Hellmann makes up for its slenderness by means of a short biography of Hadley, and several helpful and interesting notes. The reprints are published by Messrs. A. Asher and Co.

THE *Journal of Botany* reprints some very interesting extracts from Mr. T. Kirk's presidential address to the Wellington (New Zealand) Philosophical Society, on the displacement of native by introduced species of plants. Next to man, the chief agents in this destructive work in New Zealand are sheep and rabbits, but the black rat has also had his share. "Some districts are eaten almost bare by these close feeders, little being left except the tough bases of *Poa cæspitosa* and the wiry ligneous stems of *Mühlenbeckia*, and similar plants; even the woolly leaves of some species of *Celmisia* are often closely cropped, the result being that the more delicate plants are all but extirpated over large areas." Introduced plants like *Silene anglica*, *Erigeron canadensis*, *Rumex obtusifolius* and *crispus*, *Bromus sterilis*, and *Holcus lanatus*, have almost driven out the original littoral vegetation in some districts. Even more destructive are the ravages caused by the parasites, animal and vegetable, which some of these strangers bring with them. Some idea of the extent of this invasion may be gathered from the fact that the first catalogue of naturalised plants in New Zealand, published in 1855, comprised forty-four species; while at the present time Mr. Kirk is himself acquainted with 304 species, while others put the number at 382.

WE have received the first number of vol. iii. of *Poggendorff's Biographisch-Literarisches Handwörterbuch der Exacten Wissenschaften* (J. A. Barth, Leipzig), which is to contain short biographical notices of mathematicians, astronomers, physicists, chemists, mineralogists, geologists, geographers, &c., living within the period 1858–1883. The first number extends from "d'Abancourt" to "Beilstein," and the whole volume will contain about fifteen numbers, appearing at intervals of six weeks (3*s*. each). The times preceding 1858 have already been dealt with in the first and second volumes (price 28*s*.), and any gaps which have been discovered since will be filled up in the present volume. A fourth volume is to cover the years from 1883 to 1900. The whole work will be a monument of careful compilation, and will do much to unify the world of science. The plan of the work is admirably designed. Short biographical notices are followed by a detailed enumeration of the papers and books contributed to scientific literature. Among the men of this first number, Sir G. B. Airy is *facile princeps* in the volume of his writings, as the four closely-printed columns of titles testify. There are many Arabian and other philosophers who are now seldom heard of, such as Abraham ibn Esra of Toledo, Al Marokeschi of Marocco, and Al Mahani of Khorasan, which this dictionary preserves from unmerited oblivion. Taken as a whole, the dictionary appears to be highly trustworthy, and the print and paper leave nothing to be desired.

IN the current number of the *Comptes rendus* there is an account, by M. H. Moissan, of some further experiments on the preparation of the diamond. With the view of obtaining the greatest possible pressure upon the solution of carbon in iron during solidification, the cooling with mercury or other metal was arranged in such a manner that small spheres from 5 mm. to 10 mm. in diameter were produced. These spheres gave specimens both of the black and transparent varieties of diamond, which, although very small (0·01 to 0·02 mm.), were remarkably regular and perfect in shape, agreeing exactly with the forms found in nature.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mr. V. Lloyd; two Amaduvade Finches (*Estrelda amandava*) from India, a Paradise Whydah Bird (*Vidua paradisea*) from West Africa, presented by Miss M. von Laer; a Raven (*Corvus corax*), British, presented by Mr. A. H. Cullingford; a Martinique Gallinule (*Ionornis martinicus*) from South America, presented by Mr. A. W. Arrowsmith; a Cape Viper (*Caucus rhombeatus*), a Puff Adder (*Vipera arietans*), a Cape Bucephalus (*Bucephalus capensis*), five Hoary Snakes (*Coronella cana*), a Ring-hals Snake (*Sepedon hæmachates*), four Crossed Snakes (*Psammophis crucifer*), six Rufescent Snakes *Leptodira rufescens*), three Rough-keeled Snakes (*Dasypeltis scabra*), four Rhomb-marked Snakes (*Psammophylax rhombeatus*), a Delaland's Lizard (*Nucras delalandii*), a Defenceless Lizard (*Agama inermis*) from South Africa, presented by Mr. J. E. Matcham; four Midwife Toads (*Alytes obstetricans*), South European, presented by Prof. Gustave Gilson; a Gentoo Penguin (*Pygosceles tæniatus*) from the Falkland Islands, deposited; eight Amherst Pheasants (*Thaumalea amherstiæ*), two Peacock Pheasants (*Polyplectron chinquis*), two Himalayan Monauls (*Lophophorus impeyanus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE PLANET SATURN.—In the *Astronomische Nachrichten*, No. 3365, Prof. Barnard comments upon the accounts of various new markings on the rings and body of this planet. In company with Profs. Burnham and Hough, he carefully examined Saturn with the 18½-inch refractor at Dearborn Observatory. The planet was in a good position for seeing, being on the meridian, and during the evening several difficult double-stars were accurately measured. In spite of this, no abnormal features could be discerned, either on the globe or on the rings. The recently reported observations of new divisions, ragged edges to the crape-ring, &c., were all invisible. In fact the planet appeared very similar to what Prof. Barnard usually saw with the 36-inch Lick, although the latter, with its larger aperture, made the identification of details less difficult.

