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PHYSICS DIVISION

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REPORT FOR MONTH ENDING NOVEMBER 30, 1945

L. W. Nordheim

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New Units

During the past period considerable thought has been given to the objectives of the laboratory. It is felt that the development of breeding has become of less immediate necessity due to the very successful operation of the present production plants. This consideration does not detract from the importance of breeding in a long range nucleonics development, but it indicates that more extensive preliminary studies should be made with regard to the various possible types and to power production. The most urgent tasks would seem to be as follows: Development of a high flux unit for experimental purposes, enlargement of production facilities for new isotopes, and development of a compact atomic power unit for specialized uses.

In view of the lesser emphasis on the breeding aspect, the question of heterogeneous versus homogeneous structure for a thermal enriched P-9 machine seems to be opened up again. A preliminary survey of the heterogeneous type has been made. It appears that such a pile can be built with approximately the same performance, dimensions, and material requirements as the homogeneous unit. The heterogeneous pile would, at the expense of a few percent neutron losses, eliminate or minimize most of the serious outstanding problems of the enriched pile, such as tank corrosion,

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gas evolution, pumping of active solution, and reactivity fluctuations. A more detailed description of such a unit will be given in the next report.

The auxiliary equipment for a new pile program has also been under active discussion. The critical experiments for mixtures of enriched uranium and P-9 can be easily adapted to yield information for heterogeneous units, and will be even more important than before, since the theory of such a unit is somewhat more complicated.

A high flux unit, furthermore, will in itself not be a precision instrument due to inevitable fluctuations and changes in reactivity. Plans are being formulated for an enriched pilito, to be operated at zero power, and built as a precision instrument for danger measurements. In order to achieve maximum stability and reproducibility it is advisable to have hydrogenous material in solid form with normal light hydrogen as moderator.

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General Physics Research

Section I - (Snell)

The C^{14} factory has continued to operate satisfactorily. Techniques of assay are being improved and work on the C^{14} gamma rays has been continued. A comparison of the yield with the beta rays stopped in lead and aluminum confirmed that the gamma rays are not bremsstrahlen.

Neutron temperature measurements are continued with various absorbers and detectors in order to develop techniques for reliable flux measurements in standard graphite piles, thermal columns and other piles. The measurements of the temperature in the Clinton pile with Mn detectors are almost completed and indium and gold are also used.

The cross section of photoneutrons in Be from Na^{24} gamma rays has been measured and found to be about 6×10^{-28} cm^2.

The experiments on the criticality of vessels under assistance from a group from site Y have been completed. A final report is in preparation.

Measurements of turbulent fluctuations have been successfully carried out in a smooth pipe and have shown that the methods employed work satisfactorily. A scale model of a cylindrical reactor will now be investigated.

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Section II - (Weinberg)

Several investigations have been started on problems concerning power production in piles. Calculations are in progress for a finite U-H_2O lattice with graphite deflector and a seed of enriched U. The possibility of power extraction from a thermal breeder with P-9 as moderator has been investigated following a suggestion from Wollan that the isotope producing reflector be used as a superheater. This scheme appears to be quite hopeful if the pile can be made to hold pressures of order 2000 lbs/in^2.

Calculations have been made on the expected response for the proposed fast pile oscillator.

The thermal utilization in a myrnaloy layer has been calculated for the case of a P-9 reflector between the pile and the myrnaloy and a graphite backing on the other side.

A reservoir tank for the critical experiments with 25 in P-9 that will be safe with a given amount of 25 at all concentrations can be obtained by giving it the shape of a truncated cone. Calculations are being made to obtain suitable values for the dimensions of such a tank.

A new method has been developed to take into account the actual cell structure in a lattice geometry in place of the usual method of replacing a cell by a cylinder of

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equal cross section. Calculations have been made for water lattices, where consideration of this effect relieves to some extent the previous discrepancies between experiment and theory.

Section III -(Wollan)

The pile oscillator development has been very actively continued. The fast oscillator (200 cps) is about ready for installation. The slow oscillator with large stroke showed at first a large spurious response which has now been traced to a piston effect of the oscillator boat in its channel, and suitable remedies have been found. It should soon be possible to use the oscillator for the study of fission product cross sections.

The crystal spectrometer has been modified so as to obtain higher flexibility. Also a double crystal type has been set up and double reflections have been obtained with rock salt. This new set up will make it possible to study the reflective power of crystals for monoenergetic neutrons.

