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SUMMARY OF THE RESEARCH PROGRESS MEETING

March 10, 1949

H. P. Kramer

Berkeley, California

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INFORMATION DIVISION
Radiation Laboratory
Univ. of California
Berkeley, California

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On the Deflector of the 184" Cyclotron. J. Vale.

The proton beam in the 184" cyclotron has been successfully deflected and its intensity has been measured by an ionization chamber. A current of 10^{-10} amp. was found when the beam was intercepted by a counting area with a 2" diameter. By taking into account the size of the aperture by which the beam leaves and any possible spread it was concluded that the counter was exposed to only $\frac{1}{2}$ of the beam's cross section. On the assumption that the proton beam like the deuteron beam varies linearly in intensity with diameter it is estimated that the strength of the total deflected beam is 2×10^{-10} amp. The intensity of the internal circulating beam is $\frac{1}{2}$ μ amp. Thus, the beam is reduced in deflection by a factor of 4×10^{-4}. In the past it was possible to deflect the accelerated deuteron beam with a decrease by no more than a factor of 1/10. The present high loss can be minimized considerably by correcting the inaccuracies in timing to which it is attributable.

In order to achieve the higher voltage between the electrical deflector bars that is necessary for operation with 350 Mev. protons, a new set of transformers has been installed. Each transformer is driven by eight thyratron circuits, whose design is shown in Fig. 1. A new non-inductive resistance has been inserted between the plate and the high voltage line. The decrease in inductance has cut the pulse rise time to .2 μ sec. (See Fig. 2) The peak voltage which can now be placed on the deflector bars is 200-250 kv. Each thyratron is capable of furnishing 11 kv. It is however not necessary to use the thyratrons to the full extent. In order to deflect the deuteron beam the thyratrons were run at 4.5 kv. And it was thought that 7.0 kv. would be sufficient

to deflect the proton beam. However, its was found to be necessary to run the thyratrons at 9.5 kv. for proton deflection.

The transformer core laminations have been reduced to $\frac{1}{2}$ of their former thickness in order to minimize eddy current losses.

The Permeability of Membranes. Dr. Using.

The membranes that surround living cells possess the property of discriminating among the ions in the blood, allowing some of them to pass into the cell and rejecting others. Furthermore, the power of the membrane is biased in direction. Ions that are readily admitted are not easily passed out. This matter of the discriminatory permeability of membranes has been investigated quantitatively by means of tracers.

Inside the cell, the most abundent cation is K^+. In the surrounding blood stream its concentration is low. In the plasma, the concentration of Cl^- is high but in the cells, it is comparatively low. This phenomenon is interpreted by Conway's hypothesis which states:

$$K_o/K_i = Cl_i/Cl_o .$$

In this formula the symbols for the chemical elements refer to the concentrations and the subscript o denotes that the ion is located outside the cell and i indicates that the ion is inside the cell. The formula is an expression of the notion that the potential gradient across the membrane controls the flux of ions into and out of the cell. It represents a good approximation to the actual situation when the concentration of potassium ion in the blood is not below a certain minimum value.

Tracer experiments with labeled sodium ion have demonstrated that the potential gradient across the membrane is not the only factor that controls the flux. By suspending a frog's leg muscle in a solution containing labeled Na^+ and observing the time rate of change of the concentration of Na^+ in the solution it was possible to determine the speed of exchange of sodium ion through the membrane. Fig. 3 shows the apparatus and the results with Na^+.

In the search for the mechanism of transfer across the cell membrane that was needed to complement Conway's hypothesis, two possibilities were considered:

1. the diffusion of free ions
2. actual transport.

For free diffusion, the following formula holds true:

$$M_i/M_o = \bar{a}_o/\bar{a}_i$$

where M denotes the flux of ions in unit time and $\bar{a}$, the electrochemical activity is defined by

$$RT\log\bar{a} = RT \log a + F \psi .$$

The calculated value of the ratio M_i/M_o is 50. The value that was found by experiment is 1. This discrepancy clearly eliminates free diffusion as a consequential mechanism for the motion of ions through the membrane.

By actual transport is meant a mechanism for ion transfer across the membrane that requires some of the energy that is generated within the cell. The minimum energy needed for actual transport was calculated to be about 30% of the total energy available from metabolism in the cell. This requirement seems to be too high and therefore this possibility must also be ruled out as being improbable.

Perhaps, the explanation for the singular behaviour of sodium ion with regard to its passage through the cell wall is that there exists an enzyme-like substance in the membrane that binds these ions, moves them through the membrane and releases them on the other side.

Experiments with labeled iodides have been carried out to measure the rate at which iodides enter and leave the cells. It was found that the experimental results can be interpreted simply on the basis of the potential difference.

Light Iodine Isotopes. L. Marquez.

	120	121	122	123	124	125	126	127
$_{54}Xe$								
$_{53}I$		1.8 hr.	13.2 hr.	56d K	4d β^+		13d β^-, γ	
$_{52}Te$								
$_{51}Sb$								
$_{50}Sn$								

Table of Light Iodine Isotopes

$_{51}Sb^{121}$ was bombarded with 30 and 38 Mev α-particles and a 56 d. K-captive activity was found. The 56 d. I activity had previously been assigned to the mass number 125. This bombardment, however, points to an assignment to the mass number 123.

In the bombardment of ordinary antimony ($Sb^{121-123}$) with 60 and 100 Mev α particles 40 min., 1.8 hr., 13.2 hr., 4 d. and 13 d. activities were seen. These were given the mass assignments indicated in the section of the isotope table that accompanies this report. (The mass assignment for the 40 min. activity is less than 121.)

The 40 min., 1.8 hr., 13.2 hr. I activities were also produced by the α-bombardment of Sn^{121}.

