angular momentum are available. A large fraction of the reactions would have to proceed by this mechanism to explain the abrupt discontinuities.

IV. SUMMARY AND CONCLUSIONS

The main results of the neutron survey we have reported are new reference points for neutron yields by protons and a suggestion of targets to be used in more detailed experiments to study the processes responsible for neutron production at energies of tens of Mev. The yield data themselves suggest that the statistical theory of nuclear reactions is not capable of explaining the discontinuities observed, and the simple calculations we have performed support that suggestion. More detailed calculations do not appear to be justified until more detailed experiments are available. In particular, it would be well to study the charged-particle emission as well as neutron emission from separated isotopes in the regions near calcium and zinc. Measurements of the angular distributions could be compared with theoretical predictions[16,28] that are available, and energy distributions might be helpful in deciding whether the statistical theory is applicable. A comparison of neutron-induced reactions would also be valuable in deciding what role the neutron excess plays, and whether it is the neutron excess of the target or compound nucleus that is important.

V. ACKNOWLEDGMENTS

One of us (G. P. M.) would like to acknowledge the encouragement and interest of Dr. Chester M. Van Atta. Thanks are due Bob Watt, Wendell Olson, and all members of the operating crew of the linear accelerator for their generous cooperation and assistance in all phases of the experimental work. Dr. Warren Heckrotte was very generous in discussions of the theory, and Mrs. Ellen Campbell coded and performed the calculations on the IBM-650 computer.

[28] S. T. Butler, Phys. Rev. 106, 272 (1957).

PHYSICAL REVIEW VOLUME 109, NUMBER 6 MARCH 15, 1958

Average Decay Energy of Tritium

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(Received December 2, 1957)

The heat output of tritium has been determined by calorimetry. If one assumes a half-life of 12.26 years, the average beta energy is shown to be 5.57±0.1 kev. This is considerably lower than the value previously reported, and an explanation of this discrepancy is offered.

A SENSITIVE calorimeter has been built to study the heat output of tritium. Its operation depends upon the measurement, by differential resistance thermometry, of the equilibrium temperature attained by a heat source which is thermally insulated from its surroundings. The calorimeter was calibrated by means of an electrical heater.

The average figure for the energy output of tritium due to decay, obtained by a thermal study of thirteen tritium samples, was 0.319±0.001 watt/g. In these tritium samples, hydrogen was the only adulterant, the tritium concentration being assayed by mass spectrometer. The volume of each sample was measured and the gas was absorbed onto pyrophoric uranium for calorimetric study. By using the half-life value of 12.26_2 years recently determined by Jones,[1] the average decay energy of tritium may be calculated and is found to be 5.57±0.01 kev.

This is considerably lower than the value, 5.69 kev, previously reported by Jenks *et al.*[2,3] These authors, however, also obtained a value for the half-life, 12.46 years, which is higher than that obtained by Jones. Their calculations were based upon the following data for one sample of tritium:

(a) Disintegration rate $=2.436\times10^{11}$ dis/sec,
(b) Quantity of tritium $=2.571$ std/ml,
(c) Heat output $=2.218\times10^{-4}$ watt.

From data (b) and (c), the heat output of tritium may be calculated as 0.3208 watt/gram, in good agreement with the value obtained in the present work. This agreement indicates that the reason for the discrepancy in the average energy of beta decay is due to an error in the disintegration rate datum (a), which automatically accounts for the high value obtained for the half-life by Jenks, Ghormley, and Sweeton.

[1] W. M. Jones, Phys. Rev. 100, 124 (1955).

[2] Jenks, Ghormley, and Sweeton, Phys. Rev. 75, 701 (1949).

[3] Jenks, Ghormley, and Sweeton, Phys. Rev. 80, 990 (1950).