The beta spectrometer has been used to obtain the spectrum of Pa^{233}. In the program of study and preparation of soft gamma ray sources, a number of iridium sources have been prepared. The 48-day indium proved unsuitable since it apparently contains a hard component. The 20-day cesium is under investigation.

Absorption curves for gamma activities from fission products at various short delay times have been obtained and

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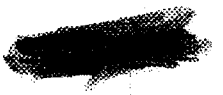

are being analyzed. Energies up to 3.7 mv have been found.

The apparatus for determination of capture gamma rays has been completed and is ready for tests.

Section IV - (Borst)

The fissionability of Pa^{233} has been investigated with a new particularly carefully prepared sample. An upper limit of 1 barn can be given for the thermal fission cross section, that is Pa^{233} is probably not thermo-fissionable. Work on the separation of Th^{231} (UY) is continued but has not yet been completed.

A mass spectograph of the Nier analytical type has been transferred to our site and is being set up in the physics building.

The neutron spectrometer measurements of the 25 fission spectrum show indications of deviations from the 1/v law similar to those of the absorption spectrum.

The investigation of photoneutrons from fission has been held up by difficulties in the pneumatic tube operation. A new tube has been developed and installed. This tube goes completely through the pile and can be replaced fairly easily if required.

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Physics Section I

A. H. Snell, Section Chief

Total technical personnel (including supervision)..... 11 (this period)

Problem Assignment Number	Subject	Status	Percentage of Section Manpower Report Per.	Next Per.
PX1-7	C^{14} Production	Active	30	30
PX5-4	Neutron Temperature in Pile	Active	10	10
PX8-1	Gamma Ray Spectra	Inactive	0	0
PX8-2	Photoneutron Sources	Active	10	20
PX10-4	Be^{10}	Inactive	0	0
PX10-6	Fast Neutron Yields	Inactive	0	0
PX14-1	Criticality of Vessels	Active	30	10
163-X39P	Service Flux Measurements	Active	10	10
PX3-14	Lattice Layer	Inactive	0	0
PX8-4	Mean Gamma Energy per Beta	Inactive	0	10
PX5-15	Controls	Active	10	10
		Total.....	100	100

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PX1-7 - C^{14} Production - (Norris, Meiners)

Operation of the factory has been continued on a satisfactory basis, except that the radiation level has again become uncomfortably high. One and a half days were lost last month because of a shutdown. An attempt is being made to seal a possible air leak in the centrifugal pump; if successful, this should give some C^{14} of high specific activity, such as is needed for certain physical measurements which interest us.

Techniques of assay are steadily being improved. More work has been done on the carbon 1^4 gamma rays. A comparison of their strength when the betas are stopped in lead and in aluminum has confirmed our opinion that they are not bremsstrahlen. Attempts at measuring their energy by critical absorption methods have so far been inconclusive.

We have about 32 mc of C^{14} on hand.

PX5-4 - Neutron Temperature Measurements - (G. Branch)

In order to develop a technique that will give reliable measurements of neutron fluxes in the graphite standard pile, thermal columns, and chain-reacting units, we are continuing to investigate the utility of various absorbers and detectors.

The measurements of the neutron temperature in the Clinton Pile are almost completed. Because of the high activities induced in the Mn detectors exposed near the center of the pile, the flakes are allowed to cool for about 20 hours before counting with a G-M counter and then the residual activity is allowed to decay for at least another 2^4 hours

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before the flakes are again used. To reduce the hazard from handling the hot flakes, the exposures are made at the rate of two per day. This low rate also allows the detectors to cool sufficiently before being used again, the number of calibrated Mn flakes being limited and because of breakage continually being reduced.

To date six activations of 1 cm^2 Mn flakes shielded with 5/8" x 5/8" x 0.050" Pyrex plates have been made in the pile, six activations with the faces of the flakes protected by 5/8" x 5/8" x 0.019" squares of cadmium, and about fifteen of the flakes not covered with an absorber. Activations are now being made with each face of the flakes shielded with two thicknesses of Cd in order to determine the absorption in the Cd of the fast neutrons. Also activations will be made with the flakes shielded by both Pyrex and Cd so that the activity induced by the thermal neutrons transmitted through the Pyrex may be computed.

