by the use of two glass Lummer plates (thickness = 10 mm and 4.7 mm) as well as of two quartz Lummer plates (thickness = 5.6 mm and 4.4 mm).

Every strong Ne II line was found to consist of two components, the weaker one lying always on the short wave-length side of the stronger one. The intensity ratio of the two components was found by eyes' estimates to be about 1:9. As in the case of the Ne I spectrum,[2] the weaker component can be ascribed to the less abundant isotope Ne^{22} and the other component to the isotope Ne^{20}. Measured isotope effects in some typical lines are given in Table I, and the structure of the lines λλ3378 and 3393 is reproduced in Fig. 1.

TABLE I. Isotope effect in the Ne II spectrum.

λ(A.U.)	Allocation	Isotopic displacement $\Delta\nu$ (cm^{-1})
3727.1	$3s\ ^2P_{1/2}(^3P) - 3p\ ^2D_{3/2}(^3P)$	0.22_7
3713.1	$3s\ ^2P_{3/2}(^3P) - 3p\ ^2D_{5/2}(^3P)$	0.23_3
3392.8	$3s\ ^2P_{1/2}(^3P) - 3p\ ^2P_{3/2}(^3P)$	0.25_7
3378.3	$3s\ ^2P_{1/2}(^3P) - 3p\ ^2P_{1/2}(^3P)$	0.25_1
3323.8	$3s\ ^2P_{3/2}(^3P) - 3p\ ^2P_{3/2}(^3P)$	0.26_0
3694.2	$3s\ ^4P_{5/2}(^3P) - 3p\ ^4P_{5/2}(^3P)$	0.15
3568.5	$3s\ ^2D_{5/2}(^1D) - 3p\ ^2F_{7/2}(^1D)$	0.13_5
3345.5	$3s\ ^2D_{5/2}(^1D) - 3p\ ^2P_{3/2}(^1D)$	0.15_4
3319.8	$3s\ ^2D_{3/2}(^1D) - 3p\ ^2P_{1/2}(^1D)$	0.16_6

All the lines of the doublet system belonging to the combination $3s(^3P) - 3p(^3P)$ that were measured showed a distinctly larger isotope effect (of the order of 0.25 cm^{-1}) than the other lines, especially than the combination $3s(^3P) - 3p(^3P)$ of the quartet system. This situation seems to be somewhat analogous to the Mg I spectrum[3] where the $3p\ ^1P_1 - ns\ ^1S_0$ combination has a larger isotope effect than the $3p\ ^3P - n\ ^3S_1$ combination.

It is hoped to measure in the near future the structure of the lines of other combinations than those here reported and to obtain a more quantitative conclusion.

[1] The Ne II spectrum was classified by T. L. de Bruin and C. J. Bakker, Zeits. f. Physik **69**, 19 (1931).
[2] H. Nagaoka and T. Mishima, Sci. Pap. Inst. Phys. Chem. Research (Tokyo) **25**, 223 (1934); R. Ritschl and H. Schober, Physik. Zeits. **38**, 6 (1937); H. Schober, Physik. Zeits. **40**, 77 (1939).
[3] L. G. Mundie and K. W. Meissner, Phys. Rev. **65**, 265 (1944).

Photo-Induced Reactions at 20 Mev

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October 1, 1948

CALCULATED binding energies of neutrons and protons in nuclei indicate that it is energetically possible to remove one neutron or proton from all nuclei with 20-Mev photons. Because of the Coulomb barrier it can be expected that the cross sections for (γ, n) reactions will be larger than those for (γ, p) reactions at the above energy. This letter reports on results obtained when various elements were irradiated with x-rays from a 20-Mev betatron using a platinum target.

The energy spectrum of the x-rays is not known exactly, but the number of photons having a given energy is probably approximately inversely proportional to their energy, up to the maximum energy limit.

