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Physics-General

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Summary of the Research Progress Meeting

October 7, 1948

Henry Kramer

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Summary of the Research Progress Meeting

October 7, 1948

Henry Kramer

Comparative Metabolism of Globulin-Bound Iodine in Normal and Cancerous Animals. K. Scott.

The purpose of this study is to find a radioactive element which can be administered to detect and diagnose deep-seated cancers. It was expected that this could be accomplished by taking advantage of the extremely high metabolism of cancers. Moreover, in the course of this investigation, some clues might be found which would help in explaining the mechanics of this high metabolism.

Rabbits were chosen to act as agents for the production of the globulin-bound iodine. They were administered radioactive I^{131}. Then, the thyroid was removed and its globulin fraction containing the iodine-bearing thyroxine ($C_{15}H_{11}I_4NO_3$) was extracted by repeated washing with HCl and subsequent precipitation. The substance which was obtained in this fashion probably contains iodo-tyrosines in addition to the desired thyroxin. However, to avoid further tampering with a sensitive biological entity, the substance was used in the resulting form.

A tumor was transplanted in rats, the iodine was administered intravenously, and the resulting activity was observed. It was found that the uptake by the tumor of thyroglobulin was negligible. However, it turned out that the skin organ, the entire skin of the animal considered as an entity, showed 3 to 5 times as much activity on the day following the introduction of the iodine than the skin organ of a non-tumorous animal.

An attempt was made to relate the skin activity to the relative size of the tumor. A graph was plotted to exhibit the skin uptake as a function of the size of the tumor. The ordinate was chosen as the percentage of the administered dose of radioactive iodine I^{131} which was deduced from the count to have lodged in the skin. The abscissa represents the percentage which the weight of the tumor constitutes of the weight of the entire animal.

t was found, for example, that the skin activity of an animal with a tumor which constituted 5% of its total weight was four times as large as that for an animal without a tumor. The graph is shown schematically in Fig. 1.

It was further discovered that under the influence of I^{131} the tumor does not metastasize, that is, infiltrate the skin. For this reason, the results are all the more interesting since they establish a relation between the tumor and the host. A fundamental object of further study will be to determine the mechanism, possibly the existence of a chemical entity, which enables the tumor to affect its host with results such as increased skin activity.

