are dealt with. Of these there are upwards of 300, and a rough estimate of the total number of species in the world puts them at 3000. Prof. Hackel is a well-known and accepted authority on this difficult family, so that the translation will be welcome to those botanists who are not familiar with either Latin or German. The introductory chapter on the structure, morphology and physiology of grasses enhances the value of this little book.

It may be of interest to add, in this connection, that the grasses of British India, described in Sir Joseph Hooker's voluminous "Flora," just completed, number 850 species belonging to about 150 genera!

W. B. H.

The New Poultry Guide for British Farmers and Others. By Kinard B. Baghot-De la Bere. Pp. 65. (London: Seeley and Co., Ltd., 1897.)

THIS book is addressed to small landowners and tenant farmers of Great Britain. It is a concise and practical guide to the selection and keeping of poultry for profit. Written by one who has had a wide experience, the book should appeal forcibly to the distressful agriculturist, and make him start a poultry farm at once

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Liquefaction of Air by Self-intensive Refrigeration.

FROM a recently published paper by Dr. Carl Linde, on the above subject, it appears that in his most successful attempt without the use of auxiliary refrigeration, he was able, with a copper-tube apparatus weighing 132 lbs., to liquefy air in two hours, with an average higher pressure of 190 atmospheres.

It will be of interest to those who have followed this subject to hear of the latest performance, which constitutes a great advance on the above results; the weight of the copper coil having been reduced to less than one-sixth, the time required for liquefaction to less than one-fourth, and the pressure of the compressed air to less than one-half.

An apparatus which I designed on an improved plan, and which was completed in May 1896, was exhibited at work at the conversazione of the Royal Dublin Society held on the 10th inst.; and, the liquid being easily removable as produced, it supplied the material for repeated demonstrations during the evening, with the usual experiments.

Air at an average pressure of 87 atmospheres was supplied by a compressor lent by Messrs. Arthur Guinness, Son, and Co., which had been formerly used for compressing carbonic acid gas; and the compressed air was carried through 80 feet of copper pipe to the room in which the apparatus worked. No auxiliary cooling by carbonic acid or other agents was used to reduce the temperature of the compressed air before or after it reached the apparatus.

The copper tube in the exchanger, weighing only 20 lbs., was disposed in a special arrangement of coils, so that the temperature was exchanged over a range of 202° C. within 1½ of a degree, the compressed air entering at + 10° C., passing through the liquid state at − 192° C., and issuing a few seconds later at +8·6° C.

When a start was made with the apparatus at atmospheric temperature, the jet of liquid air was clearly seen in twenty-five minutes, and the liquid was collecting in the receiver in thirty-three minutes from the start. When the apparatus was cooled down by continuous working, the liquid began to collect again in two minutes after emptying the receiver, and accumulated at a good rate: the exact quantities of liquid and air for a given time have yet to be measured.

The receiver is a glass vessel protected by a vacuum of the kind invented by Mr. Crookes, first applied to refrigeration work by M. Cailletet, of Paris, and improved and popularised by Prof. Dewar. It is further protected by a special glass attachment fitted in such a way that the vacuum vessel can be readily removed without any risk of fracturing it by movement in contact with rubber hardened by cold to the rigidity of stone, and can be quickly replaced without interfering with the effective action of the apparatus.

The apparatus has been very strongly and neatly made by Brin's Oxygen Company, of Westminster, and tested to a very high pressure. It should be mentioned that in the almost impossible event of a joint giving way, no one can be hurt, since the high-pressure air exists only in the form of a thin column or thread with very small admission-passages. The harmlessness of a burst under these conditions has been practically demonstrated with a joint constructed in such a way as to burst inside a similar construction at 120 atmospheres, when the effect proved to be quite as mild as had been anticipated, and entirely harmless—a mere blowing-off.

This is the only apparatus existing in the United Kingdom which liquefies air without auxiliary refrigerating agents.

March 13. W. HAMPSON.

Patterns produced by Charged Conductors on Sensitive Plates.

IN your issue of January 21, 1897, Mr. James I'Anson publishes some coin photographs showing the effect of the brush discharge around the edge of the coins, and around the portions in high relief, and asks if any similar results have been obtained by others.

In the *Physical Review* (vol. ii. p. 59, 1893) is an article on electric photography, in which are published some similar photographs made by me in 1892 by exactly the same method described by Mr. I'Anson. The same method is also described by Prof. F. J. Smith, whose "Inductoscript" should be by this time well known in England. The rays from the discharge around the edge of the coin are plainly shown in one of my photographs in the *Physical Review*, and are commented upon in the article.

I also gave a photograph made by the same process when the coin was insulated from the photographic plate by a sheet of mica, and mentioned others made with the coin insulated from the plate by shellac, paraffin, and gutta-percha, which would seem to disprove Mr. I'Anson's theory that the brushes are due to electrified streams of air coming in contact with the sensitised plate.

During the past year, I have repeated these experiments with both the coin and the photographic plate carefully insulated and placed between the plates of a condenser attached to the discharging knobs of a large induction coil. I have made in this way photographs of coins, and other conductors, imbedded in the centre of a block of paraffin two centimetres thick, under which circumstances they could not send off streams of electrified air.

I have also repeated in this way some of the X-ray shadow effects by placing objects between the condenser plates and the photographic plate, to intercept the waves sent off from the condenser plates themselves. A good conductor placed near the photographic plate will regularly be photographed more strongly than the condenser plates, even though it be only one thickness of gold-leaf on glass; but if placed several centimetres from the photographic plate, and near one of the condenser plates, it may cast a shadow on the photographic plate. An insulator placed upon the photographic plate usually casts a shadow upon it, but in some cases insulators of high specific inductive capacity seemed more transparent than the air to the waves sent off from the condenser plates.

Since the oscillations in such a condenser field must correspond very closely in character with longitudinal waves in the ether, it seems probable that if X-rays are longitudinal ether waves, their wave-length must be very short; as, otherwise, they would induce waves in conductors similar to those induced in an alternating condenser field.

I enclose a photograph of two coins placed side by side on a sheet of mica which was laid upon the photographic plate. The whole was placed in a light-tight box, and inserted between the condenser plates, from which it was carefully insulated by large panes of heavy plate-glass. The condenser plates were 4·5 cm. apart, and a 5 cm. spark was passed between the discharging knobs of the coil for two minutes, after which the plate was taken out and developed in the usual manner. It was found later that an exposure of a few seconds gave equally good results.

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