during the 100 days of the exposition, with over 4,000 lights burning, there was not at any time a suspension of light from failure of the appliances of the Edison electric lighting company.''

Of the arc-lights, lamps were chosen, one at a time, from the circuits, and inserted in the same circuit in the photometer-room, care being taken that no change was made in the circuit adjustments. Indicator-cards were taken from the engine used, during the testing of each lamp. The strength of current, and fall in electromotive force, were also determined with an amperemeter and voltmeter; but, as only relative results were desired, these instruments were not graduated.

The photometer-bar was fifty feet long; and tests showed that there was no reflection vitiating the results, from the dead-black surface of the walls of the room. The photometric tests were made with an Edison incandescent light as a standard. Fifteen tests from candle to incandescent, and ten from incandescent to arc lights, were made for each lamp, five arc-light tests being between the same number of tests of the standard.

The arc-light was cut out during the tests of the standard, and a new cup was allowed to form before the next set of tests was made.

The dynamos were worked to their full advertised capacity in regard to the number of lights in the circuits; and four lights were tested in each case, with the following results: —

	Jenney.	Thomson Houston.
Total number of lights in circuit	16	12
Total mechanical horse-power	26.92	11.79
Average horizontal intensity in candles .	496.5	291.8
Average intensity per horse-power . . .	306.5	296.9
Relative efficiency of lamps from light, current, and fall in electromotive force .	1.055	1

From these tests, and an examination of the dynamos, lamps, regulators, etc., the awards were made as follows: to the Edison company, for isolated lighting, medals for the best incandescent system and light, and for the best dynamo and lamp for the incandescent light; to the Fort Wayne Jenney electric lighting company, medals for the best system and dynamo for arc-lighting; but, to the Thomson Houston electric lighting company, a medal for the best arc-light, because, "while the light of the Jenney was slightly stronger per horse-power of electrical energy used in the lamp, it was not quite so steady as the Thomson Houston." H. W. EATON.

THE LATE MR. DARWIN ON INSTINCT.[1]

AT the meeting of the Linnean society this evening (Dec. 6) a highly interesting posthumous paper on Instinct, by Charles Darwin, will be read and discussed. We have been favored with an early abstract of the same, which we here present to our readers.

After detailing sundry facts with reference to the migratory instincts of different animals, Mr. Darwin proceeds to suggest a theory to account for them. This theory is precisely the same as that which was subsequently and independently enunciated by Mr. Wallace in *Nature*, vol. x. p. 459. Thus, to quote from the essay: "During the long course of ages, let valleys become converted into estuaries, and then into wider and wider arms of the sea; and still I can well believe that the impulse [originally due to seeking food] which leads the pinioned goose to scramble northward would lead our bird over the trackless waters; and that, by the aid of the unknown power by which many animals (and savage men) can retain a true course, it would safely cross the sea now covering the submerged path of its ancient journey."

The next topic considered is that of instinctive fear. Many facts are given showing the gradual acquisition of such instinctive fear, or hereditary dread, of man, during the period of human observation. These facts led Mr. Darwin to consider the instinct of feigning death, as shown by sundry species of animals, when in the presence of danger. Seeing that 'death is an unknown state to each living creature,' this seemed to him 'a remarkable instinct:' and accordingly he tried a number of experiments upon the subject with insects, which proved that in no one case did the attitude in which the animal 'feigned death' resemble that in which the animal really died; so that the instinct really amounts to nothing else, in the case of insects at all events, than an instinct to remain motionless, and therefore inconspicuous, in the presence of danger. From the facts given with regard to certain vertebrated animals, however, it is doubtful how far this explanation can be applied to them.

A large part of the essay is devoted to 'Nidification and habitation,' with the object of showing, by an accumulation of facts, that the complex instincts of nest-building in birds and of constructing various kinds of habitations by mammals, all probably arose by gradual stages under the directing influence of natural selection.

The essay concludes with a number of 'miscellaneous remarks' on instincts in general. First the variability of instinct is proved by sundry examples; next the fact of double instincts occurring in the same species; after which, "as there is often much difficulty in imagining how an instinct could first have arisen," it is thought "worth while to give a few out of many cases of occasional and curious habits, which cannot be considered as regular instincts, but which might, according to our views, give rise to

[1] From *Nature* of Dec. 6.

such." Finally, cases of special difficulty are dealt with. These may be classified under the following heads: 1. Similar instincts in unallied animals; 2. Dissimilar instincts in allied animals; 3. Instincts apparently detrimental to the species which exhibit them; 4. Instincts performed only once during the lifetime of an animal; 5. Instincts of a trifling or useless character; 6. Special difficulties connected with the instinct of migration; 7. Sundry other instincts presenting more or less difficulty to the theory of natural selection.