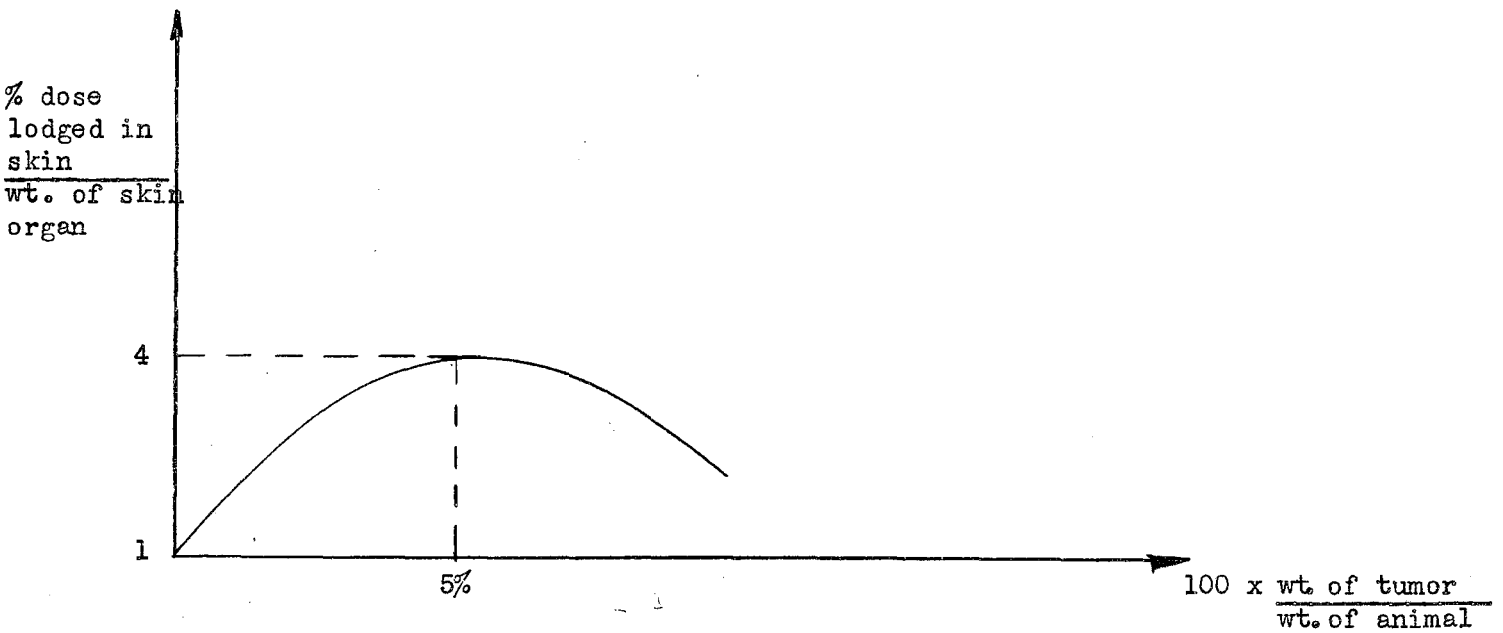

Fig. 1

Skin-uptake of I^{131} by tumorous rats

The Ion Exchange Separation of Hafnium and Zirconium. K. Street.

Because of the great similarity in chemical properties and the invariable concurrence of $_{72}Hf$ and $_{40}Zr$ the separation of pure samples was in the past accomplished with great difficulty by endless fractional crystallization. Now a method of separation is available which makes use of an ion-exchange column and achieves more satisfactory results and at the same time constitutes a tremendous saving in time and labor.

The method operates by making use of the difference which exists between the two ions with regard to the equilibrium between the liquid and the solid state. A vertical tube is filled with a resin to act as an eluting agent. In this case Dowex 50 was used. The solution to be tested is placed on top of the column and that portion which has passed through the elutriant is withdrawn at the bottom at a constant rate. The concentration of the ions of one kind in the solution which is drawn off at the bottom of the tube at some time t is a function of the distribution coefficient which is a characteristic constant of the ion. This coefficient is the ratio between the portion of ions which is suspended in the resin and the portion of ions contained in solution. The speed V at which ions move downward through the resin is given by

$$V = \frac{1}{K + 1} \times \text{(velocity of ion motion)}$$

where $K = \frac{\text{amount in resin}}{\text{amount in solution}}$, is the distribution coefficient.

In order to avoid polymerization, the oxides had to be treated with 2M HCl. Zr and Hf tracers were added. A test run was carried out with 15 mg. HfO_2 and 35 mg. ZrO_2. The crystals which were obtained after treatment were dissolved in a suspension of 1 cc. of 250 to 500 mesh Dowex 50 spheres in 30 cc of 2 molal perchloric acid. The resin slurry was then placed on an ion exchange column 1 cm. in cross section and 30 cm. in length. The results are shown in the curve of Fig. 2. The solid line was found by measurement of tracers; the dotted line, by optical spectrographic analysis. At about 65 ml. the ratio Hf/Zr has the value 800, at about 80 ml., it is .3, and at about 110 ml. its value is less than .001. These results demonstrate that the separation is quite good.

The separation is more or less independent of relative concentration and the method can be adapted to handle both large and tracer quantities of material.

For a more detailed description, see UCRL-191, "The Ion Exchange Separation of Zirconium and Hafnium", Kenneth Street, Jr. and Glenn T. Seaborg, October 11, 1948.