Because of the small size of the 1 cm^2 detectors the "edge effects" are large and the transmission of neutrons from all angles through the Pyrex to the detectors is not uniform. Larger sized detectors and absorbers could not be used because of the finite size of the pneumatic tube conveyor and also because of the magnitude of the flux. However, these same detectors and absorbers have been used to measure the temperature in the Clinton standard pile at a distance of 55 cm from a Ra-Be source. At the present time 2" x 3" Pyrex glass plates are being

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ground to 0.040" for use with large indium foils, 4 x 6.5 cm, as detectors to measure the neutron temperature at the same location in the graphite column, which measurements will serve as a check on the above pile neutron temperature measurements. The indium foils will be counted flat beneath a G-M counter to give greater statistical weight to beta's emitted from the center of the foil than to those emitted from the edges. Also we are planning to cast and roll gold absorbers, 2" x 3" x 0.050", for use with these detectors. At a later date the neutron temperature as a function of distance from the source in the standard pile will be measured with the indium foils if the method proves feasible.

From considerations of thermal neutron diffusion theory, we have derived the following expression for the relation between the neutron velocity and the observed transmission of thermal neutrons through a 1/v absorber as detected by a 1/v detector:

$$A/A_0 = n\,4/\sqrt{\pi}\int_0^\infty x^2 e^{-x^2} E_2(K\delta/vx)\,dx,$$

where v is the most probable velocity in a Maxwellian distribution and $K\delta$ is an absorber constant measured directly in a monoenergetic beam as described in the October monthly report, MonP-24. $E_2(K\delta/vx)$ is an E function tabulated by Placzek in MT-1. The above integral

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has been numerically evaluated for various values of the ratio $v/K\delta$ and $v/K\delta$ has been plotted against the transmission ratio, A/A_0. A similar curve has been obtained also from the relation

$$A/A_0 = E_2(K\delta/v),$$

which one derives on the assumption that all thermal neutrons have the most probable velocity. The two curves are almost identical for transmission near 1/2, indicating that the E function is a good approximation to the integral for transmission near 1/2.

PX5-2 - Photoneutron Sources - (Sternberg, Barker)

The photoneutron cross-section of Be for Na^{24} gamma rays has been under study. A value of 6.4×10^{-26} cm^2 has been obtained under the assumption (well supported by experiment) that there is one high-energy gamma quantum per beta.

PX14-1 - Criticality of Vessels - (Abelson, Barker, Baker, Newson, Hoyt, Kupferberg, Shrader, Snell)

The experimental part of the latest phase of these experiments has been completed, and the material has been shipped back. A report is in course of preparation.

PX5-15 - Turbulence Studies - (Saxon)

In order to verify the simplest geometry in turbulent flow, the model of a long smooth pipe was used. The transparent walls, the pipe being made

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of Pyrex, enabled motion pictures to be taken of air bubbles introduced into the turbulent water flow. By photographing perpendicular to a thin axial layer, brightly illuminated, one obtains tracks of the bubbles. Knowing the frames per second and the effective shutter time, one can get absolute velocities from the length of the tracks and their inclinations to the axis of the tube. From an analysis of 1500 such tracks, the following data are obtained:

The average axial velocity, $\bar{y} = 109$ cm/sec,
giving a Reynold No. $R = 1.04 \times 10^5$,
the root mean square turbulent
component perpendicular to the
axis, $\sqrt{(\bar{x})^2} = 15.2$ cm/sec

$$\frac{\sqrt{(\bar{x})^2}}{\bar{y}} = 0.14 \quad .$$

From the article in the Philosophical Magazine, Vol. 21, 1936, by A. Fage, one obtains a value of $\frac{\sqrt{(\bar{x})^2}}{\bar{y}}$, considerably smaller, about 0.08. However, this value is for $R = 1.83 \times 10^4$, and it is probable that the ratio increases somewhat with R.

The next geometry to be studied will be a 1/5 scale lucite model of a cylindrical reactor; a similar procedure to that used above will be followed.

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Physics Section II

A. M. Weinberg, Section Chief

Total technical personnel (including supervision).....8 (this period)

Enriched U-H_2O Lattices (Cashwell)

Calculations are in progress to determine the critical size of an enriched U-H_2O lattice surrounded by a finite lattice of ordinary U-H_2O, the whole being encased in an infinite graphite reflector. These calculations are of interest in connection with a proposal to extract useful power from slightly enriched U.

Since a straightforward calculation of the critical size in a three region system is very complicated, the following perturbation method was devised. First, the pile proper is supposed to be uniformly enriched, and its critical size when surrounded by an infinite graphite reflector is calculated by the usual two-group theory. Then the pile is perturbed by enriching the central core slightly and depleting the outer layers. The amount of enrichment needed to maintain this three region system at critical is calculated by the ordinary first order perturbation theory.

