to be worth continuing, and could obtain further material for me for this purpose, I should be greatly indebted to you. If you can make any use of this communication, it is at your service.

NOTES

PROBABLY few are aware of the magnitude or special aim of the Cornell University. While our own rulers can scarcely grapple with the Education question because of the unsettled state of Ireland, the Government of the United States laid the foundation, during the height of the most terrible struggle for existence of modern times, of one of the most important educational movements the world has ever seen. On the 2nd of July, 1862, Congress passed an Act granting public lands to the several States and Territories which might provide colleges for the benefit of agriculture and the mechanical arts; the share of the State of New York amounting to 990,000 acres. In 1865, this grant was conferred on a University about to be established, on the condition that the Hon. Ezra Cornell should give to the institution 500,000 dollars, with a few other conditions. This munificient grant was afterwards supplemented by another of 200,000 dollars; and the University was established at the village of Ithaca. It is needless to say that the Act of Inauguration provides that the education shall be given to all comers irrespective of creed, colour, or race; the motto of the founder being, "I would found an institution where any person can find instruction in any study." Besides the original grants, the University has since been enriched by private liberality, with gifts of public buildings, laboratories, libraries, museums, a herbarium, printing-press, &c. A simple, but, as far as it goes, a strict entrance examination in geography, English grammar, and arithmetic and algebra, admits intending pupils as undergraduates, and they can then take their choice of pursuing their studies in either of several departments in which degrees are conferred, in Science, Philosophy, Arts, or in some other special subjects, the full course extending over four years. The special feature of the University, however, is what is called the voluntary labour scheme, by which students are enabled to work out a portion or the whole of the expenses of their education, either by unskilled labour on the farm, or by skilled labour at the printing-press or workshops. The University Register just published states that the scheme has thus far been worked with a degree of success hardly to be expected at so early a stage. We shall look with great interest on the progress of the University.

WE are in a whirl of soirées. Last Saturday the second Royal Society's soirée of the season drew together a brilliant gathering, and we shall next week give an account of the scientific novelties exhibited. On Wednesday the President of the Linnean Society's conversazione came off, and to-morrow Sir R. Murchison, the president of the Geographical Society, freceives his friends at Willis's Rooms.

THE question of admitting lady students of medicine to classes in the Edinburgh University on the same footing as other students was discussed at the half-yearly meeting of the University Court on the 19th inst. Professor Masson moved a resolution in favour of so admitting them, and quoted Miss Pechey's case in support of his motion. Mr. Balfour, Professor of Botany, seconded the resolution. Mr. Laycock, Professor of Physic, moved a negative resolution. Professor Christison seconded the amendment, which was carried by 58 votes against 47 in favour of the motion.

A PROPOSITION was some time ago made to telegraphists by Mr. Robert B. Hoover, of Alleghany, Pennsylvania, to present Professor Morse, the "father of the telegraph," with a testimonial upon his eightieth birthday. The response was general, and the nucleus of a fund was immediately raised. It has since been found that this fund will warrant the casting of a bust, or perhaps a full-length figure, of the professor; so the original idea of making Professor Morse a birthday testimonial has been abandoned, and a really national one is to take its place.

THE corner-stone of a new college for Melbourne, which is to be affiliated with the Melbourne University, under the title of Trinity College, was laid on the 10th Febru[illegible] by the Right Rev. the Bishop of Melbourne. The building stands near the south-west corner of the reserve, to the north of the University, and considerable progress in the erection of it has already been made by the builder. Only a small portion of the whole design, namely, the Provost's lodge, &c., has been undertaken, and it is to cost 7,500*l*. The funds in hand amount to 4,000*l*., and the buildings will be carried out as far as the money will allow.

THE schooner yacht *Norna*, Mr. Marshall Hall, owner and master, is fitting out to dredge off the west coast of Spain and Portugal. Mr. W. S. Kent, of the British Museum, and Mr. Edward Fielding accompany the expedition.

EVENING Technical Schools are to be established in the chief towns of Massachusetts. A museum of mechanical inventions and models of machinery are to be formed in connection with each, and there is to be one instructor for every twenty-five pupils.

WE regret to have to announce the death, in his 82nd year, of Mr. Jonathan Couch, of Polperro, Cornwall, a well-known naturalist. His name is especially associated with ichthyology, the