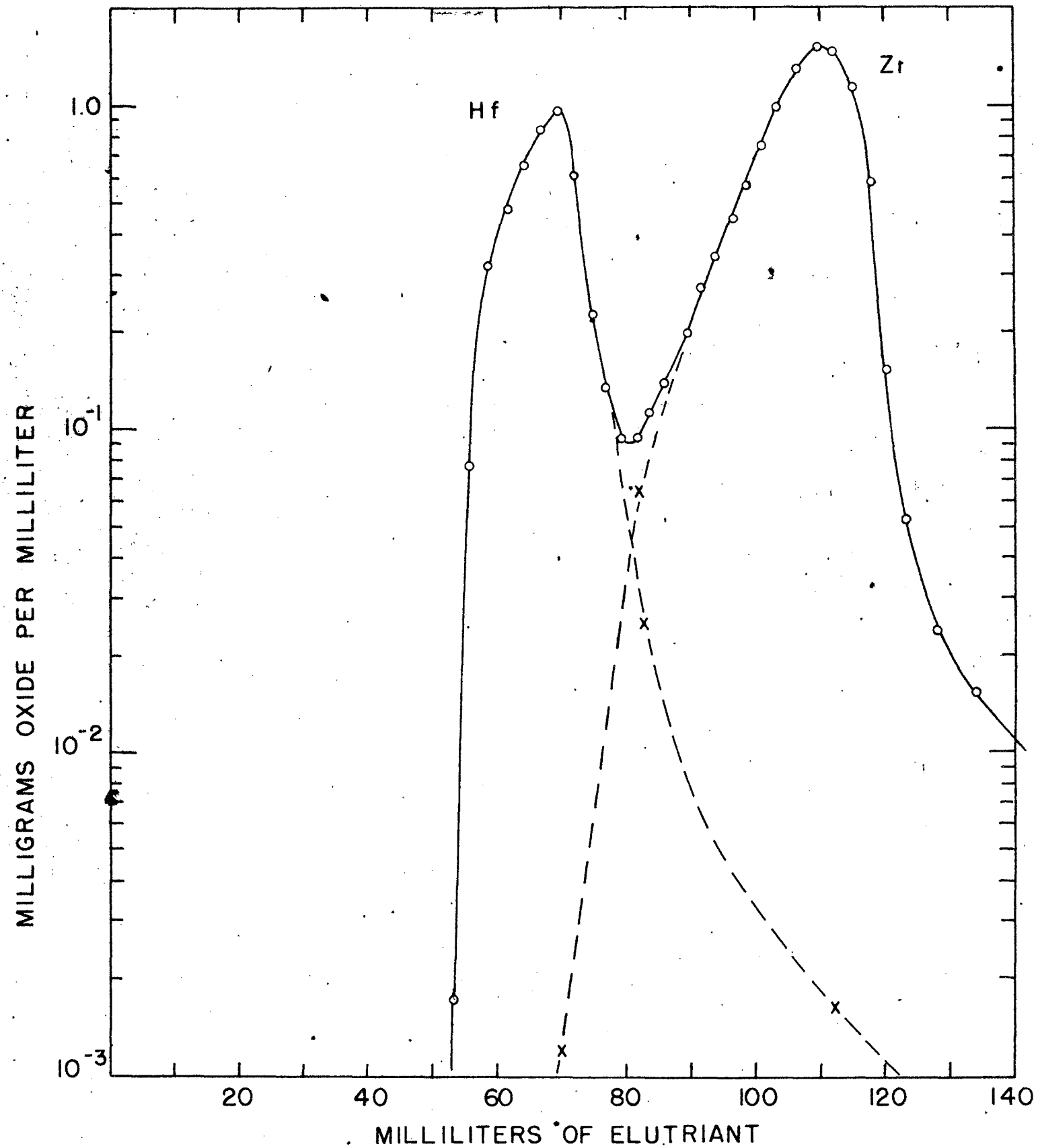

FIG. 2

ELUTION OF Zr AND Hf WITH 6.0 MHCl

Secondary Proton Production from 90 Mev Neutrons. H. York.

