

pected effect for s terms disagree with Schwinger's, which were based on a development of quantum electrodynamics. A re-examination of the writer's calculations showed that an error was made in a mathematical transformation. The corrected result is in agreement with Schwinger's as well as with the now established connection of the anomalously large hyperfine structure of the ground state of hydrogen and deuterium³ with the anomalous magnetic moment of the electron spin.⁴

¹ G. Breit, *Phys. Rev.* **72**, 984 (1947).

² Julian Schwinger, *Phys. Rev.* **73**, 415 (1948).

³ J. E. Nafe, E. B. Nelson, and I. I. Rabi, *Phys. Rev.* **71**, 914 (1947); D. E. Nagel, R. S. Julian, and J. R. Zacharias, *Phys. Rev.* **72**, 971 (1947).

⁴ P. Kusch and H. M. Foley, *Phys. Rev.* **72**, 1256 (1947); H. M. Foley and P. Kusch, *Phys. Rev.* **73**, 412 (1948).

Erratum: Neutron-Proton Scattering at 100 Mev

[*Phys. Rev.* **73**, 641 (1948)]

JULIAN EISENSTEIN AND FRITZ ROHRLICH
*Lyman Laboratory of Physics, Harvard University,
Cambridge, Massachusetts*

WE are sorry to report two misprints which occurred in our Letter to the Editor under the above title.

For the Yukawa potential the singlet range should read 1.18×10^{-13} cm instead of 1.8×10^{-13} cm and is, as stated, the same as the triplet range. The cross section at 100 Mev in the Born approximation is 0.101×10^{-24} cm² and not 0.111×10^{-24} cm².

Note on the "Natural Radioactivity of Rhenium"

NATHAN SUGARMAN

*Argonne National Laboratory and Institute for Nuclear Studies, University
of Chicago, Chicago, Illinois*

AND

HAROLD RICHTER

*Argonne National Laboratory, Chicago, Illinois
April 13, 1948*

IN examining the isobaric pair Re^{187} – Os^{187} for radioactivity, Naldrett and Libby¹ found an activity in Re which they attributed to β^- -radiations from Re^{187} . The range of the particles was 3.5 mg Al/cm² with a corresponding upper energy limit of 43 kev. The samples were purified sufficiently to separate other elements with the exception of the chemically similar Tc (element 43). Since it appeared possible to the authors that the radiations observed might originate in a natural isotope of Tc present in the Re, the Re was subjected to chemical operations which were shown in tracer studies to free it of Tc, and then measured. The activity was essentially unchanged. The details of the chemical separation of Re from Tc and the results of the activity measurements follow.

The Tc tracer used was prepared by irradiation of ammonium molybdate in the "thimble" of the Argonne heavy water pile. The 5.9-hr. Tc^{99} was isolated by using a modification of the radiochemical procedure of Glendenin,²

The Tc activity is distilled from fuming H_2SO_4 in an air stream. Re carrier is added to the distillate and Re_2S_7 precipitated. After solution of the precipitate in conc. HNO_3 and two evaporations with 3 ml conc. HCl, the solution is diluted to 20 ml with H_2O . The solution is neutralized with NH_4OH and four precipitations of

TABLE I. Activity measurements on Re and purified Re_2S_7 .

Sample	Area (cm ²)	Sample thickness (mg/cm ²)	Activity (c/m)	Half-life Re^{187} (yrs.)
Re No. 1	260	4.2	38.5 ± 1.5	6.2×10^{12}
Re No. 2	170	5.0	39.3 ± 1.6	4.0×10^{12}
Re_2S_7 (No. 1a)	240	2.9	21.5 ± 1.4	6.3×10^{12}
Re_2S_7 (No. 1b)	250	2.9	20.4 ± 1.5	6.9×10^{12}

$\text{Fe}(\text{OH})_3$ are performed. The level of Tc activity in the tracer solution is determined in an aliquot, more Re carrier is added, and tetraphenylarsonium perrhenate precipitated. The radiochemical purity of the samples was shown to be very high (>99 percent Tc activity) by decay and absorption measurements.

Two methods of separating Re from Tc are given by Perrier and Segré.³ These consist of distilling Re but not Tc from H_2SO_4 solution in a stream of moist HCl, and precipitating the sulfide of Re alone from 10N HCl. In studying the separation of Re from Tc tracer by sulfide precipitation, another method was found in which Tc is volatilized from a solution by alternate evaporations with HNO_3 and HCl. After five HNO_3 –HCl cycles less than 2 percent of the Tc remained while the loss of Re was negligible.

The separation was tested by adding an aliquot of the Tc tracer to two HNO_3 solutions, each containing ~ 0.6 g Re. The solutions were evaporated almost to dryness. Two successive evaporations were then performed with 15 ml conc. HCl. Alternate evaporations of one addition of 10 ml conc. HNO_3 and two of 15 ml conc. HCl were performed until five such cycles had been completed. Finally, the solutions were diluted to 125 ml, aliquots removed, neutralized, and tetraphenylarsonium perrhenate precipitated. A comparison of the activity in the precipitates to that of the activity added, after correction for the fraction of Re counted, showed that more than 98 percent of the Tc had been removed.

Two one-gram samples of metallic Re (British Drug Houses, Ltd.) were dissolved in conc. HNO_3 and subjected to the separation procedure described above. Although macro-Tc might be expected to behave differently from tracer Tc in some chemical operations, it is probable that Tc, if present, would have been separated from Re. The two Re samples were converted to Re_2S_7 , counted, and the activity compared to that of untreated Re metal.

Activity measurements were made in the "screen-wall" counter used by Naldrett and Libby. Anticoincidence shielding added to the counter by Mr. E. C. Anderson reduced the background from 160 c/m to 50 c/m and greatly shortened the counting procedure. Samples of metallic Re (Re No. 1, British Drug Houses, Ltd.; Re No. 2,

Johnson Matthey and Company, Ltd.) and of Re_2S_7 prepared as described were counted. The results are summarized in Table I. The half-life values were calculated from the counting data in the manner described by Naldrett and Libby.

The agreement in half-lives found from Re No. 1 and the Re_2S_7 samples shows that the activity in the samples cannot be attributed to an isotope of Tc. The sulfide samples were also counted through 3.7 mg Al/cm² and no activity was observed. This result is in agreement with the observed radiation characteristics of Re and lessens the possibility that the activity in these samples could arise from contamination introduced during the preparation of the samples.

The half-life values found for Re^{187} cluster into two

groups, 4×10^{12} yrs. and 6.5×10^{12} yrs. The difference appears to arise from a loss in sensitivity of the counter for the samples of larger area. The Re No. 2 sample of 170-cm² area yielded a half-life of 4.0×10^{12} yrs. in good agreement with that found by Naldrett and Libby of 3.8×10^{12} yrs. for samples of the same area.

Some of the work on which this document is based was performed at the Institute for Nuclear Studies, University of Chicago.

The authors take this opportunity in expressing their gratitude to Dr. H. Levi for her generous assistance and to Professor W. F. Libby for his advice and encouragement.

¹S. N. Naldrett and W. F. Libby, *Phys. Rev.* **73**, 487 (1948).

²L. E. Glendenin, Plutonium Project Record **9B**, 8.11.2 and 12.9 (1946).

³C. Perrier and E. Segré, *J. Chem. Phys.* **5**, 712 (1937); **7**, 155 (1939).