The comparison between A and B gave the difference in behavior between Fe and C, once we had established the fact that practically no disintegration electrons came from negative mesons in the 5-cm iron plate. The comparison between A and C gives the difference in behavior between negative and positive mesons in carbon. This must be considered as a qualitative comparison because of the slightly different action of the magnetic field in concentrating mesons of different ranges (4 cm C+5 cm Fe in one case and 4 cm of C in the other). We could not, of course, add 5 cm of Fe for the positive mesons too, since positive mesons do decay in Fe.

The great yield of negative decay electrons from carbon shows a marked difference between it and iron as absorbers. Tomonaga and Araki's calculation also give for carbon a much higher ratio of capture to decay probability for negative mesons, so we are forced to doubt their estimation. It is possible that a suitable dependence of the capture cross section, σ_c, on the nuclear charge, Z, might explain these results; however, if the ratio of the capture to decay probability also depends on the density as Tomonaga and Araki pointed out, then it would require a very irregular dependence on Z to also explain the cloud-chamber pictures of some authors[6] showing negative mesons stopped in the chamber without any decay electrons coming out.

Concerning the difference between M_+ and M_- in carbon, we should like to point out that it is not necessary to assume that σ_c for carbon has an appreciable value for negative mesons. A positive excess, $(H_+-H_-)/(H_++H_-)$ of 20 percent in the hard component, as it seems to be[7] is sufficient to explain our results since this gives $H_+/H_-=1.5$ which is greater than M_+/M_- for carbon. Impurities in the graphite could also explain some preference for M_+, with a suitable dependence of σ_c on Z.

Further experiments on this subject are now in progress, in an attempt to calculate the capture cross section, and to know how it depends on Z.

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Further Remarks on the Redundant Zeros in Heisenberg's Theory of Characteristic Matrix

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RECENTLY Dr. Opechowski[1] made a remark on my previous communication concerning the redundant zeros.[2] Reasoning in accordance with the current scheme of quantum theory, he came to the conclusion that all the eigenvalues of the closed states in the problem discussed in my note were given by the first condition, and there were no eigenvalues given by the second condition. That is of course quite correct. In fact it is a result already well known, and that is why the term "redundant zeros" was introduced for the eigenvalues given by the second condition.

Dr. Opechowski has, however, apparently overlooked the fact that I was studying the eigenvalue problem from the point of view of the theory of characteristic matrix, a new scheme of quantum theory recently proposed by Heisenberg.[3] In applying this theory to the spherically symmetrical states of a particle in a central field of force, one determines first $S(k)$, the eigenvalue of the characteristic matric for the spherically symmetrical states and *real* values of k. The quantity $S(k)$ is equal to the ratio of the amplitude of the outgoing wave to that of the incoming wave. One then performs an analytic continuation into the complex plane of k and determines the zeros of $S(k)$ in the lower half of the complex plane. Proceeding in this way, I obtained both sets of eigenvalues mentioned in my note. It is clear that my conclusion based on the new scheme of quantum theory cannot be invalidated by Dr. Opechowski's considerations based on the current scheme of quantum theory.

The question of the part played by the characteristic matrix as a fundamental concept in the future development of quantum theory need not be considered here, as that is irrelevant to the point at issue.

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Production and Isotopic Assignment of a 90-Day Activity in Element 43*

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PREVIOUS deuteron bombardments of Mo using the cyclotron have led to the production of a variety of periods associated with the chemistry to be expected from element 43.[1,2] However, the mass assignment of many of these isotopes has not been reported. Neutron bombardments of purified samples of $Ru(OH)_3$ in the Clinton self-sustaining chain reacting pile have been found to produce a number of these same activities, and, in one case at least, an isotopic assignment seems possible.

Experiments have been carried out wherein growth was observed of a daughter activity formed by K-capture decay of a previously-discovered three-day Ru^{97} isotope.[3] Extensive chemical tests in which the known six-hour 43^{99} activity was employed as a monitor have shown this daughter activity to be an isotope of element 43, thus permitting its assignment to 43^{97}. The activity has been observed to decay with a half-life of 93 ± 5 days over three months time. The radiations have been found to consist

largely of very soft electrons of 1.5 mg/cm² half-thickness in Al, along with possibly a small amount of unconverted gamma-radiation and probably x-rays. The half-period and character of the radiations possessed by this 43 isotope suggest that its activity is the same as that observed by Cacciapuoti and Segrè[1,4] from the deuteron bombardment of molybdenum.