An attempt is being made at present to explain the mechanism by which a α particle transmutes $_{50}Sn^{121}$ to $_{53}I$ isotopes. Also, work is going on to fill the place in the table that was left vacant by the reassignment of the 56 d. activity.

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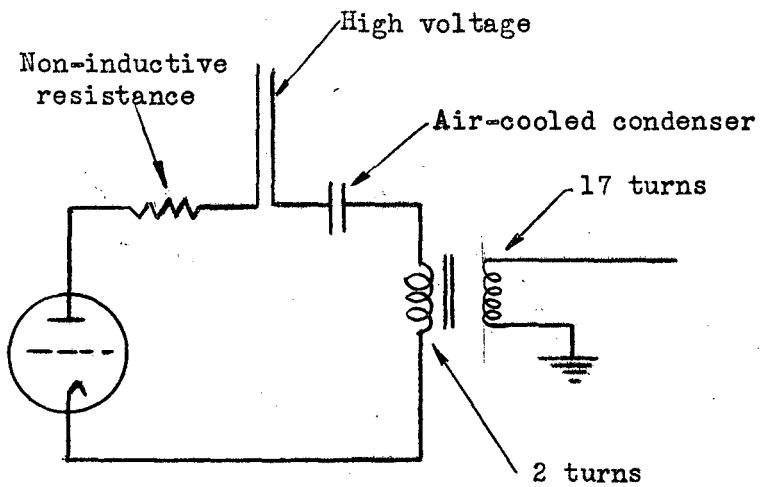


Thyratron Circuit

Figure 1

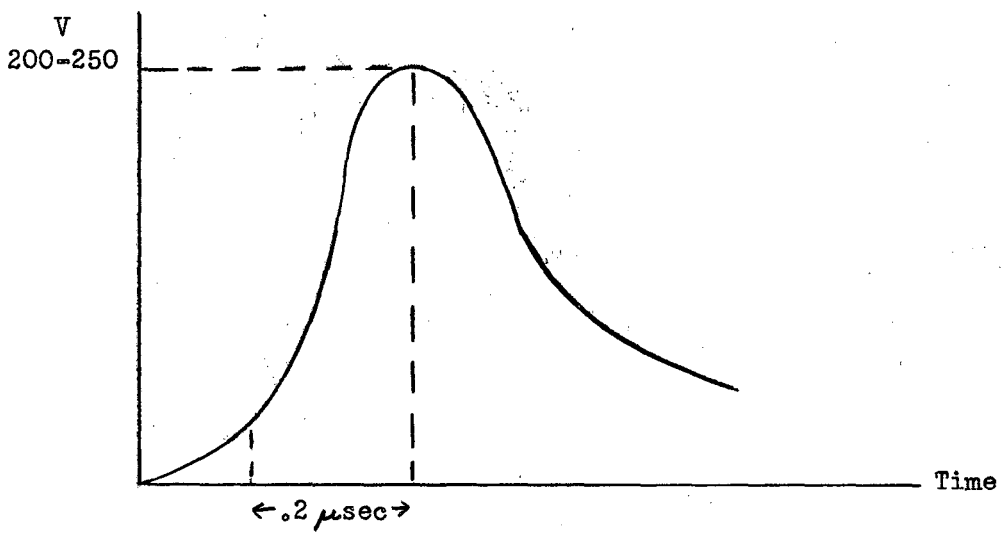
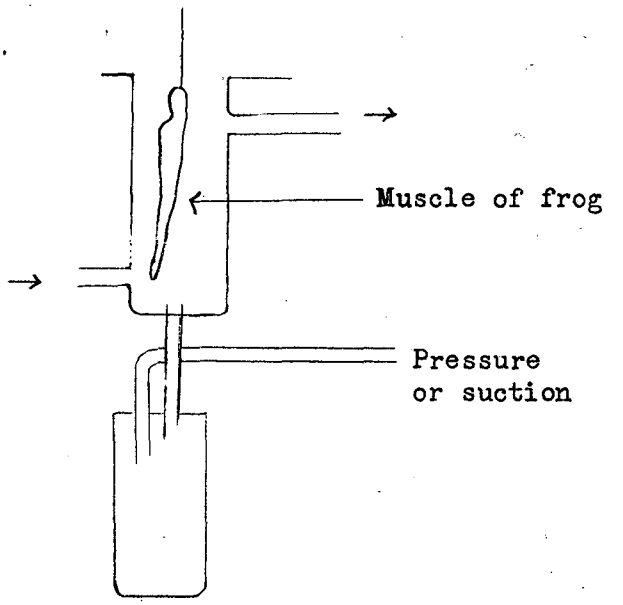
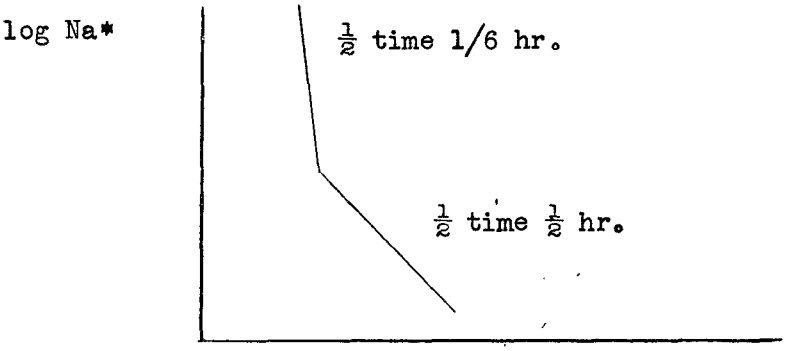


Figure 2





Removal Time of Sodium and Apparatus for Determination

Fig. 3.