change of products between cytoplasm and nucleus, or respiratory activity.

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A NEW TYPE OF ELECTRON SPECTROGRAPH

THE slit system of the instrument is essentially a Hull magnetron with a very narrow slit in the anode. This slit is parallel to the oxide coated filament which is mounted on the axis of the cylindrical anode and the whole is placed in a uniform magnetic field parallel to the filament. Before the electrons reach the anode they are acted on by both the radial electric field and the magnetic field as in the magnetron, but those which pass through the slit travel in circular paths under the action of the magnetic field alone. The condition for the focussing of the electrons is that they shall traverse a semi-circumference after passing the narrowest aperture in their path, and an analytical consideration of the angles of emergence from the slit shows that in a plane perpendicular to the filament, this condition is satisfied on the line through the filament perpendicular to that joining it and the slit. This focussing is very sharp, even for electrons accelerated by less than 30 volts if small electron currents are used, and it has been suggested that this may furnish an extremely accurate direct method of determining e/m.

With this apparatus, preliminary unpublished work, indicating that commercial photographic emulsions are very insensitive to electrons accelerated by about 30 volts or less, has been confirmed. It has been found, however, that when the emulsion is covered with a very thin film of fluorescent lubricating oil, it is sensitive to electrons of much lower velocities and its sensitivity to those of higher velocities is increased by 40 or 50 times.

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SPECIAL ARTICLES

ILLINIUM

AN important result of the development of Moseley's atomic number rule has been the impetus it gave to the search for missing elements. It is true that later arrangements of the Periodic Table indicated that eka-caesium, eka- and dwi-manganese, and eka-iodine were missing, but there were no theoretical grounds for supposing that eka-neodymium might exist, until Moseley's rule showed that element number 61 was still to be identified. Moseley's work was of inestimable value to one engaged in completing the list of chemical elements for several reasons: first, it gave definite information as to the existence and location of gaps in the Periodic Table; second, it gave a basis for the calculation, prior to its discovery, of the X-ray spectrum of an element and indicated a technique by which lines in that spectrum might be identified; and finally, it gave origin to a method of examination so searching that a mixture of two elements, so closely similar in chemical properties as to be almost inseparable, could be definitely analyzed. Were it not for the work of Coster and Hevesy on the X-ray examination of zirconiferous minerals, the presence in them of element number 72 would probably be still unsuspected and hafnium, or celtium, would still be listed among the rare earths. Chemical tests made on zirconium ores had frequently indicated the non-homogeneity of zirconium, but they could not give the definite proof afforded by an X-ray analysis.

The proof that a rare earth element was missing, whose atomic number would place it between neodymium and samarium, explained the sharp break in the sequence of properties that comes in the rare earth group between those two elements. The differences in solubilities of the double salts formed by rare earth nitrates with magnesium nitrate, appear to be quite uniform, excepting in the case of neodymium and samarium, since fractional recrystallization of that double salt will accomplish a strikingly sharp separation of those two elements. There is the same break in the sequence of solubilities of other salts, in basicity, as indicated by the rate of hydrolysis, etc. It also appears that the absorption spectra show the same general variation, and, as will be shown later, the absorption bands of number 61 seem to fit into the regular sequence.

Because element number 61 might be expected to share the striking similarity in properties and the common occurrence in minerals of the other members in the rare earth group, it seemed logical to institute a search for it in monazite sands, a mineral in which the first members of that family, the so-called cerium earths, predominate. Since that mineral is rich in neodymium, 60, and in samarium, 62, it would be surprising to learn of the absence of 61 there and its presence in a mineral containing little or none of 60 and 62.

The original material used in the investigation was the rare earth residue remaining from monazite sands after the extraction of thorium and part of the cerium for use in the manufacture of Welsbach mantles. It was donated to the laboratory by the Lindsay Light Company, of Chicago. After the remaining cerium was removed by the usual methods, the other rare earths were fractionally recrystal-