Power Extraction from Thermal Breeders (Murray and Weinberg)

Power extraction from a thermal homogeneous breeder is difficult because of the low temperature of the fluid. A recent suggestion by E. O. Wollan to use the thorium blanket as a superheater for the steam produced by the pile proper makes the outlook for power from a thermal breeder rather more promising. In this proposal, the pile fluid which

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is circulated at high pressure, is used to produce low grade steam ($\sim 200^{\circ}C$, 500 lb/in^2). The steam is passed through the Th blanket where the power output due to capture γ's and fission of accumulated 23 can easily average 15% of the pile power. This ratio of superheat to pile heat is well in the range of standard practice.

The pressure in the pile tank would be high, perhaps 2000 lbs/in^2. However, if the thorium could be fabricated into tubes to hold the high temperature steam, the pressure on the tank could be relieved by running the blanket at high pressure. This pressure could then be taken up by a steel tank which would serve as a combination pressure tank and thermal shield.

A heterogeneous pile is better adapted than a homogeneous one to power production because in the heterogeneous arrangement the pile coolant can be used directly as the working fluid. In a homogeneous pile the working fluid is heated by transfer of heat from the pile fluid. This involves a loss in efficiency which is eliminated in a heterogeneous power pile.

Fast Pile Oscillator (Schweinler)

The response of the pile to an absorber the strength of which oscillates with frequency $\omega/2\pi$ is

$$\frac{\delta n}{n}(r, t) \overset{(R)}{=} \frac{c}{r} e^{-\lambda r + i\omega t}$$

where δn is the perturbation to the neutron density n in the absence of the oscillator, r is the distance from oscillator to detector, t is the time, $\overset{(R)}{=}$ means "is equal to the real part of", c is a real constant,

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and $\mathcal{H}$ is a complex number the method for obtaining which is given in CP-3066 (Wigner).

This formula is valid as long as neutron waves reflected from the walls of the pile need not be considered. The constant c is evaluated by integrating the flux associated with this neutron distribution over a sphere around the oscillator, and equating it to the time-average sink strength of the oscillator. These calculations show that the maximum value of $\delta n/n$ for an oscillation frequency of 200 sec^{-1} is 7.5×10^{-3} at r = 60 cm and 2×10^{-4} at r = 120 cm in the forthcoming experiment.

A memorandum about the fast oscillator has been prepared. It will be issued as soon as computations of the correction for finite detector size, now in progress, are completed.

Myrnaloy Utilization (G. P. Nordheim)

The calculations on the utilization of thermal neutrons in various arrays of thorium have been continued. A thorium slab of the thickness corresponding to a row of rods of radius 2 cm and distance 10 cm is placed into a D_2O reflector of thickness 20 cm with finite graphite backing. The thermal utilization f as function of the graphite thickness x is given in the following table:

x (cm)	0	5	30	50	100	∞
f	.10	.52	.84	.89	.91	.91

Truncated Cone Reservoir Tank (Scalettar)

The reservoir tank for the critical experiment on the enriched pile will be in the form of a truncated cone and a variational calculation

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was carried out to find its critical laplacian for 2000 grams of 25 present in various volumes of D_2O in the tank. The Laplacian is given by

$$\mu^2 = \frac{\int |\text{grad}\varphi|^2 \, d\tau}{\int \varphi^2 \, d\tau}$$

where φ was selected so as to vanish on the boundary of the tank:

$$\varphi = J_0 \left\{ \frac{2.4048}{r_1 + z \tan\alpha} r \right\} \sin \frac{\pi z}{h}$$

where z is measured from the tank base, h is the height of the tank, r the radial distance from the central axis, r_1 the radius of the tank base, and α the half-angle of the vertex of the cone. A comparison of the Laplacian of the reactor with 2000 gms present as compared with the required critical Laplacian is given below.

h (ft)	V(liters)	Conc.(gms/liter)	Laplacian at this concentration	Laplacian required for criticality
1	108	18.5	$\leq 62 \times 10^{-4}$	162×10^{-4}
3	597	3.35	~ 35	43
5	1610	1.25	~ 18	25
6	2370	0.845	~ 12	19

The tank will therefore always be slightly below critical. An additional factor of safety will be provided by a distribution of cadmium in the tank.

