a) Si l'on admet pour Cr^{55} une énergie de désintégration β d'environ 2 MeV, selon l'allure générale de la surface d'énergie dans cette région, il s'en suit que sa période doit être supérieure à une centaine d'années.

b) Le cas d'une période très courte paraît improbable, nos recherches dans cette direction ne nous en ont d'ailleurs donné aucun indice.

c) Il se peut, par contre, que le rayonnement cherché ait une énergie sensiblement inférieure à 0,1 MeV et ait échappé à notre observation.

d) Mentionnons enfin la possibilité que le seuil de la réaction (n, p) soit très élevé, impliquant un rayonnement d'une énergie à peu près égale. Une étude de cette réaction à l'aide d'une chambre d'ionisation permettrait de trancher ces questions.

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Zusammenfassung

Die dem Cr^{55} zugeschriebene Aktivität konnte durch die Reaktion Mn^{55} (n, p) Cr^{55} mittels Li-D-Neutronen nicht merkbar erzeugt werden. Die Möglichkeiten zur Erklärung dieses Resultates werden erörtert.

The Reaction between Hydrogenperoxide and Iron Salts

In a recent note BRAY and PETERSON[1] have discussed ANDERSEN'S work[2] on the reaction between hydrogenperoxyde and ferric salts, particularly with regard to the induction period which was found by this author and they arrived at the conclusion that these results can be understood on the basis of the theory of HABER and WEISS[3]. In the course of our recent studies of the reaction between hydrogenperoxide and iron salts it has been found that ANDERSEN'S empirical kinetic equation can be derived also from the reaction scheme of HABER and WEISS. The equations which were proposed in 1934 are given below with their original numbering

$$Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + OH^- + OH \quad (k_1) \qquad (1)$$
$$H_2O_2 + OH \rightarrow H_2O + HO_2 \quad (k_2) \qquad (2)$$
$$H_2O_2 + HO_2 \rightarrow O_2 + H_2O + OH \quad (k'_3) \qquad (3)$$
$$H_2O_2 + O_2^- \rightarrow O_2 + OH^- + OH \quad (k_3) \qquad (3')$$
$$Fe^{2+} + OH \rightarrow Fe^{3+} + OH^- \quad (k_4) \qquad (4)$$
$$Fe^{2+} + HO_2 \rightarrow Fe^{3+} + HO_2^- \quad (k_{10}) \qquad (10)$$
$$Fe^{3+} + HO_2^- \rightarrow Fe^{2+} + HO_2 \quad (k_{13}) \qquad (13)$$
$$Fe^{3+} + HO_2 \rightarrow Fe^{2+} + O_2 + H^+ \quad (k_{14}) \qquad (14)$$
$$Fe^{3+} + O_2^- \rightarrow Fe^{2+} + O_2 \quad (k'_{14}) \qquad (14')$$

For an adequate description of the reaction, in general all the above reactions have to be taken into account. In particular, it has been found by a number of authors[4] that in the presence of certain metal ions (ferric, cupric, ceric, cobaltic) the formation of molecular oxygen takes place predominantly by a reaction of the type of equation (14'), as proposed also by HUMPHREY and WEISS[1].

Thus for the kinetics of the reaction with ferric salts the equations (1), (2), (4), (10), (13), (14') must be taken into account. Treating this system of six equations for the stationary state of the radicals (OH and HO_2) and of the ferrous-ferric system one can obtain an expression which contains only the *total* concentration of the iron salt, f, added originally as ferric salt. Thus, $f = \{[Fe^{2+}]_s + [Fe^{2+}]_s\}$ represents the sum of ferrous and ferric ions in the stationary state. If one introduces the well-known experimental fact[2] that in the system, hydrogenperoxyde-ferric ions, the stationary state is situated predominantly on the ferric side, i. e.

$$[Fe^{2+}]_s \ll [Fe^{3+}]_s \qquad (I)$$

then the resulting equations assume a relatively simple form. In this way one obtains eventually the following differential equation for the rate of decomposition (x concentration of the hydrogenperoxide at time t)

$$-\frac{dx}{dt} = \alpha x \sqrt{\frac{\beta x}{\gamma x + \delta}} \qquad (II)$$

with

$$\alpha = \frac{2 k_1 f}{[H^+]}, \quad \delta = \text{prop. } f, \quad \beta \text{ and } \gamma \sim \text{constants.}$$