The purpose of the investigation is to map the angular and energy distributions of the secondary protons produced in various substances by bombardment with 90 Mev neutrons. It is hoped that the results of the investigation will shed light on the mechanics of production of the protons.

An apparatus was set up outside the neutron channel of the cyclotron. It was designed so that it could discriminate between energy levels and could be adjusted to make counts at different angles. The scheme of the arrangement is shown in Fig. 3.

The sensitivity of the energy discrimination of the apparatus was checked with protons from H_2 and was found to be as predicted within the probable error.

Fig. 4 shows the angular distribution of the protons from Pb, Cu, and C at all energies exceeding 18 Mev.

Fig. 5 shows the appearance of the energy distribution of protons from Cu and C. Fig. 6 shows the somewhat different energy distribution from Pb.

Fig. 7 shows the angular distribution at a given energy for three energies, 25 Mev, 41 Mev, 73 Mev of protons from Cu. It is seen that these curves are almost exponential. On the assumption that they actually are exponential, an exponential curve was fitted to each of the experimental curves. The half angles which were obtained on this hypothesis are shown below.

E	1/2 E
73°	15°
41°	16°
25°	$\binom{29}{23}^\circ$

It was observed that protons with relatively low energies were found relatively forward, i.e. at small angles from the neutron beam. The attempt to explain this phenomenon gives rise to some interesting speculations regarding the n-p process.

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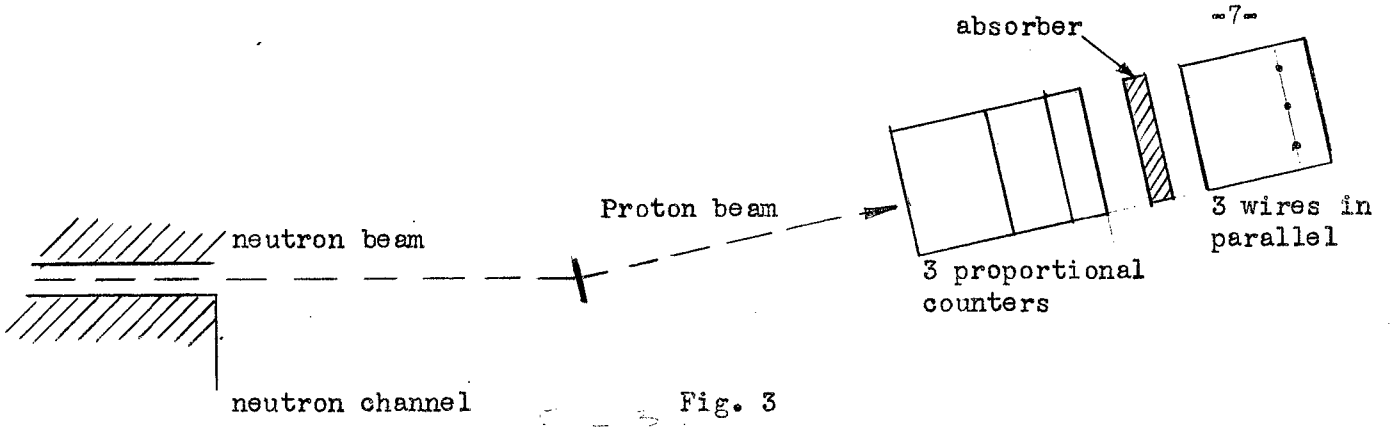