Neutron Distribution in Hexagonal Lattice (Murray)

The correction in the calculated maximum to average neutron density in a hexagonal lattice caused by the deviations from circular symmetry has been computed. The results for a U-H_2O lattice in which the rod radius is 1.5 cm follow:

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Volume ratio (H_2O/U)	Hexagonal cell	Circular cell
	average nv / maximum nv	average nv / maximum nv
1.5	0.895	.924
2.0	0.899	.928

According to these results, a foil placed in a water lattice with 2:1 volume ratio will indicate a water utilization which is too high by not more than 11%. While this correction is in the right direction to resolve the discrepancy between calculated and observed thermal utilizations, it is still too small by a factor of about 3.

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Physics Section III

E. O. Wollan, Section Chief

Total technical personnel (including supervision)..... 10 (this period)

Problem Assignment Number	Subject	Status	Percentage of Section Manpower Report Per.	Next Per.
PX6-1	Pile Oscillator	Active	25	25
PX10-5	Energies of Delayed Neutrons	Active	10	0
PX10-8	Crystal Spectrometer	Active	20	22
PX10-16	Characteristics of Fission Products and Neutron Induced Activities	Active	7	7
PX11-1	Soft Gamma Sources	Active	6	
PX10-18	Short Half-Life Gamma Energies	Active	25	
PX10-19	Capture Gamma Energies	Active	15	20
	Unassigned			20
		Total.....	100	100

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PX6-1-Pile Oscillator - (Noak, Strong, Koch, Mollan)

Difficulties have been encountered at pile temperatures in the bearing operation of 200 cps oscillator. A number of oilless type sleeve bearings have been tried without success although a newly constructed air cushion bearing seems promising. After one modification of the present air bearing has been made this oscillator part of the unit should be ready for installation. A new highly selective amplifier has been found to be very satisfactory. Also, the chambers, stringer sections, and pile accommodations are completed.

The lubrication difficulty with the slow oscillator pulleys has been eliminated by the use of graphite bearings. Numerous tests to determine the nature of a large spurious signal reported previously have shown that it was caused by a piston effect in the boat channel. The reduction of this signal by a factor of six down to 20 mm^2 of cadmium was accomplished by opening up the air passage to allow a free flow of air past the moving boat. It is believed that complete elimination of the small remaining signals due to the piston effect and boat absorption can be accomplished by the oscillation of an out of phase compensating boat. A program of fission product cross section studies is now being planned in collaboration with chemistry group.

PX10-5 - Energies of Delayed Neutrons - (Burgy, Millard)

A final report is being prepared.

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PX10-8 - Crystal Spectrometer - (Sawyer, Wollan, Peterson)

This month has been occupied largely with modifications of the apparatus with a view to increase the flexibility of the equipment. The long slit system for producing the convergent beam for use with our transmission bent crystal spectrometer has been relocated in the 4" square channel in the pile shield so as to make it possible to obtain in addition to the convergent beam an uncollimated beam for use with plane crystals. The uncollimated beam is taken out from the upper part and the convergent beam from the lower part of the channel. Such a set-up will permit us to use either beam without making changes in the line-up of the spectrometer.

During the past week we have set up a double crystal spectrometer and we have found it possible to get double reflections when both crystals are of rock salt. Such a double crystal set-up does not correspond to the high resolving power instrument which one connects with double crystal spectrometer work in x-ray studies. The use of a first crystal to give a monoenergetic beam does, however, permit one to make studies of the reflecting power of crystals both for Bragg reflection and diffuse scattering which cannot be accomplished with the nonhomogeneous neutrons which came directly from the pile.

The first double crystal rocking curve is shown in Fig. 1.