Equation (II) can be easily integrated and gives (a initial concentration of the hydrogenperoxide, $F = \delta/\gamma$)

$$\left\{\sqrt{1+\frac{F}{x}} - \sqrt{1+\frac{F}{a}}\right\} + \tfrac{1}{2}\left\{\ln \frac{\left(\sqrt{1+\frac{F}{x}}-1\right)\left(\sqrt{1+\frac{F}{a}}+1\right)}{\left(\sqrt{1+\frac{F}{x}}+1\right)\left(\sqrt{1+\frac{F}{a}}-1\right)}\right\} = \tfrac{1}{2}\alpha\sqrt{\frac{\beta}{\gamma}}\, t. \qquad (III)$$

One can show that, under the conditions in question, (F/x) and $(F/a) \ll 1$ hold with good approximation and thus the square roots can be developed up to the linear terms, which gives

$$0{\cdot}434\, F\left\{\frac{1}{x} - \frac{1}{a}\right\} + \log\frac{a}{x} = 0{\cdot}434\, \alpha\sqrt{\frac{\beta}{\gamma}}\, t. \qquad (IV)$$

This is identical with ANDERSEN'S empirical equation[3], whereby his constants B and A are expressed in the following manner

$$B = 0{\cdot}434\, \alpha\sqrt{\frac{\beta}{\gamma}} = \text{prop. } \frac{f}{[H^+]}, \quad A = 0{\cdot}434\, F = \text{prop. } f.$$

The reaction mechanism outlined above shows also an important qualitative feature, viz., that some OH radicals are produced also in a mixture of hydrogenperoxide and ferric salts on account of the intermediate formation of ferrous ions which can react according to equation (1). It is thus to be expected that the reactions of OH radicals (e.g. hydroxylation of benzene and its derivatives[4]) should be found also by starting with a ferric salt and hydrogenperoxide. This is in agreement with the observations of ANDERSEN[5] and with a number of results obtained in this laboratory.

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[2] V. S. ANDERSEN, Act. Chem. Scand. *2*, 1 (1948).
[3] F. HABER and J. WEISS, Proc. Roy. Soc., (London) [A] *147*, 332 (1934).
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[1] C. W. HUMPHREY and J. WEISS, Nature *163*, 691 (1949).
[2] Cf. A. SIMON, W. HAUFE, TH. REETZ, and R. PREISSLER, Z. anorg. Chem. *230*, 129 (1936).
[3] V. S. ANDERSEN, Act. Chem. Scand. *2*, 1 (1948).
[4] H. LOEBL, G. STEIN, and J. WEISS, J. Chem. Soc. (London) 2074 (1949). – J. H. MERZ and W. A. WATERS, ibid., p. 2427 – G. STEIN and J. WEISS, ibid. p. 3245, Nature *161*, 650 (1948).
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A fuller discussion of all these problems will be published elsewhere. JOSEPH WEISS

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Zusammenfassung

Es wurde gezeigt, daß eine von S. ANDERSEN kürzlich gefundene empirische Gleichung, die die Reaktionskinetik der Reaktion zwischen Wasserstoffsuperoxyd und Ferrisalzen in einem ziemlich weiten Bereiche gut wiedergibt, aus dem Haber-Weißschen Reaktionsschema abgeleitet werden kann.

The Influence of Organic Solvents on the Growth of Plants

While studying the influence of hormonal extracts on the growth of shoots of different plants we often used organic solvents for the extraction. There arose the problem whether minute quantities of these solvents do not themselves influence the sprouting and growth of plants. In order to resolve this question we investigated the influence of aqueous solutions or emulsions of most commonly used organic solvents (amylalcohol, ethylalcohol, butylalcohol, acetone, benzene, chloroform, petroleumether, sulphuricether and xylen) on the sprouting and growth of plants. As we see in the plant growth hormones, the stimulating or inhibiting action of a given chemical substance on the growth of plants depends mainly of the strength of its solution. It was therefore necessary to examine the dilution of solvents on the widest possible scale. We have therefore used dilutions or emulsions within the limits of 1:5 to $1:10^9$. Shoots of oats cultivated on Petri dishes and sprinkled daily with dilutions and emulsions of various organic solvents served as objects for our experiments. We weighed for each Petri dish the same quantity of oat seeds (5 or 10 grams). In every experiment we used for each solvent 13 dishes (equal to the number of dilutions we worked with) which gave, together with the water control, a total of about 120 dishes.

