sented an address on behalf of the Society. They regarded the Rothamsted experiments as the highest contribution that had ever been made to the science of agriculture.

Prof. E. Kinch presented an address from the Royal Agricultural College, Cirencester. He alluded to the great educational value of the Rothamsted experiments, to the kind reception of the students at their annual visit to the Station, and to the debt of gratitude they owed to Dr. Gilbert for his services as honorary professor at the College.

Mr. Ernest Clarke, in the absence of M. Tisserand, then read an address from the Société National d'Agriculture de France. Mr. Clarke mentioned that several other addresses were on their way to this country.

Sir John Lawes, who, on rising to reply, was received with hearty cheering, said that it was only a very few months since he and his wife received the congratulations of many friends on having attained fifty years of married life, which was occasionally called a golden wedding. That afternoon he had to return thanks to that distinguished company for congratulating himself and Dr. Gilbert on the work they had carried on together for fifty years. When two persons were joined together in marriage they could not part—they were bound together by a solemn tie. Dr. Gilbert and himself were bound by no ties. During the whole of the fifty years Dr. Gilbert had been perfectly at liberty to leave him, and he to leave Dr. Gilbert; they had remained together from their mutual love of the work they had undertaken. He had given to this work all the time that he could spare consistently with other duties; but Dr. Gilbert had given his whole time to it, and had it not been for the labours of Dr. Gilbert, the affairs of Rothamsted would have been in a different state to that in which they now were. Dr. Gilbert had given his life to the experiments—had given the most arduous part of his life—had given his holidays, and this very year he was going to Chicago to deliver a course of lectures on the work at Rothamsted.

He had now had sixty years' experience of agriculture. When he began farming in 1834 the country was suffering from agricultural depression, the crops were so large that they more than supplied the wants of the nation; now our wheat crop only sufficed for one-third of our consumption, and the rest had to be furnished by other countries. He was afraid that their investigations had been of more use to the foreigner than to the English farmer, for the latter had always grown good crops, and thus could not meet lower prices by an increased production, while the foreigner had been able to do this.

Sir John Lawes expressed his cordial thanks for the various presentations made to him that day, and especially for the granite boulder, which he playfully said would probably still be in existence when the portrait had been transferred from the drawing-room to the bedroom, and from the bedroom to the garret, and people had forgotten whom it represented, and who painted it.

Dr. Gilbert expressed himself as unable to return thanks adequately for the ovation of that day. Referring to the early years of their investigations, he said that they commenced with orthodox views; but that, as they could not alter the laws of nature, they presently found that they were at variance with received opinion, and their scientific friends looked on them with pity. Their first paper was subjected to merciless excision by the editor of the journal to which it was sent, and they with difficulty secured its publication. Those who opposed became, however, finally their firm friends, and they had since published in that very journal papers occupying about 2,000 pages. The reason they had been able to steer clear of error in their numerous experimental inquiries at Rothamsted was that they had adhered resolutely to the motto of the Royal Agricultural Society, and had associated practice with science throughout the whole course of their researches. Agriculture, more perhaps than any other art or industry, was dependent upon the intelligent application not of one but of many branches of science, and hence it was that the experimental agriculturist found himself in contact at one time with the botanist, at another time with the physiologist, and again with the chemist and the geologist, the statistician and the economist. He mentioned that he had in preparation a jubilee edition of the memorandum sheet on the Rothamsted experiments, and concluded by expressing his warmest thanks for the sympathetic kindness which his friends had shown him that day.

Sir Joseph Hooker, in proposing a vote of thanks to the executive committee of the Jubilee Fund, said that he had never seen chemistry and botany united to such good purpose as in the investigations of Lawes and Gilbert.

Sir John Evans, treasurer of the fund, in responding, said that the boulder of Shap granite which they saw before them weighed nearly eight tons, and had twice broken down on its way to Harpenden. He need hardly say that a considerable weight had been taken off his mind when he at last had the satisfaction of seeing the huge monolith firmly planted in the place it now occupied.

The Earl of Clarendon proposed a hearty vote of thanks to the Chairman, which was carried by acclamation, and the formal proceedings terminated.

The portrait of Sir John Lawes, by Hubert Herkomer, R.A., was afterwards on view in the laboratory.

A garden party at Rothamsted was held later in the afternoon, which was attended by most of the visitors.

THE GEOLOGISTS' ASSOCIATION IN IRELAND.

THE visit of the Geologists' Association to the counties of Dublin and Wicklow, under the direction of Profs. Sollas and Cole, extended officially from July 24 to July 29; but a number of members arrived in Dublin for Sunday, July 23, and visited the cathedrals and places of historic interest in the city, under the guidance of Rev. Denis Murphy, S.J. On Monday the full party examined the grits and *Oldhamia*-slates of Bray Head. The Rev. Dr. Haughton, F.R.S., delivered a speech of welcome, standing on the rocks of the headland, and Prof. O'Reilly and Prof. Sollas, F.R.S., explained the structure of the mass, showing how the more resisting grits have caused a wrinkled flow of the shales and slates between them. The excursion was continued to the fine intrusive junction of the Leinster granite and the Ordovician rocks at Killiney, the latter being metamorphosed into mica-schists with abundant andalusites and some garnets.