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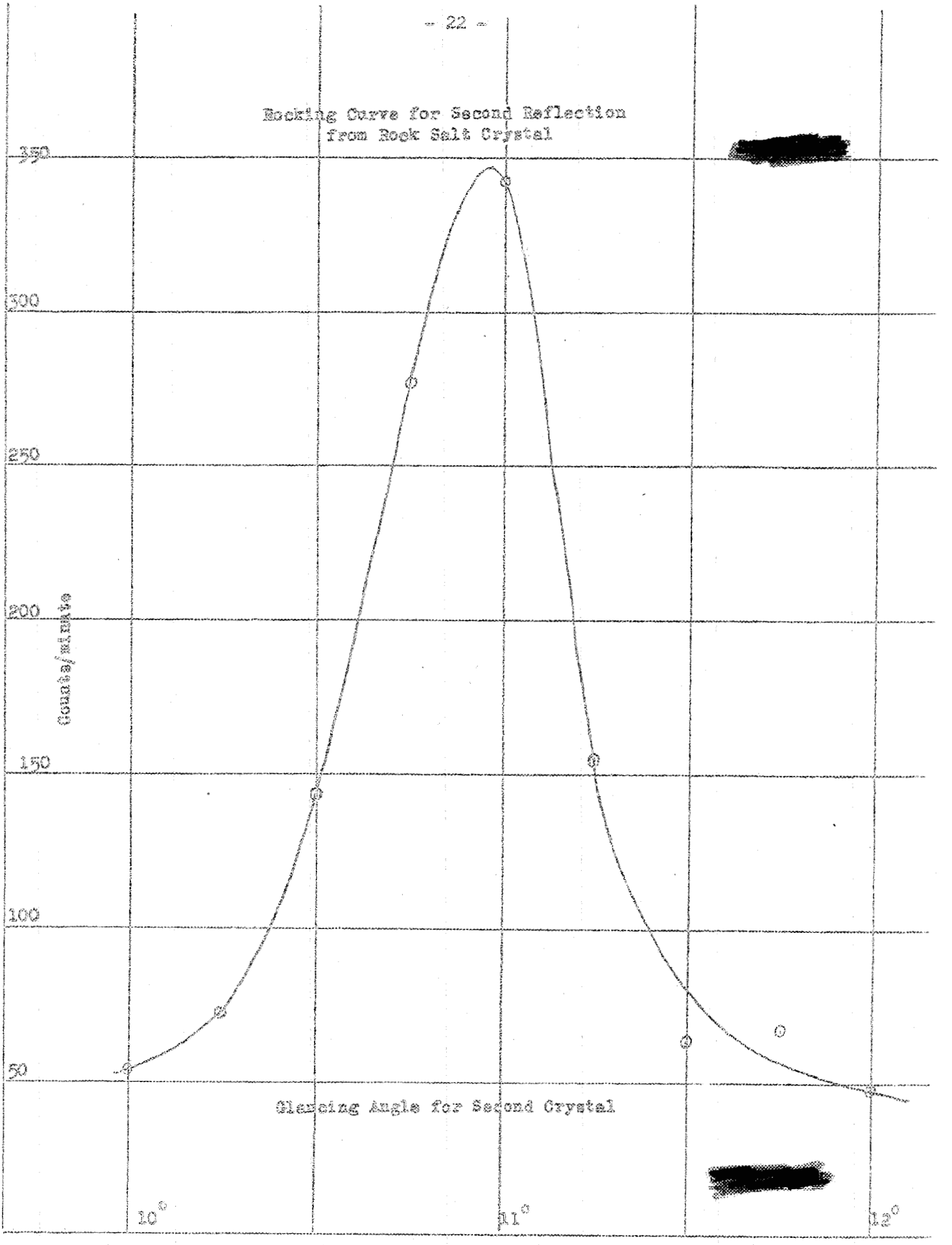
Rocking Curve for Second Reflection
from Rock Salt Crystal
350
300
250
200
150
100
50
Counts/minute
Glancing Angle for Second Crystal
10°
11°
12°

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PX10-16 - Characteristics of Fission Products and Neutron Induced Activities - (Levy)

We are in the midst of measuring the beta-ray spectrum of 27 day Pa^{233}. When this is concluded the gamma spectrum will be investigated. Rebuilding the counters to remove all materials that might absorb alcohol has proved to be very successful as they are now almost as stable as ordinary glass counters.

PX11-1 - Soft Gamma Sources - (Levy)

The eight iridium sources, two each of .5, .25, .05, and .01 curries, have been measured and delivered to the "customer". Attempts to make a one currie gamma source where the energy of the gammas is in the 100 to 200 kev region from 48 day indium have been abandoned since continued measurements indicate the high energy component (.5 mev) does not decay out. In fact, the half-life of this activity is approximately 48 days. A more careful analysis of the 48 day indium activity will be made under PX10-16. Absorption measurements of the gammas from 26 day cesium will be made to determine if this activity may possibly be used.