After 15 days we determined on each plate: the number of shoots; the height of each shoot; the total weight of the shoots; the total weight of the roots.

The figures thus obtained, compared with the water control, gave the measure of the inhibiting or stimulating influence of each organic solvent in a given dilution. We performed 12 experiments on about 1400 dishes investigating about 220,000 seeds.

The influence of the solvents on the shoots proved to be very strong:

(1) Solvents used in a low dilution (degree of dilution depends upon the solvent) were very toxic and provoked a marked inhibition of the germination of seeds and of the growth of shoots (inhibition area).

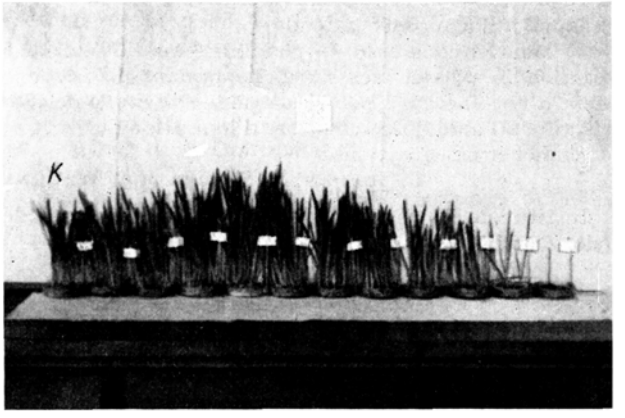
(2) Moderate dilutions did not show any influence, neither stimulating nor inhibiting; the shoots did not differ from the control either in number or in height and weight ("neutral area").

(3) In high dilutions there was a marked stimulating influence concerning the number of shoots as well as the height and weight of stems ("stimulating area").

The average growth of the shoots as well as their height and weight was approximately the double of the water control ones.

The maximum stimulation appeared with dilutions $1:10^5$ to $1:10^7$. The stimulating influence disappeared with dilutions lower than $1:10^7$. These relations are illustrated by the enclosed figure.

Amylalcohol proved to have the most toxic inhibiting effect; the least toxic was petroleumether, but on the other hand it stimulated growth most strongly.



Oat shoots cultivated on chloroform emulsion in a dilution from 1:5 to $1:10^9$ (from right to left). *K* = water control.

Considering their toxic action, all the investigated solvents can be ranged as follows: amylalcohol, butylalcohol, xylen, benzen, ethylalcohol, acetone, chloroform, sulphuricether, petroleumether. The more toxic a solvent is, the larger is its inhibition area, the more its neutral point is shifted towards smaller concentrations, and the smaller is its stimulating area. We give below the average value number we obtained for various solvents in all used dilutions (Table).

The results obtained show that traces of organic solvents in extracts of various tissues may influence the growth and development of plants, which must be taken into consideration in all experiments on plants.

The mode of action of the organic solvents is not yet quite clear and requires further investigation.

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Zusammenfassung

Bei der Untersuchung verschiedener Organextrakte im Pflanzenwachstumstest haben wir oft zur Extraktion organische Solvenzien verwendet. Es war deshalb wichtig, den Einfluß der Extraktionsmittel an und für sich zu untersuchen. Es wurden wäßrige Lösungen oder Suspensionen folgender Stoffe untersucht: Azeton, Amyl-, Äthyl- und Butylalkohol, Benzol, Chloroform, Petroläther, Schwefeläther und Xylen. Es wurden Verdünnungen von 1:5 bis $1:10^9$ verwendet. Mit diesen Verdünnungen wurden täglich Hafersamen in Petri-Schalen begossen. Insgesamt wurden zwölf Untersuchungen auf ca. 1400 Schalen durchgeführt. Für jedes Solvens haben wir eine toxische, hemmende Zone in kleineren Verdünnungen, eine neutrale in etwas größeren und eine Stimulierung des Wachstums der Stengel, ihrer Zahl und ihres Gewichts in ganz großen Verdünnungen festgestellt. In noch größeren Verdünnungen bleibt die Wirkung aus. Amylalkohol war am meisten toxisch. Mit Petroläther gab es die stärkste Förde-