NEW NEBULOSITY IN THE PLEIADES.—W. Stratonoff, in the *Astronomische Nachrichten*, No. 3366, describes the results of recent long-exposure photographs of the Pleiades, taken with a refractor of 13 inches aperture. Three photographs are mentioned, obtained with exposures of 9h. 54m., 17h. 36m., and 25h. The first two show most of the known nebulosity, but the third shows the existence of several new features. The chief of these is a long straight streak of nebulosity extending from $\alpha = 3h.\ 40{\cdot}7m.$, $\delta = +24°\ 4'$ to $\alpha = 3h.\ 41{\cdot}9m.$, $\delta = +24°\ 4'$, roughly about 20′ north of Alcyone. The breadth of this is from 20″ to 30″; it is almost parallel to the neighbouring line of nebulosity described by M. M. Henry, and has a very similar form.

Another slight nebulosity is visible on the plate near the star 18m., in the form of several filaments lying north and south, and varying in breadth from one to three minutes of arc.

NEW VARIABLE IN HERCULES.—Mr. T. D. Anderson, of Edinburgh, gives in the *Astronomische Nachrichten*, No. 3366, a description of his observations of a 9th magnitude star, leading to the discovery of its variability. This is the star B.D. + 27°·2772, whose position for 1855·0 is given as R.A. = 17h. 4m. 58·4s., Decl. + 27° 14′·3. The star could not be found in September 1895, using a 2¼-inch refractor, but in October of the same year it was easily seen with the same instrument. Taking two neighbouring stars of magnitude 8·8 and 9·6 for comparison, he found the variation in magnitude to be from 9·2 to below 10 in about a month. In July 1896 he again found the star to be invisible as in September 1895, although the neighbouring 9·6 magnitude star was easily seen again.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE annual summer meeting of the Institution of Mechanical Engineers was held last week in Belfast, commencing on Tuesday, July 28, and concluding on Friday, July 31. There were two sittings for the reading and discussion of papers, the following being a list of those presented:—

"Flax Scutching and Flax Hackling Machinery," by John Horner, of Belfast.

"Electric Lighting in Belfast," by Victor A. H. McCowen, Electrical Engineer to the Belfast Corporation.

"Unusual Corrosion of Marine Machinery," by Hector MacColl, of Belfast.

"Rope Driving," by Abram Combe, of Belfast.

"Description of the Belfast Gas Works," by James Stelfox, Engineer and Manager.

"Description of the Alumina Factory at Larne Harbour," by James Sutherland, Manager.

"Partially immersed Screw-Propellers for Canal Boats; and the influence of Section of Waterway," by Henry Barcroft, of Newry.

The last paper was not read.

On members assembling on Tuesday, July 28, in the Examination Hall of Queen's College, Belfast, addresses of welcome were given by the Lord Mayor of Belfast, Mr. Pirrie, and by Mr. W. H. Wilson, the chairman of the Reception Committee. After this the chair was taken by the President, Mr. E. Windsor Richards, and the first paper was read.

