con: $F(\eta) = f(\eta)\, e^{j\omega t}$, componente, secondo y, della intensità di corrente di Foucault. L'espressione del «nucleo» è riconducibile a trascendenti elementari, la cui esplicitazione non offre alcuna difficoltà. L'equazione integrale suscritta è risolubile col metodo delle successive sostituzioni di LIOUVILLE-NEUMANN, e dato che il coefficiente dell'integrale ($d\,\eta$) in essa è sufficientemente piccolo, la soluzione $f(\xi)$ può limitarsi al 1° termine dello sviluppo in serie di NEUMANN. La successiva determinazione del flusso magnetico dovuto a queste correnti (inducenti e indotte insieme), in ogni punto dello spazio, ad una data distanza, si ottiene applicando la legge di BIOT-SAVART. Rimane da notare che la lastra: ($W \ll 2\,l$, $2\,l$, $2\,L \gg 2\,l$), deve avere la dimensione L prevalente sulle altre, e la teoria è valevole in ambiti di misura (riconoscibili sperimentalmente), in cui non si risentono le influenze al contorno. E con ciò riteniamo di aver dato un'idea di questo «nuovo capitolo» di «Geofisica Applicata», già avviato a soluzioni soddisfacenti, tali da permettere possibilità applicative e concreti contributi nella ricerca in miniera.

A. BELLUIGI

Istituto di Geofisica, Università Cagliari, il 11 dicembre 1948.

Summary

The principles are set forth for the use of inductive methods (at low frequency) for the prospecting of conductive ores in the galleries of the mines.

As these conductive ores in the gallery pillars are bodies limited in space (veins, plates, etc.) attention is given to the problem of the inductor in connection, for instance, with a plane conductive plate of limited dimensions.

This problem is essentially reducible to the solution of an integral equation of the second type, integrable by approximation.

Notices on Proposed Magnetic Lenses of Toroidal Type

Not long ago, a magnetic lens of toroidal type has been proposed by W. T. HARRIS[1] to focus a parallel beam of charged particles of like energies in cosmic rays. When, with a one year's delay, this number of the Phys. Rev. arrived and we heard of his proposal, we were also working on the problem of magnetic lenses of such a type based on the idea of A. SZALAY, and the construction of a toroidal lens was in progress, but our purpose and results are fundamentally different from his. I.e. we want to focus a beam of electrons of like energies originating from a point-like source.

For a homogeneous toroidal magnetic field I have deduced—on simple geometrical grounds—the equation of the profile towards the source and towards the collecting mechanism resp. If we place the origin and the X-axis of our co-ordinate system in the symmetry plain coinciding with the axis of the lens, this equation is the following:

$$X = y\,\frac{A - y}{\sqrt{R^2 - y^2}} \qquad (1)$$

where A is the distance of the source and of the collecting mechanism resp. from the origin and R is the radius of the path of the electrons in the magnetic field (Fig. 1).

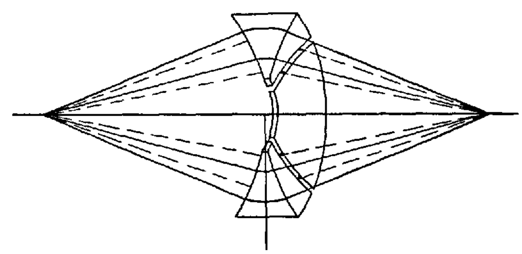

Fig. 1.

As a consequence of

$$\oint \mathfrak{H}_s\, ds = \frac{4\pi}{c}\, N \,.\, J \qquad (2)$$

the magnetic field strength decreases with increasing radial distance as $1/r$, and it can be easily shown that such a magnetic field will not focus the electrons proceeding from the source; this relation is valid only in case of a toroidal solenoid with air, or with a homogeneously filled iron core. These two types of lenses are uninteresting for us, because in the case of the first very strong magnetic fields were necessary, such as in the case of the previous β-lenses, and in the second case the electrons could not pass through the lens. But, if the core of the magnetic lens is partially filled with iron and partially with air, the value of the integral on a chosen circle in the core of the toroidal solenoid, the centre of which is the origin, is

$$\oint \mathfrak{H}_s\, ds = l_0\, H + l\,\frac{H}{\mu} = \frac{4\pi}{c}\, N \,.\, J \qquad (3)$$

where H is the component of the magnetic field strength in vacuum, μ the magnetic permeability of iron, l_0 the path of integration in a vacuum and l in iron resp. The field strength in the air gap, where the electrons pass through the lens, is

$$H = \frac{4\pi}{c} \cdot \frac{N \,.\, J}{l_0 + l/\mu}\,. \qquad (4)$$

$\mu \gg 1$ (about 3000), therefore, if l_0 is constant, in case of every possible circle, the magnetic field is approximately homogeneous. These conditions can be realized, if the gaps are plane parallel and are not very wide. The construction in this way is easier than in the proposition of HARRIS.