PX10-18 - Hard Gamma Radiation from Fission Products - (Rose, Burgy, Willard, Bloss)

Analysis of the absorption data obtained on gamma activity from fission products at short time is nearly complete. At this time, we wish to report only the results on the hard gamma energies. Five absorption curves were obtained, corresponding to times of 3/4, 1-3/4, 2-3/4, 8-3/4, 18-3/4 seconds decay after 1.5 min irradiation. The mean of the highest energies obtained from these curves is 3.7 mv.

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The average deviation from this mean is 0.5 mv.

We plan to make calculations on the photoneutron production to be expected in a heavy water pile due to these gamma rays.

PX10-19 - Determination of Energy of Capture Gamma Rays - (Koch, Burgy, Willard)

Most of the apparatus for this experiment has been completed by the shops and is now ready for tests. The D.C. power supply for the helmholtz coils has been installed and a regulation study will be made as soon as the coil stand, cooling coils and main coils have been moved into position. This will be done this week. The timing wheels and circuit for the cloud chamber are also nearing completion. Although photography of electron tracks was possible with the present light and camera system, new vapor arcs have been ordered and a more versatile camera will be built.

MonP-33

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Physics Section IV

L. B. Borst, Section Chief
S. Bernstein, Associate Section Chief

Total technical personnel (including supervision)..... 10 (this period)

Problem Assignment Number	Subject	Status	Percentage of Section Manpower Report Per.	Next Per.
PX10-7	Fissionability of ^{240}-10	Inactive	0	0
PX10-8	Neutron Diffraction	Active	20	10
PX10-10	Deuterium Gamma Ray Spectrometer	Inactive	0	10
PX10-14	Poisoning Coefficients	Inactive	0	0
PX10-15	Photoneutrons from Fission	Active	40	50
PX10-17	Fissionability Studies	Active	30	20
	Heat Evolution from Bombarded Thorium	Active	10	10
		Total.....	100	100

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PX10-17 - Fissionability Studies

Protoactinium - (Floyd)

A sample of about 1.5 mc of 27 day Pa^{233} was very carefully separated from associated U^{233} by four MnO_2 precipitations under carefully controlled conditions. We wish to thank Messrs. Creek and Dohlman for the preparation of the sample. The growth of U^{233} has been followed by fission count for more than thirty days using fission sensitive plates. A normal growth curve was observed (Fig. 2). The first exposure, three hours after chemical separation, showed five events in the area examined. At 27 days after separation the same area showed 1200 events. The uranium growth in the first three hours is equivalent to eight events. Pa^{233}, therefore, has no observable cross section. An evaluation of the reliability of these measurements places an upper limit of 1 barn upon the thermal fission cross section of Pa^{233}.

Separation of Th^{231}(UY) and Th^{234}(UX_1) - (Dial)

The process described in last month's report did not remove uranium to a sufficient degree to allow definite results to be obtained from the photographic plates.

A fast-column separation was attempted, but could not be made sufficiently complete in short enough time of separation. Fast-column experiments continue. A search is being made for suitable complexing ions.