Fig. 3

Experimental Arrangement

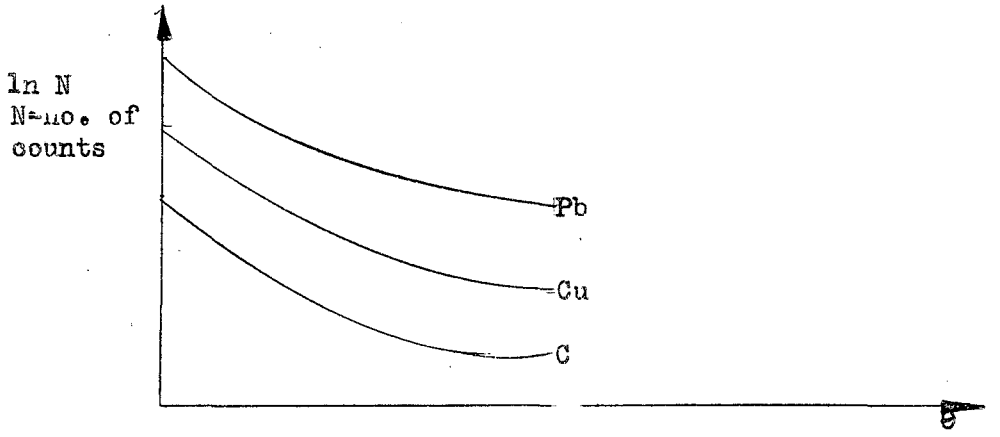

Fig. 4. Angular distribution for Pb, Cu, and C.