Now, we must consider a difficulty occuring in both cases: in the model given by HARRIS and by SZALAY as well. It is well known that a magnetic field is exactly homogeneous only inside a plane parallel gap, but at its limit strong inhomogenity arises. In our case we have electrons of very high kinetic energy. Therefore, and because of the inhomogenity arising symmetrically on both sides of the lens, if the electrons enter and leave the toroidal magnetic field of the lens at right angles, it can be hoped the focusing effect will not be spoiled. It is obvious that these conditions are not satisfied in the case of the above-mentioned models, but it is possible to construct a model which overcomes this difficulty, at least towards the preparation and further increases the efficiency of the preparation, increasing the intensity of the beam reaching the collecting mechanism, which is by itself a very great problem in case of the weak β-preparata.

[1] W. T. HARRIS, Phys. Rev. *71*, 310 (1947).

The general idea of this new form of a toroidal magnetic β-lens is the following: — We construct the profile of the toroidal magnetic field towards the preparation so that this surrounds it semispherically, and the profile towards the collecting mechanism is determined so that the electron beam is focused by the magnetic field of the lens.

It is obvious that our model has one symmetry axis. Using a plane section of the model containing this symmetry axis, our problem is reduced to a simple geometrical one:—We have one circle with radius R (this is the cross section of the boundary surface of the toroidal magnetic field towards the preparation situated in the centre of this circle). We determine the orthogonal circles of radius ϱ (this is the path of the electrons in the homogeneous magnetic field determining the radius ϱ). Now, we choose the point P on the axis of the magnetic lens, which will be the focus of the lens, then from point P we draw tangents to each orthogonal circle. The loci of these points of contact give the desired bounding line (which is the cross section of the surface of the magnetic lens towards the collecting mechanism).

From simple considerations of orthogonal circles, it follows that

$$\alpha \leqq \frac{1+p^2}{p}, \text{ or } \varrho \leqq \left\{\frac{p^2-1}{2p}\right\}^2, \text{ or } p \geqq \alpha + \sqrt{\varrho^2-\beta^2} \quad (5)$$

where α and β are the co-ordinates of the centres of the orthogonal circles, p is the distance of the collecting mechanism from the source (being the origin of our co-ordinate system). These relations are very important for us because they determine some conditions for p and ϱ. The first two give, for given p, the limes superior of ϱ by which the minimum of the magnetic field strength is determined. The third gives the limes inferior for p at a given magnetic field.

If we want to determine the equation of the profile towards the collecting mechanism, it is more convenient to use a parametric form. This method corresponds completely to the graphical construction, and it calls our attention to the general idea of our method.

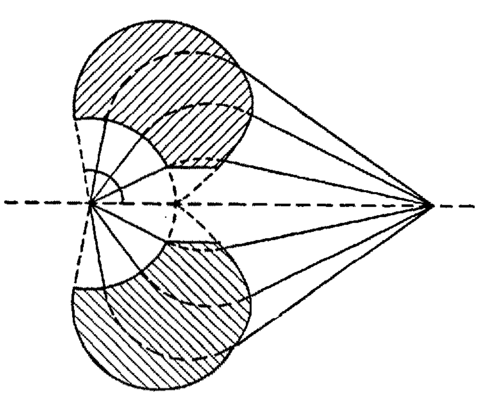

Fig. 2.

The equation of the above-mentioned first circle, with the radius R, is in parametric form (Fig. 2)

$$\mathfrak{x} = R\cos t\,\mathfrak{e}_1 + R\sin t\,\mathfrak{e}_2\,,\ 0 \leqq t \leqq 2\pi$$

where $\mathfrak{e}_1$ and $\mathfrak{e}_2$ are the unit vectors of the co-ordinate system. The equation of its tangent is

$$\mathfrak{c}^1 = -\sin t\,\mathfrak{e}_1 + \cos t\,\mathfrak{e}_2.$$

This circle must be crossed orthogonally by a second circle with the radius ϱ, at a point which corresponds to the value of the parameter t. The centre of this second circle is obviously given by

$$\mathfrak{a} = \mathfrak{x} - \varrho\,\mathfrak{c}^1 = \left\{R\cos t + \varrho\sin t\right\}\mathfrak{e}_1 + \left\{R\sin t - \varrho\cos t\right\}\mathfrak{e}_2.$$

The equation of this circle is

$$\begin{aligned}\bar{\mathfrak{x}} &= \mathfrak{a} + \varrho\cos\tau\,\mathfrak{e}_1 + \varrho\sin\tau\,\mathfrak{e}_2\,,\ 0 \leqq \tau \leqq 2\pi \\ &= \left\{R\cos t + \varrho\,(\sin t + \cos\tau)\right\}\mathfrak{e}_1 \\ &\quad + \left\{R\sin t - \varrho\,(\cos t - \sin\tau)\right\}\mathfrak{e}_2\,. \end{aligned} \quad (6)$$