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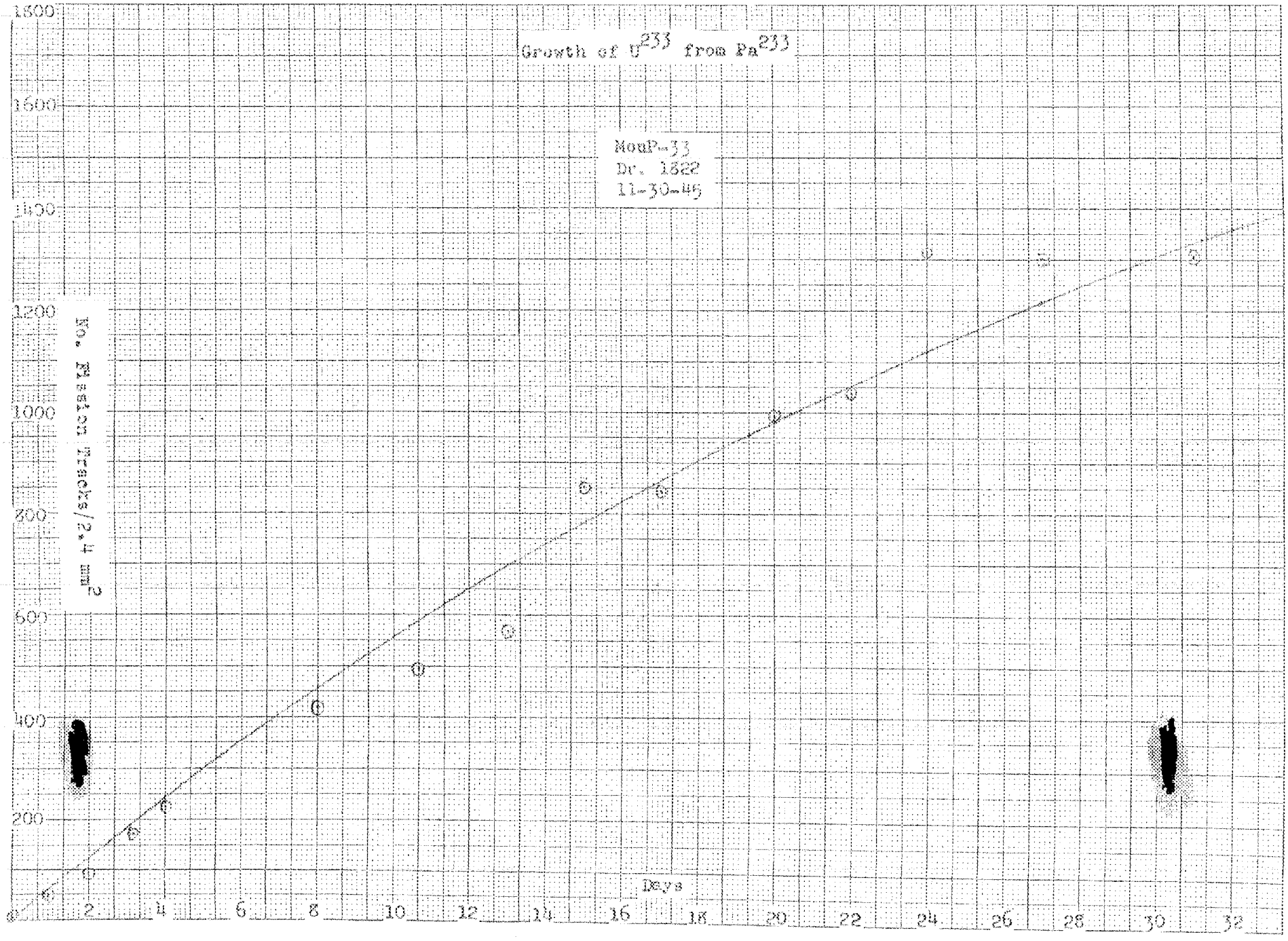

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Three precipitation methods, $Zr(IO_3)_4$, $Ce(IO_3)_4$, and LaF_3, were tried on a 100 ml scale. Calculation showed that larger equipment than we have would be required for successful use of any of these methods. One sample which was followed through, contained too much uranium.

Scavenging precipitations from solutions in which Th is complexed or not coprecipitated, show $Ce_4[Fe(cn)_6]_3$ is particularly hopeful.

Mass Spectrograph - (Schofield, Thompson*)

A mass spectrograph of the high mass analytical type developed by Mier, has been transferred from K-25. This instrument is being set up at the present time with a view toward separating small samples of rare isotopes for fissionability studies.

PX10-8 - Neutron Diffraction - (Osborne, Hasbrouck)

Difficulties experienced with the grazing incidence fission chamber have been largely overcome. Comparison of the 25 fission spectrum with a boron spectrum in the region of the thermal maximum, shows deviation from 1/v performance similar to that shown in absorption.

PX10-10 - Deuterium Gamma Ray Spectrometer

No work has been done this period.

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*On loan from Instrument Section.

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PX10-15 - Photoneutrons from Fission - (Wolfe, Ulrich, Steinberg, Bernstein)

Most of the time during the past month was spent in the design, construction and installation of a fast pneumatic tube in Hole 50. A new tube became necessary because of the great difficulties encountered in attempting to remove a rabbit which had become lodged inside the pile. The new tube is 38 feet long and goes completely through the pile instead of being "dead-end" as the old one was. The main features of the new tube are:

(1) A long rod can be inserted into the tube to push a rabbit out of the pile if such a procedure becomes necessary.

(2) The entire pneumatic tube can be removed from the pile and a new one inserted in about two hours. The graphite stringers carrying the tube need not be disturbed during this operation, nor is it necessary to dismantle the apparatus on the south platform where the measurements will be made.

The apparatus is being tested at this time. Several small defects have already appeared, but it is believed that these can be remedied within the next few days.

The additional man-power assigned to this experiment during the past month should facilitate progress.

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