This was Mr. Horner's contribution on flax scutching and flax hackling machinery. It was illustrated by a number of wall diagrams, without the aid of which it would be impossible to describe the intricate mechanism used in the flax industry. It is a task we will not attempt. A point of economic interest which came out in the discussion may, however, be referred to. A gentleman connected with the industry pointed out the lamentable waste that occurs owing to the unsatisfactory methods of scutching followed in Ireland. It appears that the flax-growers are always more anxious to get their money quickly for their produce than to get a full return. To scutch flax properly requires time, and also more costly machinery than is generally used in Ireland. On the continent the growers are more far-sighted, and have a larger command of capital; at any rate they have superior machines, which are more expensive at first cost, and, moreover, take a longer time in performing the operations. The foreign growers have their reward. The yield is 20 to 25 per cent. greater than with the Irish machines; and though it costs about double as much to scutch a given quantity of flax on the continental system, the yield is so much greater that a far larger profit is ultimately obtained. We gathered also from subsequent visits to the flax mills in Belfast that the continental flax is much preferred by the manufacturers, being cleaner and more easily worked. One would be inclined at first sight to attribute these facts to the conservative and shortsighted methods of the people of this country; for we are very prone to accuse ourselves of errors of this kind. It may be some satisfaction, therefore, to persons of a cynical disposition to find that the generally astute Americans are guilty of a similar fault. Mr. Dobson, of Bolton, a well-known maker of cotton-spinning machinery, told the meeting that there was an immense loss in the preparation of raw cotton, due to the very primitive ginning machinery used by the cotton-growers. It is evident that both here and in America we have something to learn from the more frugal and painstaking flax-farmers of the continent of Europe.

Mr. McCowen's paper on the electric lighting in Belfast followed. The chief feature of interest in the Belfast installation is the fact that all the prime movers are gas engines. Six of these are on the Hartley and Kerr system. They are supplied by Dick Kerr and Co., of Kilmarnock. Four are double acting, with the cylinders working tandem-wise, and having two pistons on the same rod. These engines run at a speed of 160 revolutions per minute, and indicate 120 h.p. The number of explosions per minute is 320 or 330, or 2 per revolution. The remaining two of the six gas engines are single cylinder and double acting. They also run at 160 revolutions, and indicate 60 h.p. The number of explosions per minute is 160, or one per revolution. Naturally the cyclical variation in speed of the tandem engines is very small, owing to the number of explosions, their low initial pressure, and their even distribution; the number of explosions being four to one, in comparison with the single cylinder, single acting engine; there being four complete Otto cycles in two revolutions. The method of governing is worthy of attention, as being different from that usually adopted of missing an explosion. The impulses are continuous, and the supply of gas is graduated per stroke according to the load. The quantity of air supplied to the cylinder is practically constant, the quantity of gas only being varied. This under ordinary cases would lead to a difficulty of ignition. As is well known, a poor mixture of gas and air ignites slowly; but it is said that stratification takes place in the cylinder. Taking advantage of this, gas is admitted to the cylinder later and later in the charging stroke; although even at full power a considerable quantity of air is drawn into the cylinder before gas is taken in. The full supply of air almost immediately follows the piston, while there is only a small portion of rich and explosive mixture near the ignition chest. It will be easily understood that the mechanism by which the somewhat novel operations are carried out is of an interesting nature. It was explained by the author by means of wall diagrams; but in the absence of these we can only refer our readers to the published transactions of institutions in which the diagrams will be reproduced.

These slower running engines drive the dynamos by rope-gearing, but there are two smaller engines of the high speed vertical type, manufactured by the Acme Gas Engine Company of Glasgow. They have four single-acting cylinders arranged in two lines of two in tandem, working on to opposite cranks. At full speed they run at 380 revolutions per minute. In the paper tables were given detailing the various conditions of running, quantity of gas used, &c. Without going into the details of these tables, it may be stated that the efficiency of the tandem engines does not appear to be very high, 27·4 cubic feet per electrical h.p. per hour being the best result. This, of course, could be beaten by an engine running on the Otto cycle; but we must remember that for electric lighting purposes the Otto cycle, with its one impulse in four strokes, is not well adapted unless an enormously heavy fly-wheel be used. It is the old problem that so often faces the engineer: to get efficiency in one direction something has to be sacrificed in another; and, so far as electric lighting is concerned, the engineer apparently has to choose between an increased consumption of gas, or the prospect of unsteady lights. From experience we can say that the Belfast station gives good results if we simply regard the product. But we believe that when an extension of the station is undertaken—as there is every prospect there will be shortly—steam, and not gas, will supply the motive power.

