LETTERS TO THE EDITOR.

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Resonance Radiation and the Quantum Theory.

IN the *Philosophical Magazine* for September, 1916, Dr. Silberstein has made an attempt to explain the resonance radiation of iodine vapour on the basis of classical dynamics by assuming that the resonator is non-Hookean—i.e. that its restitutive elastic force is not simply proportional to the displacement. On this theory, the principal lines in the resonance series should appear at constant frequency-intervals, and to support this view Dr. Silberstein has given a tabular statement of the frequencies and their differences, based upon the work of Prof. R. W. Wood. A critical examination of the figures shows, however, that the frequency-intervals are by no means constant, but have a decided tendency to decrease on the long wave-length side. This has, indeed, been remarked upon by Prof. Wood himself (*Phil. Mag.*, October, 1912). I find on calculation that it is *not* the frequencies themselves, but *their square-roots*, that show constant decrements in the series. The following table, prepared from Prof. Wood's data (*loc. cit.*, p. 684) for the mercury green line excitation, demonstrates this clearly:—

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0	54937.5	...	...
1	54279.0	658.5	141.0
2	53646.9	645.3	138.5
3	53013.0	641.5	137.0
4	52386.0	637.8	137.7
5	51759.0	635.7	137.6
6	51144.0	632.3	137.3
7	50523.0	630.7	137.4
8	49911.0	628.2	137.3
9	—	—	—
10	48696.0	624.1	137.2
11	48096.0	621.9	137.1
12	47493.0	620.4	137.2
13	46902.0	618.1	137.2
14	—	—	—
15	45726.0	614.1	137.1
16	45147.0	611.9	137.0
17	44562.0	610.3	137.1
18	43983.0	608.6	137.4
19	43419.0	606.2	136.9
20	42855.0	604.1	136.9

The constancy of the figures in the last column over twenty lines seems altogether too striking to be accidental, and rather suggests an analogy with Moseley's law for the high-frequency spectra of the elements, according to which the square-roots of the frequencies of the K and L characteristic radiations increase by equal steps with the atomic number of the element—that is, on Sir E. Rutherford's theory, with the charge on the nucleus. If, in the same element, we imagine a configuration (permanent or quasi-stable) of the atom, in which the electrons revolve in successive concentric rings, the effect of the nucleus and all the other electrons on any one electron may be approximately represented by a single nucleus of proper equivalent charge; and a mechanism in which this equivalent charge, corresponding with the successive electrons in the atom, varies by successive equal steps would, on the quantum theory, exhibit the phenomena of resonance radiation,

as in the case of iodine vapour. It seems possible that this idea may find application in the fuller development of Bohr's theory of spectral series.

T. K. CHINMAYAM.

210 Bow-Bazar Street, Calcutta, October 15.

An Optical Phenomenon.

IN addition to the accounts in NATURE referred to by Mr. J. W. Giltay in your issue of November 22, the phenomenon mentioned by me in NATURE of October 18 had previously been far more fully described by Dr. John Aitken in a paper "On a New Variety of Ocular Spectrum" in the *Journal of Anatomy and Physiology*, vol. xiii., p. 322; and, as stated in this paper, the phenomenon noticed by Mr. C. Carus Wilson (NATURE, October 25), when travelling by train in a rear coupé compartment, was described by Prof. Silvanus Thompson in the report of the British Association for 1877. Dr. Aitken experimented with rotating discs divided into about twenty-four sectors, white and black alternately, and with endless bands of paper with black bars painted across them. A convenient way of viewing the apparent motion was to look at a sheet of mottled paper, after looking at the rotating disc or moving band, when the markings on the paper appeared to move in a contrary direction to the exciting impression. Though some of the mottlings seem to flow past the others, it was found by Dr. Aitken that a straight line drawn across "the spectral stream" did not appear to be bent, as one might have supposed would be the case. If, after viewing the rotating disc, another similar disc or the drawing of a wheel is looked at, the second disc or the wheel appears to rotate in a contrary direction to the first; but if the second disc is larger than the first, or the spokes of the wheel are extended to a greater size than the rotating disc, "this extension will entirely destroy all appearance of rotation, and the wheel will appear at rest. Do not these last experiments suggest that the seat of illusion is deeper than the retina?"

C. J. P. CAVE.

December 3.

THE CONTROL OF THE NON-FERROUS METAL INDUSTRIES.

BEFORE the war the world's markets for the majority of the non-ferrous metals were very largely controlled by a group of German metal companies engaged primarily in buying metals and acting as selling agents for producers. How complete this control was few people knew. The outbreak of war disclosed it in all its formidableness. The most important of these concerns was the Metallgesellschaft of Frankfort-on-the-Main. This place was the centre of certain German financial interests which had combined to establish the Metall Bank and the Metallurgische Gesellschaft. In one way or another this great organisation had established financial interests in metal undertakings, not only in Germany and Austria, but also in the U.S.A., the United Kingdom, and various parts of the British Empire.

