

type. The tables published by Lockyer and Pickering give no indications of lines in the positions calculated, but further examination of the photographs is highly desirable.

It should be noted in conclusion that Dr. Bohr's theory has not yet been shown to be capable of explaining the ordinary series of helium lines.

A. FOWLER.

Imperial College, South Kensington, October 14.

Azolla in Norfolk.

A VERY interesting case of the rapid spread of an introduced species is afforded by *Azolla caroliniana*, a North American species. So far as the Norfolk Broads are concerned, this free-floating water-fern has hitherto been confined to a single ditch or "dyke" near Horning Ferry, on the river Bure. Here the plant flourished greatly, covering the entire surface, but owing to the isolation of the "dyke" was prevented from spreading. According to an inhabitant of the neighbouring village of Ranworth, the plant has been observed in this one spot for the past fifteen years. I have no evidence as to its original introduction. The disastrous floods of August, 1912, carried some of the plant into the Bure, and its increase during the past twelve months has been extraordinary. Distributed by the tide it is now abundant in several of the Broads, and is carried by the tide in large quantities along the Bure and its tributaries, the Thurne and the Ant. It has found the still waters of South Walsham and Ranworth Broads particularly suited to its needs. It is most partial to the reed swamps of *Typha angustifolia*, so characteristic of the borders of our fen-lakes, and with this protection it is seen in large crowded expanses. More and more of the marsh and fen "dykes" are being invaded. It seems probable that the spread of the species to the other rivers of the Norfolk system, the Yare and the Waveney, will be prevented by the brackish nature of the water below Acle Bridge. I understand that a hard winter would probably kill the plant off, but its abundant sporocarps would carry it over to the succeeding spring.

Undoubtedly ecologists will soon find it necessary to include *Azolla caroliniana* in the local open reed-swamp association as a subdominant. It is a highly ornamental plant, being pale green in spring, and exhibiting a hundred shades of brown and red in autumn.

It would be interesting to know the result of competition between *Azolla* and members of the Lemnaceæ, and I am at present carrying out experiments to test this point.

W. E. PALMER.

Great Yarmouth.

The Theory of Radiation.

I OWE Prof. Nicholson an apology. His work is, of course, earlier than Dr. Bohr's, and is actually cited by the latter. The wording of my letter (NATURE, October 9) implies the reverse.

S. B. McLAREN.

University College, Reading, October 18.

RESEARCH IN AERODYNAMICS.

THE fourth volume of researches from the Institut Aerodynamique de Koutchino covers the period 1910-1912, and deals mainly with determinations of the air-resistance of various bodies and with comparisons between the results obtained at Koutchino with those of observers elsewhere. A change in the standard temperature correspond-

ing to the published results has been made since the publication of the three earlier volumes, the later determinations being referred to 15° C. instead of 0° C. to bring the results to a form more easily comparable with those of other experimental establishments.

An examination into the velocity standard of the institution has been carried out, the ultimate standard being the movement of the end of a whirling arm 16 ft. in radius. Three independent methods of estimating and correcting for the motion of the air in the room were used prior to the calibration of various anemometers on the whirling arm. The anemometers were divided into two groups, the first containing "vane instruments" and the second "pressure tubes."

It was found, when the anemometers were transferred to the wind-channel of the laboratory, that the vane type of anemometer gave somewhat lower results than the pressure tubes, and it was concluded that the latter were more trustworthy, since the centrifugal effect of whirling on the vane instruments might easily account for the differences found.

Using the new calibration of the air-channel resulting from these experiments, a series of determinations of the resistance of square plates normal to the air-current was made. The plates were 12.5, 25, and 50 millimetres side, and the values of the absolute coefficient of resistance are given as 0.58, 0.57, and 0.57 respectively. This is somewhat higher than the value hitherto accepted for plates of this size, and is more nearly equal to that previously given for plates of from 300 to 500 millimetres.

The same plates were also tested at inclinations to the air-current, the curves obtained for the normal force showing the well-known maximum at an inclination of about 35°.

Amongst the theoretical investigations is one entitled, "Méthode des variables de dimension zéro et son application en Aerodynamique." Reference is made to papers by Lord Rayleigh and others, but, curiously enough, there does not seem to be any indication throughout the paper that the author considers the method to have any further importance than that of convenience. Approached from another point of view, the method of non-dimensional variables arises directly from the principles of dynamical similarity, and is only one of the many uses of the laws governing similar motions. The importance of the physical meaning behind the mathematics appears to have been overlooked.

In the articles in this volume which deal with comparisons with other observatories it is concluded that the type of channel having enclosing walls is preferable to that of Eiffel, and that the channel used at Göttingen is more steady than that at Koutchino.

An attempt was made to repeat an experiment by Rateau on a discontinuity in the centre of pressure variations of an inclined plate. Between inclinations of 25° and 50° Rateau found a sudden change, whilst at Koutchino a continuous and well-