On the second day of the meeting, Wednesday, July 29, Mr. Hector MacColl's paper on the unusual corrosion of marine machinery was read. It appears that a cargo steamer was sunk on the coast of Scotland; she was loaded with "burnt ore," and was under water for a week. On examination, when the vessel was once more floated, the machinery was found to present an extraordinary appearance. All wrought-iron work was deeply and roughly corroded, and planed cast-iron work was rendered so soft as to be easily cut with a knife. As the engines of steamships are generally very little injured by submergence, even for lengthened periods of time, it was evident that there was, as the title of the paper indicated, an unusual cause for this state of affairs. This was found in the cargo. Burnt ore is the residue from the manufacture of vitriol from sulphur pyrites, and is generally found to contain about 4 per cent. of sulphate of copper, together with a little sulphate of iron, due to the sulphur not having been completely burnt out of the ore and becoming oxidised with sulphates. The sulphate of copper would be more or less completely dissolved in sea-water; and, as the latter contains a considerable quantity of chloride of sodium, this would react on the sulphate of copper, forming sulphate of sodium and chloride of copper. The sulphate of copper and chloride of copper are both soluble in water, and a solution of either or both dissolves wrought-iron and cast-iron. The chloride is more energetic in its action than the sulphate; but in time a solution of either, no matter how weak, will dissolve an atom of iron for every atom of copper present. If is satisfactory to know that the author was able, notwithstanding the great apparent damage done, to put the engines and boilers into working order again, and the ship is now doing duty on the high seas.

The next paper was perhaps the most important read at the meeting; it was Mr. Abram Combe's contribution on rope driving. As is fairly well known, Belfast is the home of rope driving as a means of conveying power from motor to machine; so far, at any rate, as mill purposes are concerned. The inventor was Mr. James Combe, of the author's firm of Combe, Barbour, and Combe, who are very large manufacturers of flax-spinning machinery. This gentleman in 1856 applied an expanding pulley with V-shaped sides to the differential motion of flax and tow roving frames, conveying the power by means of a round leather rope. He was struck by the efficiency of this gearing, and this led him to try the application of the same means of transmission to larger power. As a result of a number of experiments he found that the following were the best ratios of diameters for ropes and pulleys :—

$1\frac{1}{4}$	inch diam.	rope	3	feet diam.	pulley	ratio	1 to 28·8
$1\frac{1}{2}$	,,	,,	4	,,	,,	,,	1 to 32·0
$1\frac{3}{4}$	,,	,,	5	,,	,,	,,	1 to 34·3
2	,,	,,	6	,,	,,	,,	1 to 36·0

In regard to power transmitted, it was found that when working under ordinary conditions the foregoing sizes of rope transmit, for each 100 revolutions per minute made by the pulley, the following :—

Rope	$1\frac{1}{4}$	inch diam. on	3	feet pulley	would give	5	I.H.P.
,,	$1\frac{1}{2}$	,,	4	,,	,,	8	,,
,,	$1\frac{3}{4}$	,,	5	,,	,,	11	,,
,,	2	,,	6	,,	,,	15	,,

These figures may be exceeded under more favourable circumstances. The best angle of the groove on the pulley was found to be 45°, and the best speed of rope 3300 feet per minute. Illustrations and descriptions were given of many very ingenious forms of rope driving, by which power was conveyed from a driver to a single driven pulley under conditions that would have been impossible with belts, or in any case unless complicated trains of wheel gearing had been employed. In the discussion which followed the reading of this paper, a good deal of light for the uninitiated was thrown on rope driving practice. The importance of splicing was brought to the fore, and on this depends to a large extent the durability of ropes used for conveying power. A short splice will not do at all, and even the "long splice" ordinarily made by the mariner is insufficient. For 3-inch ropes the splice has to be 12 feet long; the strands being cut and divided, so as to avoid producing what sailors call a "gouty" length; that is, one where there is an increased diameter. Three patterns of rope are used; the three strand, four strand, and the served rope. The former is far the easier to splice, the latter the most difficult. A served rope, however, has the greatest flexibility; a very prominent virtue in a driving rope, as it leads to longevity, and enables smaller pulleys to be used without ill effect. In regard to material, cotton appears to be the favourite. It is almost universally used in England; naturally so in the Lancashire district, where rope-driving practice is so largely followed. In Ireland manilla appears to be most often used. There was one speaker, who came from India, and who said that he had used coir rope with great success; this is made from the fibrous material of the husk of the cocoanut. We should have thought this substance would have been altogether too elastic for the purpose. Another speaker, Mr. McLaren, had used rope-driving for ploughing purposes, but had gone far beyond the proportions advised by the author in his table. For instance, he had used a $\frac{7}{8}$-inch rope to transmit 40 horse-power, whilst his pulleys were no more than 20 inches in diameter. This rope we understood him to say was a manilla one, but the proportions seem altogether extraordinary. We should have thought a wire rope would have been more likely to answer the purpose. The speaker, however, drew the moral that too high a factor of safety was demanded by engineers in rope driving. Later on Prof. Goodman stated that he had calculated the average factor of safety in rope driving at about 90 per cent.