On Tuesday, July 25, the promontory of Portrane was visited, under the direction of Prof. Grenville Cole. The basal carboniferous conglomerates ("Old Red Sandstone") were seen above the Bala series, which is here finely fossiliferous. The igneous rocks, ashes, agglomerates, and some lavas, associated with the great volcano of Lambay, are well seen upon this coast, and a true conglomerate of volcanic blocks and of pebbles, worn from the contemporaneous coral-reefs is one of the most interesting exposures. The brecciation, under pressure, of the alternating layers of shale and limestone produces, near the Priest's Cave, a rock resembling a coarse conglomerate of limestone-pebbles in a matrix of black clay.

On Wednesday, Howth was visited; Prof. Sollas conducted the party, and Dr. V. Ball, Mr. G. H. Kinahan, and Mr. A. B. Wynne were also present. The glacial drift on striated surfaces of Carboniferous Limestone, the dolomitisation of the limestone, the Ordovician dykes of diabase in the quartzites, and the quartzites, grits, and many-coloured shales, of the Howth and Bray series, were studied along the southern shore. Casts of worm-burrows were pointed out in some of the sandstones near the Needles.

On Thursday, July 27, an early start was made for Rathdrum, and cars were taken to Glendalough and the Seven Churches. Prof. Sollas and Prof. Cole led the party to the high ridge above the upper lake to examine the amphibolite in the Ordovician slates. Prof. Sollas showed how the slates had been converted into schists by contact with the Leinster granite, and how pressure has produced a foliated structure even in the intrusive mass; but the amphibolite has converted the schists locally into a "Desmosite," consisting of quartz, garnet, and dark mica, the latter lying in planes across those of the first foliation.

On Friday the Rev. Maxwell Close acted as guide to the shell-bearing sands and gravels, 1,000 feet up on the slope of Two-rock Mountain, near the house called Ballyedmondduff. Small fragments of marine shells were freely found in the upper pit. The party then descended into Glencullen, where Prof. Cole pointed out how the valley had been at one time choked with "drift," full of striated blocks of limestone and *débris* of granite and Ordovician rocks, and how the river has now cut down into this mass, as is the case in so many valleys of the southern and eastern Alps. From Enniskerry the geologists drove through the Scalp, a bold notch in the granite ridge, with an exposure of the junction with contorted Ordovician rocks.

On Saturday a joint excursion was carried out with the Dublin Naturalists' Field Club; some members of the Belfast Field Club being also present by invitation. The whole party drove from Bray up Ben Cree to Loughs Bray, the Rev. Maxwell Close explaining the glacial dam that separates the two lakes, and the moraines in the mountain-hollows round them. The descent was made by the romantic grounds of Luggela, which were kindly thrown open by Mr. Stepney. Here the granite abuts on the metamorphosed Ordovicians, and displays, on Lough Tay itself, a fissile foliated structure of unusual delicacy. On climbing out of the deep hollow to the main road, abundant large erratics of granite, resting on Ordovician schist, were seen on all the moorland slopes.

On Sunday, July 30, Dr. V. Ball, F.R.S., conducted the party over the geological and antiquarian collections in the Museum of the Science and Art Department, Dublin, Major M'Eniry pointing out the treasures of the Royal Irish Academy collection.

THE DEVELOPMENT OF ECHINOCYAMUS PUSILLUS.[1]

THE year 1891 will remain memorable to echinologists for the richness of its products upon the morphology of the class with which they deal, not the least brilliant and far-reaching of which is the discovery by Brooks and Field of the primary bilateral symmetry of the water-vascular system of *Asterias;* but the following year will not pale beside it, if only on account of the magnificent treatise to which we now call attention. The amount of solid work which the author has compressed into his fifty-seven pages is little short of astonishing. The monograph is written in excellent English, and illustrated by nine plates well worthy of the text; and from whatever standpoint it is judged, a verdict of unstinted praise must be given.

After a short introduction, the author furnishes an account of his methods, incidentally alluding to a remarkable result obtained by fertilising ova derived from females reared in a dirty locality with spermatozoa obtained from males dredged in the open sea; and he next proceeds to the detailed consideration of the sexual elements and fertilisation, in the course of which evidence pointing to a possible chemiotaxis is adduced, in what is termed the "attractive forces" of the ova and spermatozoa. The segmentation of the oosperm is next considered. The author remarks that he has more than once seen very delicate connective filaments crossing the cleavage-cavity from one segment to another at the earliest stages in the formation of the former; and later on, in dealing with the phenomena of mesenchyme formation, he calls attention to the significant fact that in young gastrulæ it is common to find mesenchyme cells "attached by one pseudopodium to the ectoderm, and by another to the archenteron," giving the impression "that they facilitate the process of invagination." Interesting as are these facts in their bearing upon the general question of protoplasmic continuity in the animal body, they fall into insignificance beside that portion of the work which deals with the vital phenomena of segmentation itself. In the course of it the author remarks that when studying the phenomena alluded to "one gets the impression that the segments alternately attract and repel each other, and that the highest degree of attraction occurs when the nuclei after a completed segmentation have obtained their rounded distinct form and are in a state of repose." This conclusion is reached after extensive and careful observation, and the tendency of current research in cytology appears to us to suggest that the near future may show the author to have herein formulated a general law.