The elements investigated were placed about one meter from the x-ray source, and were irradiated for times governed by the half-lives expected or found. Each sample was then transferred to a position close to a thin mica-window counter tube. Pulses from the counter were fed through a scaling unit of suitable scaling factor and the scaler output was recorded on paper tape. Half-lives of less than about two minutes or more than a few months would probably not be detected by the techniques used in this survey.

The elements and compounds irradiated were of C.P. grade and were spectrographically analyzed for impurities. A list of half-lives, together with probable associated reactions, is shown in Table I.

The reactions were assigned to the half-lives, where possible, by a consideration of the following factors: the periods resulting from known $(n, 2n)$ and other reactions, relative abundances, amount and kind of impurities, and initial activities. Long periods not shown in the table are still under measurement.

Of particular interest is the fact that rhodium has a relatively large cross section, judged from the fact that the 205-day period was excited to an activity greater than 1000 counts per minute with an x-ray irradiation of only 120 hours at an intensity of about 40 roentgens per minute.

TABLE I. Reactions and half-lives resulting from irradiation with x-rays generated by a 20-Mev betatron.

Probable reaction	Half-life	Probable reaction	Half-life
$As^{75}+\gamma \rightarrow As^{74}+n$	(16.8±0.8)d	$Ag^{109}+\gamma \rightarrow Ag^{108}+n$[a]	(2.3±0.1)min.
$Cb^{93}+\gamma \rightarrow Cb^{92}+n$	(9.8±0.7)d	$Ag^{107}+\gamma \rightarrow Ag^{106}+n$[a]	(24.3±0.1)min.
$Hg+\gamma \rightarrow Hg^*$(a)	(44.4±0.5)min.	$Pd^{110}+\gamma \rightarrow Pd^{109}+n$	(14.1±0.3)hr.
$I^{127}+\gamma \rightarrow I^{126}+n$[a]	(13.1±0.5)d	$Pd+\gamma \rightarrow ?^*$	(26±5)min.
$Sn^{114}+\gamma \rightarrow Sn^{113}+n$	~100d[c]	$Pd+\gamma \rightarrow ?^*$[d]	(4.9±1)min.
$Sn+\gamma \rightarrow ?^*$	(45±1)hr.	$Rh^{103}+\gamma \rightarrow Rh^{102}+n$	~210d[c]
$Sn^{124}+\gamma \rightarrow Sn^{123}+n$[a]	(41.5±0.5)min.	$Cd^{116}+\gamma \rightarrow Cd^{115}+n$	(57.5±2)hr.
$Ru^{104}+\gamma \rightarrow Ru^{103}+n$	(45±1)d	$Cd+\gamma \rightarrow ?^*$	(19.8±0.5)hr.
$Ru^{98}+\gamma \rightarrow Ru^{97}+n$	(2.8±0.1)d	$Cd^{110}+\gamma \rightarrow Cd^{109}+n$	(38±5)min.
$Ru^{96}+\gamma \rightarrow Ru^{95}+n$	(1.6±0.1)hr.	$Pt^{196}+\gamma \rightarrow Pt^*$	(87±5)min.
$Ru^{102}+\gamma \rightarrow Tc^{101}+H^1$[a]	(16.5±0.5)min.	Bi+γ	no measurable activity
$Ba^{134}+\gamma \rightarrow Ba^{133}+n$[b]	(38±1)hr.		
$Ba+\gamma \rightarrow Ba+?$[b]	(5±0.5)hr.		

[a] Indicates reaction has been previously reported.
[b] Indicates active product followed a barium chemical separation.
[c] Indicates half-life is estimated, measurements not yet complete.
[d] Indicates activity possibly due to copper contamination.
*? or absence of mass number indicates that evidence is insufficient for an assignment.

It may also be noted that only one (γ, p) reaction was encountered. Other such reactions may have been masked by the more prolific (γ, n) activities.

The 26-minute palladium activity could have been produced by a small neutron component in the radiation. However, samples irradiated for equal times with and without paraffin and borax neutron shielding showed similar specific activities.

The authors thank Mr. S. H. Cress and Mr. D. I. Walter of this laboratory for assistance in preparing and analyzing samples.