The vector binding together one point of circle $\bar{\mathfrak{x}}$ with P is

$$\begin{aligned}\mathfrak{z} = \bar{\mathfrak{x}} - \mathfrak{y} &= \left\{R\cos t + \varrho\,(\sin t + \cos\tau) - p\right\}\mathfrak{e}_1 \\ &\quad + \left\{R\sin t - \varrho\,(\cos t - \sin\tau)\right\}\mathfrak{e}_2\end{aligned}$$

where vector $\overrightarrow{OP}$ is given by $\mathfrak{y} = p\,\mathfrak{e}_1$, $\mathfrak{z}$ being a tangent of $\bar{\mathfrak{x}}$, when

$$\mathfrak{z}\,(\varrho\cos\tau\,\mathfrak{e}_1 + \varrho\sin\tau\,\mathfrak{e}_2) = 0.$$

It follows from this conditions that the tangential point is given by

$$\tau = t - \arccos\frac{(p\cos t - R) \pm (\varrho - p\sin t)\sqrt{R^2 + p^2 - 2pR\,(\cos t + \sin t)}}{R^2 + \varrho^2 - 2pR\,(\cos t + \sin t) + p^2}. \quad (7)$$

Based on (7), (6) gives the equation of the profile in parametric form. The study of this curve is also a very interesting geometrical problem, but we are interested in the construction of the profile of the toroidal magnetic field. The condition that the electrons would enter the magnetic field at right angles is satisfied *ab ovo*. So the problem is to find a construction which yields optimal intensity conditions.

At first it can be shown that the sign of the root in the equation (7) is in our case negative. It is obvious that in the parameter intervall $0 \leqq t \leqq \pi$, and if $R = \varrho$, $p \geqq 4R$, which conditions are satisfied, the orthogonal circles have only one tangent which contains the point P and touches our profil. The condition of this is

$$\operatorname{tg}(t - \tau) = \varrho/R.$$

The exact discussion is a very difficult problem, because the necessary (but not sufficient) condition of the existence of singular points is also the same equation. But it is possible to prove that there are no essential difficulties in our case and the parameter t_{max} can be determined. Fig. 3 shows the more convenient form of the cross section of the β-lenses.

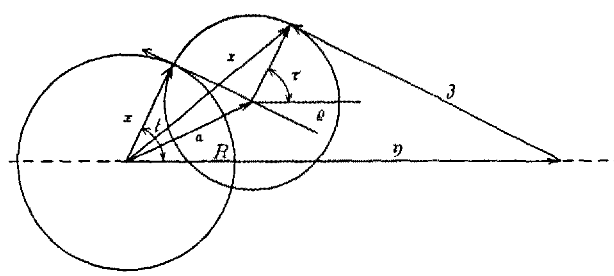

Fig. 3.

I wish to express my sincere thanks to Prof. A. Szalay, who called my attention to the problem and to Dr. B. Gyires for his kind interest and discussions concerning the mathematical problem.

Zusammenfassung

Es wird eine toroidförmige magnetische Linse beschrieben, um Elektronenstrahlen zu fokussieren. Wir geben den Grundgedanken des Modells und die Theorie der Konstruktion.

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Institute of Physics, Medical Faculty of the University of Debrecen (Hungary), October 10, 1948.

Thoriumtrijodid

Die Elemente der 4. Nebengruppe im periodischen System sind mit Ausnahme des Thoriums auch in niederer Wertigkeit als vier bekannt. Da die Tendenz zur Bildung von Verbindungen niederer Wertigkeit in dieser Gruppe beim Titan am ausgeprägtesten zu sein scheint und mit zunehmendem Atomgewicht abnimmt, ist deren Nichtexistenz beim Thorium nicht besonders auffallend, solange dieses Metall eindeutig der 4. Gruppe zugeordnet wird. Nun weisen aber die Eigenschaften der Elemente 93–96 auf die Möglichkeit hin[1], daß beim Element 89, Aktinium, eine den Lanthaniden analoge Gruppe beginnt, deren erstes Element Thorium wäre. Auf Grund dieser Zuordnung in die 3. Gruppe des periodischen Systems ist die Frage des Auftretens niederer Wertigkeit beim Thorium von erhöhtem Interesse.