Dealing next with the blastula and gastrula stages, an apical disc bearing a tuft of long cilia, akin to that of the annelid larva, is described; and the author, having proved that it has nothing to do with locomotion, provisionally suggests that it may be a larval sensory organ. The formation of calcareous deposits is recorded to first occur during the blastula stage, and the spines, interradial plates, and spherids of the young urchin, are alike traced to a "first indication" in the form of a minute tetrahedron originated by the agency of mesenchyme cells; and the author, after full consideration, inclines to the belief the "teeth" also "originate as small tetrahedrons." The detailed observations incorporated in this section of the work are of intense interest, especially in their bearing upon the attempt of Dreyer to reduce the skeletogenesis of the echinodermata and certain other invertebrated animals to a common principle of purely mechanical origin.

The young urchin is traced to a "first indication" in an ectodermic invagination of the Pluteus, as previously described by Agassiz and Mentschnikoff, and the author observes that the disc-like sac thus formed becomes differentiated into a "thick-walled bottom," which plays an important part in the development of the young urchin, and a remaining portion which "only serves as a kind of amnion."

One very curious and interesting discovery which is announced is that of a choano-flagellated condition of the cells of the ciliated band of the Pluteus, which, in the author's words, "curiously remind one of collar-cells in the Porifera;" and it is not a little remarkable that this observation should have been closely followed by that of Franzé that Bütschli's so-called "*mund vacuole*" of the Choano-flagellate Infusoria (*Codosiga botrytis*) is in reality a delicate membrane connecting the collar with a specialised sucking vacuole.

In his introduction the author confirms the surmise of Johannes Müller that certain of his (now classical) descriptions of Echinoid larvæ were those of *Echinocyamus pusillus*, and in so doing points out that nobody has in the meantime published anything on the development of that animal. Our appreciation of the excellence and value of the author's work may, perhaps, be best expressed in the assertion that it appears to us in every way worthy of this unique association with that of the great founder of our modern comparative anatomy.

[1] A Monograph, by Prof. Hjalmar Théel, Nova Acta Reg. Soc. Sci. (Upsala: Ser. iii. pp. 1-57. 1892.)

FRANCE AND INTERNATIONAL TIME.

THREE years ago M. W. de Nordling made a communication to the French Geographical Society with regard to a universal hour. In a further communication to the same society, on April 7, he traces the changes that have been made since 1889. The state of things at the present time are summarised as follows:—

(1) The time of eastern Europe, which differs by only one minute from that of St. Petersburg, is employed in Russia, Roumania, Bulgaria, and Roumelia, to Constantinople.

(2) The time of Central Europe prevails in Sweden, Germany, Austria, Hungary, Bosnia, Servia; and its adoption is assured in Switzerland, Italy, and Denmark.

(3) The time of Western Europe (Greenwich time) is in use in Great Britain, Holland, and Belgium, and, to complete its European domain, needs the addition of France, Spain, Portugal, and Ireland.

With regard to France, M. de Nordling dwelt on the fact that while civil time is referred to the Paris meridian, the railway service runs according to Rouen time, which is five minutes behind Paris time. The French Commission of 1891 remarked upon the absurdity of this system in the following words:—

"In order that there should be no ambiguity in the use of the uniform hour adopted, it will be necessary to put an end to the curious habit that exists only in France, where two timepieces are seen at all railway stations having between them a constant difference of five minutes.

"It is useless for the railway companies to say that the interior time of their stations concern them particularly, and only refer to their service; only error and confusion can result from the system. The hours of departure being regulated by the interior clock, there must always be a tendency to consider these indications as the most exact.

"To our knowledge, in no other country outside our own, is this peculiarity found, which perpetuates an error, and, in fact, puts the trains behind by five minutes."

"It is said," remarked M. de Nordling, "that the five minutes retardation are regarded with approval by travellers.

"This was probably true in 1840, when one would only go to Saint-Germain and Versailles, but to-day, when everybody discounts the five minutes, they have lost their virtue, and only force the passenger to make incessant calculations. The uncertainty is increased in the buffets, where it is doubtful whether the clock on the wall indicates interior or exterior time.

"It is not only from a national point of view that this dual hour is vexatious, but also from an international point of view. In fact, it renders our hour absolutely inappropriate to all international usage. Suppose Switzerland had adopted Paris time;