The 'conclusion' gives a summary of the general principles which have been set forth by the whole essay. This, therefore, we shall quote *in extenso*:—

"We have in this chapter chiefly considered the instincts of animals under the point of view whether it is possible that they could have been acquired through the means indicated on our theory, or whether, even if the simpler ones could have been thus acquired, others are so complex and wonderful that they must have been specially endowed, and thus overthrow the theory. Bearing in mind the facts given on the acquirement, through the selection of self-originating tricks or modification of instinct, or through training and habit aided in some slight degree by imitation, of hereditary actions and dispositions in our domesticated animals, and their parallelism (subject to having less time) to the instincts of animals in a state of nature; bearing in mind that in a state of nature instincts do certainly vary in some slight degree; bearing in mind how very generally we find in allied but distinct animals a gradation in the more complex instincts, which shows that it is at least possible that a complex instinct might have been acquired by successive steps, and which, moreover, generally indicates, according to our theory, the actual steps by which the instinct has been acquired, inasmuch as we suppose allied instincts to have branched off at different stages of descent from a common ancestor, and therefore to have retained, more or less unaltered, the instincts of the several lineal ancestral forms of any one species, — bearing all this in mind, together with the certainty that instincts are as important to an animal as their generally correlated structures, and that in the struggle for life under changing conditions slight modifications of instinct could hardly fail occasionally to be profitable to individuals, I can see no overwhelming difficulty on our theory. Even in the most marvellous instinct known, that of the cells of the hive-bee, we have seen how a simple instinctive action may lead to results which fill the mind with astonishment.

"Moreover, it seems to me that the very general fact of the gradation of complexity of instincts within the limits of the same group of animals, and likewise the fact of two allied species placed in two distant parts of the world and surrounded by wholly different conditions of life, still having very much in common in their instincts, support our theory of descent, for they are explained by it; whereas, if we look at each instinct as specially endowed, we can only say that it is so. The imperfections and mistakes of instinct on our theory cease to be surprising: indeed, it would be wonderful that far more numerous and flagrant cases could not be detected, if it were not that a species which has failed to become modified and so far perfected in its instincts that it could continue struggling with the co-inhabitants of the same region, would simply add one more to the myriads which have become extinct.

"It may not be logical, but to my imagination it is far more satisfactory, to look at the young cuckoo ejecting its foster-brothers, ants making slaves, the larvae of the Ichneumonidae feeding within the live bodies of their prey, cats playing with mice, otters and cormorants with living fish, not as instincts specially given by the Creator, but as very small parts of one general law leading to the advancement of all organic bodies, — Multiply, vary; let the strongest live and the weakest die."

DR. GRINEWETZKY'S CROSSING OF NOVAIA ZEMLIA.

ON the $\frac{1}{14}$ November, Dr. Grinewetzky described, before the Geographical society of St. Petersburg, his travels on this island. He first started on foot on the $\frac{5}{17}$ August, with Kriwoskeya and a Samoyede (a few of whom are found near Karmakuly). The weather was beautiful, the thermometer 5° C.; but soon after reaching a mountain with a very extensive view, where they passed the night, they were overtaken by a violent snow-storm, and compelled to return. In April, 1883, the Samoyede Hametz crossed the island to the south-east coast, and found Samoyede *chums* (tents). Hearing of this, Grinewetzky, accompanied by Hametz and another Samoyede, set out in sleds drawn by dogs. They had scarcely any food for the dogs, but were assured they would find plenty, as wild reindeer were abundant. This proved not to be the case; and on the fifth day the poor dogs were near starving, when a large herd of reindeer was met. Many shots were fired without effect, due to the difficulty of seeing distinctly, as the men's eyes were much affected by the reflected sunlight, and, in addition, their hands were benumbed by the cold (— 20° to — 25° C.). At last two were killed, and the dogs saved. At first a number of very steep parallel ridges, principally of black slate, were encountered. At some places, hard and exceedingly steep snow-drifts had to be avoided by ascending the surrounding hills. Excepting these drifts, there was but little snow, as, if loose, it was swept away by the strong east-south-east wind prevailing. After the water-shed between the west and east coasts is passed, the country becomes a low plateau, and the snow softer and rather deep and regular. On the $\frac{30 \text{ April}}{12 \text{ May}}$, with the temperature at — 27° C., they prepared to return, as they had already proceeded two days farther than was intended, and no chums were in sight; and, although one of the Samoyedes said the chums were only three miles distant, they began the return.

This expedition is important as the first crossing of Novaia Zemlia by civilized man. According to information collected by Tjagin (1878–79), Pakhtus-