One of the excursions during the meeting was made from Belfast to Larne Harbour, to visit the alumina factory there situated. A description of this factory formed the basis of Mr. Sutherland's paper. Although, as is universally known, aluminium is one of the most abundant metals found in the earth, there are not many of the compounds containing it which render themselves readily to the extraction of the metal. Bauxite is the one generally used for its production, and large deposits of this have been found in County Antrim. The analysis is as follows:—Alumina is 56 per cent., corresponding to aluminium 29·9 per cent., peroxide of iron 3 per cent., silica 12 per cent., titanic acid 3 per cent., water 26 per cent. The peroxide of iron, silica, and titanic acid have to be separated out before the extraction of the metal from the alumina is attempted; and it is the function of the Larne works to carry on these operations; the smelting of the ore being done by electrical methods at Foyers. That, however, is an operation which does not come within the scope of the paper now before us, but may form the subject later on of another contribution in the transactions of the institution.

It is the Bayer process which is used at Larne. The bauxite, as received from the mines, is first ground and sifted, after which it is taken to a calciner in order to remove the organic matter present, which would prevent the subsequent separation of the alumina from the caustic soda. The calciner is an iron tube lined with fire-brick, and caused to revolve on rollers. It is inclined at a necessary angle, the heat from the furnace passing up through the tube. As the tube inclines, the bauxite travels to the lower end, and falls out into a receptacle. The alumina is extracted from the ground bauxite by treating it with a strong solution of caustic soda under pressure. This operation is carried out in Kiers. A soluble compound of alumina and soda (aluminate of soda) is thereby formed, while the peroxide of iron, silica, and titanic acid remain as an insoluble compound. The Kiers are steam-jacketed, and have paddles mechanically actuated to agitate the mixture. The steam pressure in the jacket is carried up to 70 or 80 pounds, and the mixture is subjected to the heat corresponding to the pressure for two or three hours until decomposition is complete. The liquid product of the Kiers is then passed through filter presses, the impurities being insoluble are retained, while the liquid aluminate runs into tanks. The residue, or cakes of impurities, are afterwards washed to extract as much of the aluminate of soda as possible; and the washings are used for diluting the product of the Kiers. Centrifugal pumps are employed for this purpose. At present the red mud forming the residue is useless, and there is an opportunity for any chemist to suggest a means by which it could be utilised. Experiments are being conducted in this direction by the Company. The lyes from the presses contained in the filter tank are afterwards subjected to another filtering process, being passed through cellulose, consisting of paper-makers' pulp. About fifty pounds of cellulose is boiled with water to a thin pulp, and is run upon sieves; it soon settles down, and is then ready to receive the lyes, arresting all finely divided, insoluble particles that have escaped from the filter presses. Finally, there is another filtering process.

It is now necessary to separate the alumina from the soda. This is brought about by the addition of excess of more hydrate of alumina to the hydrate of alumina itself, and in this way about 70 per cent. of the alumina in combination with the soda separates out in thirty-six hours. The hydrate of alumina is then pumped out of the decomposing cylinders, in which the latter process has taken place, sufficient however being allowed to remain behind in the cylinder for beginning the decomposition of the next charge of liquor admitted. The hydrate of alumina pumped out is filtered through filter-presses, and the last traces of soda are removed by washing. The hydrate of alumina is then taken to the calcining furnace, where the water of hydration is driven off at a low temperature, leaving the alumina perfectly anhydrous. It will, however, take up water again readily, and to prevent this it is heated to about 2000° F., when it becomes crystalline, and not so liable to absorb moisture. The weak soda liquors which are obtained are concentrated by a triple-effect evaporator.

On the afternoon of Wednesday he members and their friends were shown these processes in operation at Larne.

The last paper read was that by Mr. Stelfox. It was not discussed, the time for the conclusion of the meeting having arrived.

The Belfast meeting was a complete success, the whole arrangements being carried out most satisfactorily. A large number of the works of Belfast were visited by members, manufacturers being most liberal in opening their establishments to members, and generally showing that hospitality for which Ireland is renowned. The summer meeting of next year is to be held in Birmingham, the city in which the Institution of Mechanical Engineers had its origin fifty years ago next year.

OLD WORLD METEOROLOGY.[1]

IN the year 1508 a book was published in Germany under the title of the "Bauern-Pracktik." This book had a wide circulation. It taught the farmer, the sailor, the merchant—all, indeed, who were interested in the weather—what would be its

1 "Die Bauern Praktick. Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus." Herausgegeben von Prof. Dr. G. Hellmann. (Berlin: A. Asher and Co., 1896.)