This enormously powerful group of companies controlled the world's metal markets, of which Frankfort became the centre. Their connections with other undertakings and their ramifications were exceedingly complicated and difficult to control. In some instances there was a direct financial connection; in others the connection was

established by some form of agreement. But whatever the method there was no doubt about the ascendancy acquired by the Germans. The case of lead may be cited as an example. Before the war the Germans were, by means of the so-called Lead Convention, which they organised, placed in complete control of the lead trade of the world. Attempts were also being made to secure the control of all the free lead of the world. As regards zinc the position has already been described in the columns of *NATURE* (October 19, 1916). At the outbreak of war this control was a source of great embarrassment to the Government, and for quite two years afterwards the cause of this country and its Allies was severely handicapped because we were without the necessary metal supplies, and many trades were in jeopardy. Had not the U.S.A. come to the rescue in supplying these deficiencies, particularly as regards copper, zinc, and lead, it is very doubtful whether the Allies would have been able to avoid defeat.

In order to obtain the best expert advice on the problem of how to meet this difficulty in the future, the late President of the Board of Trade appointed a strong committee composed of representatives of this country, and to this Sir Albert Stanley, the present occupant of the position, added three members representing respectively Canada, Australia, and South Africa. According to the statement made by him in moving the second reading of the "Non-ferrous Metal Industry Bill" in the House of Commons on December 3, the Committee came to the conclusion that an essential preliminary condition of the successful organisation of any counter-measure was to secure, at all events for a period after the war, that all trace of German influence and association—direct or indirect—should be eliminated from any undertaking allowed to do business in this country. The Bill aims at achieving this object.

Clause 1 provides that it is unlawful to deal in certain metals and ores without a licence. The licences to be granted are renewable annually. Clause 2 gives the Board of Trade power to require certain information and to inspect the books and documents of persons or firms who apply for, or obtain, licences. Clause 3 provides for certain penalties for contravention of the Act. Clause 4 empowers the Board of Trade to make rules for carrying out the Act, and Clause 5 specifies the metals and ores to which the Act applies. The Act is intended to be in force during the war and for five years after its termination. The President of the Board of Trade stated that the measure is designed, not in the interest of "the trade," but in that of the nation, and that the control of metals which are so essential to the development of British industries must not be allowed to fall again into German hands after the war. He also claimed that the power of control given by the Bill will be a distinct step towards securing our economic freedom.

The discussion took a somewhat curious course. The rejection of the Bill was moved by Mr. J. M. Henderson, but his amendment was not seconded,

and, therefore, was not put from the chair. Later the rejection was moved by Sir F. Banbury, and this was seconded. Finally, the debate stood adjourned. The discussion was resumed on Tuesday, December 11, when, in a division on the amendment that the Bill be rejected, there voted against the rejection 182, and for it 79, giving a majority of 103 against rejection. The result was that the Bill was read a second time.

H. C. H. CARPENTER.

THE ROLE OF SELECTION IN EVOLUTION.¹

ABOUT the beginning of the twentieth century the current of doubt as to the evolutionary importance of processes of selection grew rapidly in strength, and swept not a few naturalists off their feet. Bateson and De Vries produced evidence of the frequent occurrence of discontinuous variations or mutations; De Vries began methodical testings of what selection could do in the course of years with maize, buttercups, striped flowers, and four-leaved clover—the general outcome being that it did not do very much; and Johannsen, working carefully on "pure lines" of beans, which are self-fertilising but show fluctuating variation in the size of the seed, proved that selection continued generation after generation in a particular direction may be without result, so far as any change in average seed size is concerned. These and other considerations led to a depreciation of the importance of selection processes. As Prof. W. E. Castle says in a very interesting pronouncement:—

In the minds of many biologists at the present time selection is an obsolete agency in evolution, and an adequate explanation of evolution is to be found only in mutation and pure lines. I believe this to be a mistaken view, not because mutation and pure lines are false, but because their applicability is very limited compared with the broad field of organic evolution. To universalise them is to hide the world by holding a small object close to the eye.

As De Vries has always insisted, mutations come we know not how, but selection determines which must go and which will stay. According to Darwin, new types are for the most part established gradually; according to De Vries, they arise abruptly. According to Darwin, new types are for the most part plastic; according to De Vries, new types are fully stable. According to Darwin, one evolutionary change follows upon, and is made possible by, another; according to De Vries, one evolutionary change has no necessary relation to another. According to Darwin, natural selection determines what classes of variations shall survive, and, in consequence, what shall be the variable material subjected to selection in the next generation; according to De Vries, natural selection determines only what classes of variations shall survive, and exercises no influence on the subsequent variability of the race. According to Darwin, the further evolution of our

¹ Journ. Washington Acad. Sci., vii. (1917), No. 12, pp. 369-87.