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Electrical Conductivity of Na-Ammonia Solutions at Low Temperatures

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R. A. OGG[1] has observed that the electrical resistance of approximately one-molar sodium solutions in liquid ammonia decreases when rapidly frozen, so that the resistance of solid solutions is very low compared with the resistance of liquid solutions. Moreover, experiments carried out with an adaptation of the classical "ring experiment" in magnetic field, induced Ogg to think that these solutions may act as superconductors up to 180°K.

With successive experiments, Boorse *et al.*,[2] and Daunt and co-workers,[3] could not confirm the existence of superconductivity. Hodgins,[4] on the contrary, reports that four trials, of the numerous ones he carried out, gave positive results.

Some experiments on superconductivity and measurements of resistance carried out by us, seem to contribute to the clarification of this phenomenon. The solutions we used were approximately of one-molar concentration and were prepared by dipping into purified ammonia, glass ampoules containing sodium which had been just broken. The rapid freezing of the solutions was obtained by the falling of a small quantity of solution into a small glass having a thin plane bottom, previously immersed in the liquid air. Immediately on the bottom of the glass a solid disk was formed which in a few seconds reached the temperature of the liquid air. This operation was performed between the pole pieces of an electromagnet capable of providing a field of about 500 gauss. Afterwards the glass was rapidly extracted and brought near a magnetometer whose sensitivity was about 10^{-4} gauss. The duration of this last operation was of the order of one second. To avoid too rapid heating of the solid disk, a plush disk was applied on the bottom of the glass which could remain saturated with the liquid air. Twenty trials gave negative results. It is to be assumed that the disk was often broken during the freezing, which evidently, however, could not entirely prevent the circulation of eventual persistent currents.

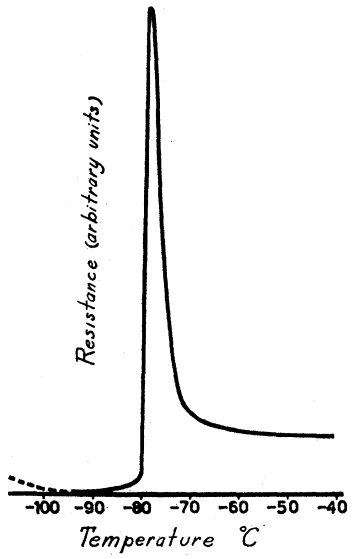

FIG. 1. Typical resistance curve of sodium-ammonia solution in the neighborhood of the solidification temperature.

Measurements of resistance of the solutions at different temperatures have been carried out, while they were progressively frozen or heated. The cell containing the solution was constructed from a small glass on whose bottom two strip platinum electrodes connected with a Wheatstone bridge, in which a resistance was continuously variable, were disposed, and the soldering of a very thin copper-constantan couple was protected from the ammonia by a little bed of white wax.

More or less rapid freezing or heating of the solution may be obtained by simple artifices. By not too rapid freezing or heating (the time necessary for the solidification or melting of the disk was of the order of one minute), it was noted that the variation of the resistance as a function of the temperature is similar to Fig. 1, which refers to one particular experiment with a 0.7 molar solution.

Evidently the resistance of the liquid solution increases very rapidly near the solidification temperature. Below this temperature a sudden decrease of resistance was observed, to a value much smaller than the one attained by the liquid solution. This phenomenon is reversible with the temperature. In the particular case shown in Fig. 1, the ratio of maximum resistance to minimum resistance is about 150, and it is to be supposed that with still slower freezing or heating this ratio might become greater. Evidently, as the solution solidifies, the resistance decreases very much. The increase of resistance which is noted immediately above this temperature is probably owing to the fact that, in the proximity of the solidification point, two liquid phases can be formed. With very rapid freezing, on the contrary, one may not note the increase of resistance which precedes the solidification, or only a very small increase may be noted. This probably occurs because solid and liquid phases are contemporaneously present but not in thermal equilibrium, and therefore it is to be assumed that the true range of this phenomenon does not depend on the velocity of freezing.

We could not measure very exactly the resistance of the solid at the temperature of the liquid air because, in the