Wir haben in diesem Sinne die Umsetzung von Thoriumtetrajodid mit Thoriummetall geprüft und im Vakuum bei 600° den Beginn einer Reaktion des in zitronengelben Blättchen kristallisierenden Thoriumtetrajodids festgestellt, welche durch mehrstündige Umsetzung, am besten durch Temperatursteigerung auf über 800°, vervollständigt wurde. Das erhaltene Produkt kristallisiert in feinen Nadeln von metallisch dunkelgrauer Farbe, ist hygroskopisch und hat die Zusammensetzung ThJ_3. Es zersetzt sich in Wasser rasch unter Disproportionierung zu vierwertigem Thorium und Thoriummetall, wobei gleichzeitig Wasserstoffentwicklung eintritt. Die letztere rührt zumindest zum Teil von der Auflösung des Thoriums in dem durch Hydrolyse sauer werdenden Medium her.

In bezug auf sein dunkles metallisches Aussehen und seine Instabilität gegen Wasser schließt sich das ThJ_3 den Verbindungen des dreiwertigen Hafniums und Zirkoniums an. Es steht im Gegensatz zu den Verbindungen des dreiwertigen Zers, die weiß oder schwach gefärbt sind (CeJ_3 = grüngelb), was auf den Edelgascharakter der äußeren Elektronenschale (O-Schale) des dreiwertigen Zers hinweist. Von diesem Gesichtspunkt aus widerspricht unser experimentelles Ergebnis der Annahme von SEABORG, daß Thorium das erste Glied von Aktiniden bildet. Eine ausführliche Mitteilung erscheint 1949 in den Monatsheften für Chemie, Wien.

E. HAYEK und TH. REHNER

Chemisches Institut der Universität Innsbruck und Staatsgewerbeschule Salzburg, den 14. Dezember 1948.

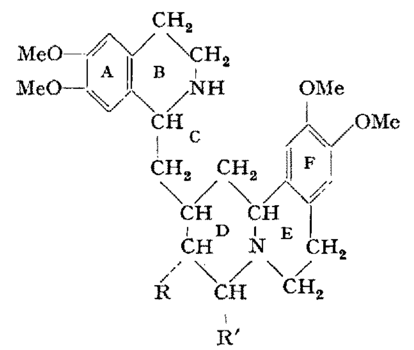
Summary

By thermal decomposition of ThJ_4 with Th we got ThJ_3 in form of metallic looking needles that react with water to ThO_2 and Th. This behaviour seems to contradict to the hypothesis of the beginning of an actinide group with thorium.

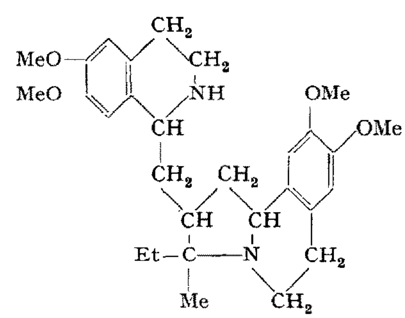
[1] G. T. SEABORG, Chem. Eng. News *23*, 2190 (1945).

The Constitution of Emetine

The results of the degradation of emetine by SPÄTH and PAILER[1] lead to two equally possible structures (I and II) for the alkaloid; the much less likely alternative (III), in which ring D is five-membered, also requires consideration. ROBINSON[2] has pointed out that structure (I) is satisfactory on biogenetic grounds; structures (II) and (III), on the other hand, cannot be readily reconciled with theories of biogenesis.



I, R = Et, R' = H. II. R = R' = Me



III

C-Methyl determinations, although probably consistent with (I), do not entirely exclude (II) or (III), for we obtained 0·97 *M* of acetic acid, while KARRER, EUGSTER, and RÜTTNER[3] obtained 1·1 *M*. We have therefore sought further evidence which would differentiate between these structures. Independently of SPÄTH and PAILER, we also have studied the Hofmann degradation of emetine[4], and in continuation of this work we have obtained a nitrogen-free, singly unsaturated substance which yields formaldehyde (33% as dimedone derivative) on ozonolysis, together with a ketone (not an aldehyde) which has not yet been fully characterized. The nitrogen-free product therefore possesses structure (IV), which is derived from (I), or less likely from (III), and the structure (II) for emetine is excluded. Further experiments with a view to determining the size of ring D are in progress.

One problem which remains to be considered is the formulation of the rubremetinium salts on the basis of (I). KARRER, EUGSTER, and RÜTTNER[5] consider that

[1] E. SPÄTH and M. PAILER, Mh. Chemie *78*, 348 (1948). – M. PAILER, *ibid.* *79*, 127 (1948).

[2] Sir R. ROBINSON, Nature *162*, 524 (1948).

[3] P. KARRER, C. H. EUGSTER, and O. RÜTTNER, Helv. chim. acta *31*, 1219 (1948).

[4] A. R. BATTERSBY and H. T. OPENSHAW, J. Chem. Soc., in the press.

[5] P. KARRER, C. H. EUGSTER, and O. RÜTTNER, Helv. chim. acta *31*, 1219 (1948).