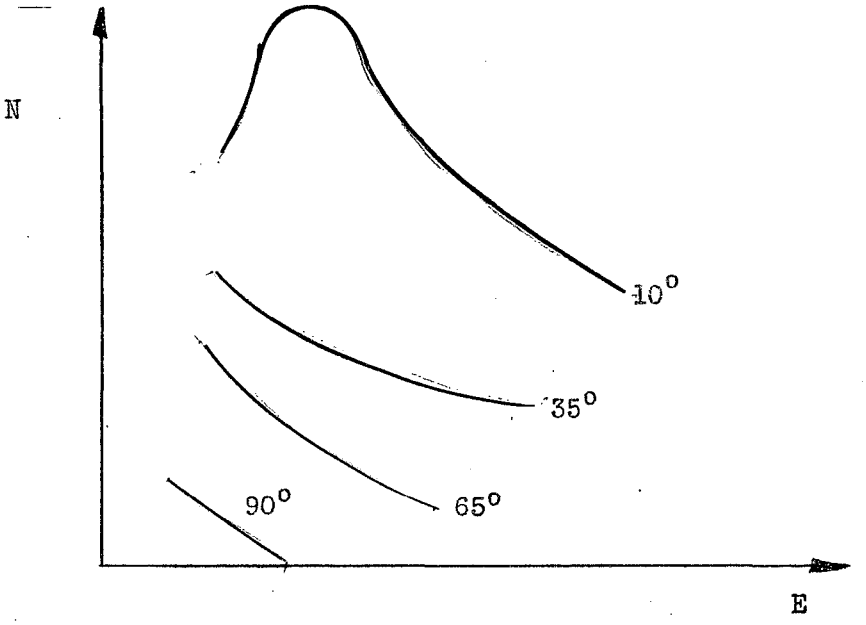

Fig. 5. Energy distribution for Cu and C

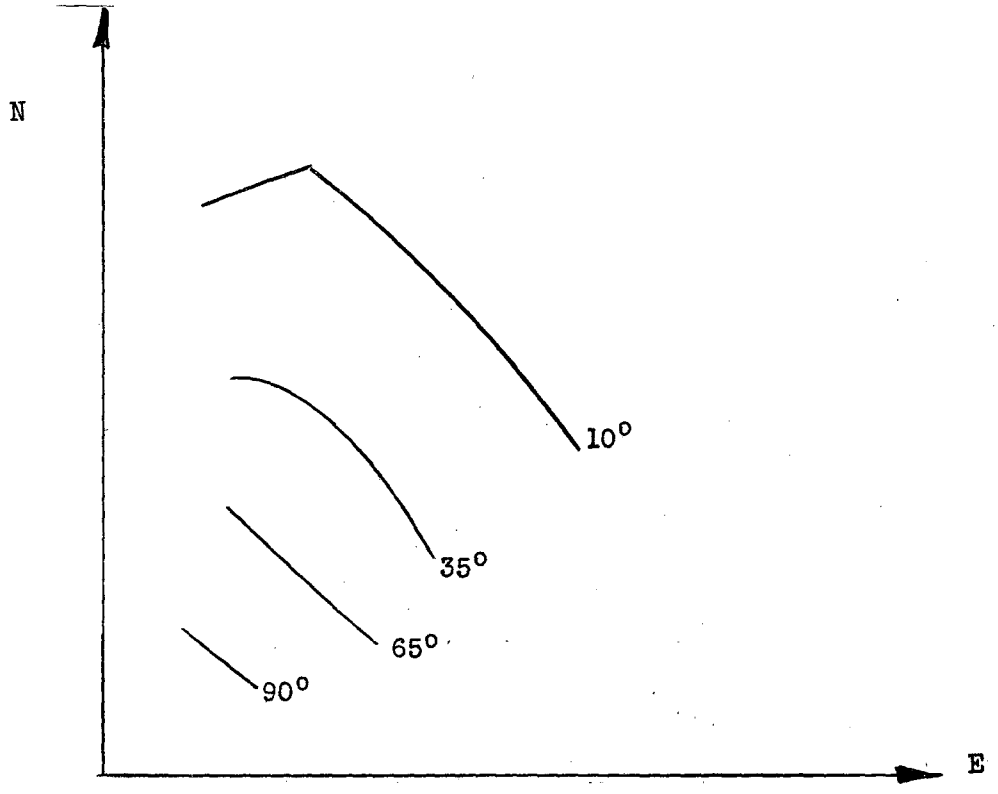

Fig. 6. Energy Distribution for Pb

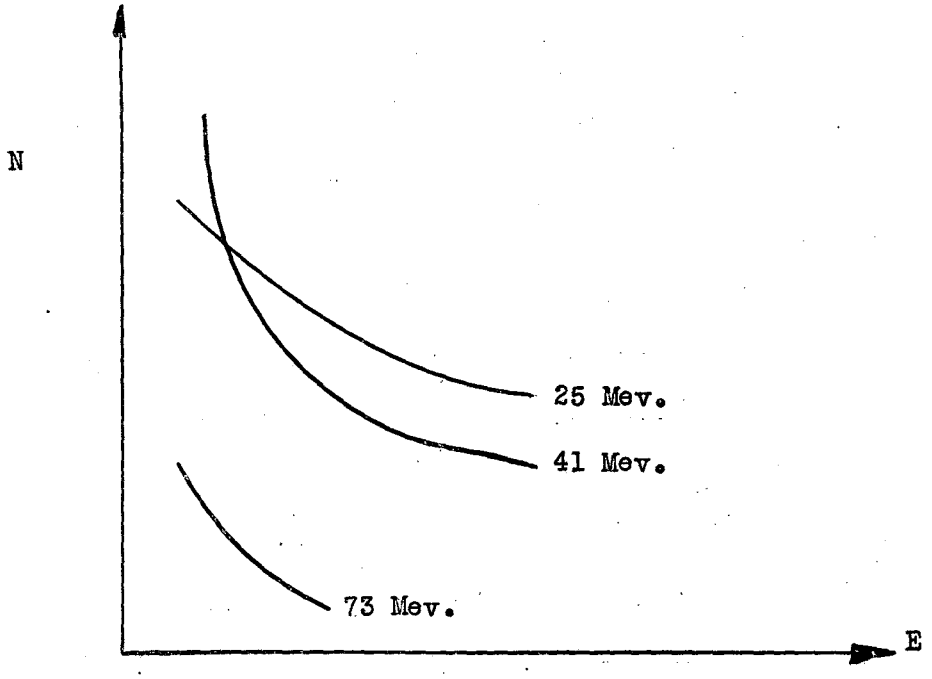

Fig. 7. Angular distribution at given energies