mum probability of capture is 500 kv. Using Bethe's values[4] for B^{10} and H^1 we obtain $Be^9 > 9.0124$.

Voltage Excitation Curve

We have determined the yield of gamma-rays as a function of proton bombarding voltage in the range 200 to 800 kv, by means of an ionization chamber. Because of the low intensity of the effect, it was necessary to use a thick target. The effect began rather abruptly at 450 kv and continued to increase to 800 kv. This may mean, if the reaction postulated above is correct, that the first maximum in the probability for proton capture occurs when the proton energy is in the neighborhood of 0.5 MEV.

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[1] Crane, Lauritsen and Soltan, Phys. Rev. **44**, 692 (1933).
[2] Crane and Lauritsen, Phys. Rev. **45**, 226 (1934); (see correction in Phys. Rev. **45**, 493 (1934)).
[3] Bonner and Brubaker, Phys. Rev., June 1, 1935 (in press).
[4] Bethe, Phys. Rev. **47**, 633 (1935).

Alternating Intensities in the Spectrum of P_2

The nuclear spin quantum number I for phosphorus was found to be 1/2 by Miss Ashley,[1] who studied the alternating intensities in the $^1\Sigma$, $^1\Sigma$ bands of P_2. Although her work proved definitely that an alternation ratio of 2 ($I=1$) or lower was out of the question, it seemed desirable to have a direct measurement of this ratio to see if any discrepancy occurs similar to that observed by Aars[2] for fluorine. Aars found a ratio varying between 3.4 and 5.5 in different bands, although the highest value predicted theoretically is 3.0, for $I=\frac{1}{2}$.

The phosphorus bands were excited in a sealed-off quartz tube containing pure phosphorus and helium at 20 mm pressure. Power was supplied through external electrodes connected to a 5 kw power-oscillator giving a wavelength of 45 m. The spectrum was photographed in the second order of the 21-ft. grating, with a step-weakener directly in front of the plate so that the band lines themselves constituted the calibration marks. The weakener had seven steps of different thicknesses of platinum sputtered on a quartz plate, and the transmissions of the steps were determined as a function of wavelength by a monochromator and quartz vacuum phoelectric cell connected to a Wynn-Williams bridge amplifier. The peak intensities of the lines were measured, and the continuous background subtracted in each case. On plotting these intensities on a logarithmic scale, two parallel curves were obtained, and the displacement required to make the curve for the weaker lines (even K) coincide with that for the stronger gave the ratio of alternating intensities. The results of measurements on five different bands are summarized in Table I, data from two different plates being given for the 5,21 and 6,22 bands.

Table I.

Bands	Lines used	g_s/g_a
5,21	$P(56)+R(68)$ to $P(66)+R(78)$	3.5 ± 0.2
	$P(47)+R(59)$ to $P(66)+R(78)$	3.4 ± 0.2
6,22	$P(5)+R(17)$ to $P(47)+R(59)$	3.0 ± 0.2
	$P(21)+R(33)$ to $P(56)+R(68)$	3.0 ± 0.1
9,28	$P(47)$ to $P(65)$	3.0 ± 0.1
	$R(61)$ to $R(77)$	3.0 ± 0.6
9,29	$P(47)$ to $P(65)$	2.9 ± 0.2
	$R(61)$ to $R(79)$	2.8 ± 0.4
10,31	$P(41)$ to $P(59)$	2.9 ± 0.1

The deviation of g_s/g_a from the expected value of 3.0 in the 5,21 band may be due to the presence of lines from a faint underlying band, or it may result from the fact that this band shows much stronger perturbations than the others which were studied. It seems hardly possible to invoke the quenching mechanism proposed by Aars to explain his results, since in the present case the fairly high pressure of helium would serve to maintain a normal distribution of molecules among the rotational states.[3] This may account for the better agreement with theory shown by the above results.

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April 17, 1935.

[1] Muriel Ashley, Phys. Rev. **44**, 919 (1933).
[2] J. Aars, Zeits. f. Physik **79**, 122 (1932).
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Arcs in Inert Gases—III

Several previous reports[1] have shown that a stable arc discharge of low amperage (5 to 10 amperes) between metal electrodes of high purity cannot be maintained under ordinary conditions in argon gas and in some of the other inert gases, provided the gases are first highly purified. In discussion of these earlier results, several arc authorities have suggested that the phenomenon might be one which occurs only in low current arcs and would probably disappear when higher currents flowed upon short circuiting of the electrodes. In a current investigation[2] of the metallurgical properties of pure iron welds made in argon, it is found on the contrary that a stable arc discharge cannot be maintained even across a gap one millimeter long, with open circuit voltages up to 60 volts and with short circuit amperages up to 120 amperes. If the open circuit voltage is increased to 62 to 64 volts or if the short circuit current is increased to 150 amperes, an arc discharge can be maintained for several seconds. If the open circuit voltage is increased to 65 to 70 volts or the short circuit amperage increased to 170 amperes, a stable arc discharge can be maintained indefinitely. These tests were carried out in argon gas of 99.5 percent purity. The electrode wires were of carefully cleaned pure iron in one case and of carefully cleaned steel wire in the other. The wires were one-eighth inch in diameter. In each case a plate of the same material was used as the opposite electrode.

The above phenomenon occurs with the welding electrode either as anode or as cathode. If the welding wire is not carefully cleaned of all drawing compound (a lime and ferrous sulphate film), the phenomenon of unstable arcing is not obtained at all. Thus it is shown that the non-arcing phenomenon reported previously for low current arcs obtains in high current welding arcs also.

The crater under the welding arc in air likewise has come to be considered an inherent characteristic of the arc. Upon this crater formation depends the penetration into and joining of the parts being welded. With argon of 99.0 percent purity or greater, there is a complete absence of crater formation in the base metal or previous weld deposit, and a resulting complete lack of penetration into, and fusion of, the parts being welded. Thus, another of the basic and essential features of the commercial arc welding process, namely, crater formation and penetration, is shown to be not an inherent characteristic of the iron arc, but fortunately is one which appears when arc welds are made in air.

A complete and detailed account of the experimental conditions of these tests, including certain important metallurgical aspects, will be published shortly.

Altogether it appears that fundamentally the high current arc is something quite different from that to which we have become accustomed by observing the arc between steel electrodes operated in air for welding.

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[1] G. E. Doan and J. L. Myer, Phys. Rev. **40**, 36 (1932); G. E. Doan and A. M. Thorne, Phys. Rev. **46**, 49 (1934).

[2] The investigation is sponsored by The Engineering Foundation of New York City.