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**Special Review of
Declassified Reports**

Authorized by USDOE JK Bratton

Unclassified TWX P182206Z May 79

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SUMMARY OF THE RESEARCH PROGRESS MEETING

by R. K. Wakerling

November 13, 1947

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Neutron Scattering. By R. Hildebrand. A series of measurements have been made of the angular distribution of neutrons scattered from small spheres of various materials placed in the neutron beam of the 184-inch cyclotron. The scattered neutrons were detected by copper covered carbon detectors placed in a symmetrical arrangement about the scatterer. The carbon detectors, which were activated by the neutrons through the $C^{12}(n, 2n)C^{11}$ reaction, were counted using an arrangement involving four counting tubes. The copper around the detectors served the purpose of stopping any protons. A carbon disk monitor was placed at the collimating channel in the cyclotron shield. This disk was also counted by the same arrangement.

To illustrate the type of results, a detector placed to detect neutrons scattered at an angle of 5° from a copper sphere gave 3848 counts in twelve minutes with a background of 1620 counts, giving a residual of 2228 counts for that interval. The ratio of the counts from the detector to the counts from the monitor was $\frac{D_C}{M_S} = 0.1019$. A similar series of counts was also made for a run without a scatterer in the beam. The ratio of detector to monitor counts in that case was $\frac{D}{M} = 0.0328$. The difference between these two ratios is 0.0691, which for our purposes will be designated by α . This quantity is next corrected for the absorption effect, the ratio of efficiency of detector to monitor, etc; and computed in the form

$$N \frac{D_T}{M_T} \frac{r_0^2}{r^2} e^{-\frac{3}{2} \alpha} \left(\frac{.693}{T_1 \frac{1}{2}} \right)$$

Figure 1.

Figure 2.

where N is the mass of the substance divided by its atomic weight, $\frac{D_T}{M_T}$ is the ratio of the efficiencies of detector and monitor, $\frac{r_0^2}{r^2}$ is the factor to correct for the inverse square effect, and a is the radius of the scattering ball of material and $T_{\frac{1}{2}}$ is its half-thickness. This quantity when plotted on a logarithmic scale gives the results shown in Figure 1 for aluminum, copper, and lead. The results to be expected from a simple diffraction theory were computed and compared with the experimental results. This is shown in Figure 2, from which it is seen that the experimental points follow quite closely the predicted ones.

Electrical Resistance of the Blood. By R. Rosenthal. It has been found that animals exposed to total body irradiation developed in their blood an anti-coagulant called heparin. This substance, which can be produced synthetically, has the property of prolonging the clotting time of the blood.

In an article which appeared in "Science" some work was reported on the variation of the electrical resistance of the blood with the amount of heparin present. If some simple relationship could be found between the electrical resistance and the amount of heparin in the blood it might be possible to get a measure of the total radiation to which the animal had been subjected. In the work mentioned above the electrical resistance was found to vary with time for normal human blood and blood from people treated with heparin in the manner shown in Figure 3. The clotting time

Figure 3.

was the same for both cases.

An effort has been made to duplicate this work in the Medical Physics Laboratory here. The procedure used was to place 2 cc of blood in a test tube and to immerse in the blood two platinum electrodes with a surface area of $1/4$ sq. cm placed $1/2$ cm apart. A 1000 cycle a.c. potential of $1/4$ volt was placed across the electrodes and readings of the resistance made at 1 minute intervals for 40 minutes. This procedure gave rise to the curves shown in Figure 4 for normal blood and blood with heparin. It is

Figure 4.

seen that these results differed markedly from those reported by the previous workers, although some of the differences may arise from the differences in the geometries of the test cells used. For example, the earlier workers used pin point electrodes. In the experimental arrangement used here the blood clot forms between the two electrodes, and since the red cells are non-conductors, the resistance rises rapidly with time after clotting begins. The experimental arrangement will be varied to discover the effects on the results obtained.

It is planned to continue this work with a series of measurements on animals and people subjected to various amounts of radiation in an effort to check the matter of prolongation of the clotting.

184-inch Deflector. By J. Vale. In an effort to determine the shape of the deflected deuteron beam as it emerges from the 1/8 inch aluminum window in the tank, a mosaic of 1/2 inch carbon squares placed 3/4 inch apart in a rectangular array was placed close to the window and bombarded for a short interval of time. The carbon squares were then counted and the intensity of the activity examined as a function of the position in the array. Figure 5 shows the horizontal distribution of the deflected beam taken along the line which passed through the point of maximum intensity.

Figure 5,

Figure 6 shows the distribution along the vertical line through the same point. It thus appears the vertical and horizontal distributions are

Figure 6.

essentially the same. It was computed that seventy percent of the beam is included in a strip 1-1/2 inch wide and three inches long across the center of the mosaic. If the width of the strip is increased to 2-1/2 inches, 80 percent of the beam falls in a section of the strip three inches long.

A careful measurement of the deflected beam current was made with a 1 inch square, thick copper target equipped with an electron catcher and mounted in an evacuated box. The variation of beam current to this target as a function of the bias voltage is shown in the following table.

<u>Bias</u>	<u>Current</u>
0	.22 x 10 ⁻⁸ amp.
-20 v	.23 x 10 ⁻⁸ amp.
+20 v	.17 x 10 ⁻⁸ amp.

From these data it appears that a current of .20 x 10⁻⁸ amperes is intercepted by a one-inch square target. On the basis of this observation and the beam distribution as determined above it is calculated that the total beam current through the window is approximately 5 x 10⁻⁹ amperes. This corresponds to a total circulating beam inside the tank of about 1/2 μ a.

It is hoped shortly to have the complete electrical system for the electrostatic deflector installed so that the deflector may be used continuously. At the present time the electrical system is so overloaded that it may be used only intermittently.

Spectrochemical analysis. By J. Conway. The spectrochemical laboratory is now prepared to handle a number of different types of problems. One of these is quantitative tests in the microchemical field on precipitates, sludges, etc., where an accuracy of 0.1 to 0.01 percent can be secured.

Quantitative analysis can also be made by means of the copper spark method. The material to be examined is evaporated on to a copper electrode which is then arced at 20,000 volts to produce the spectrum. A plain copper electrode is used to produce the comparison spectrum. The spectra are usually compared visually, although this may be done photometrically. This is a method of extreme accuracy and can detect quantities of material as small as 1/10 microgram. 100 micrograms is the limit of the amount that can be placed on such an electrode.

The spark method is also used to achieve a physical separation by carrier distillation. This is used for high melting points oxides. To illustrate, a sample of gallium oxide is arced in a carbon crater at 10 amperes. In the process of heating to the boiling point of gallium oxide 33 elements are found to be given off which can be identified. It is also possible to analyze radioactive samples. This has been done for the elements in the range of uranium through curium. Special handling is required to avoid radiation hazards. The spark discharge can be filtered through glass wool fiber and a recovery made of more than 90 percent of the material used.

A program has been started on the study of the furnace spectra of the heavy elements for the establishment of the ground states. The absorption spectra of the rare earths and the actinide elements will also be studied.