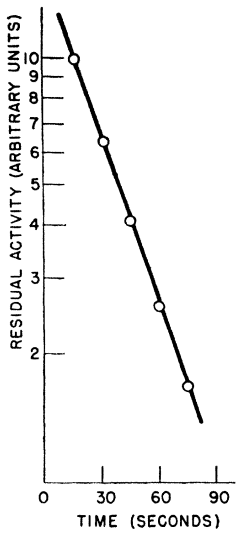

FIG. 1. Decay curve for short-lived Ag^{110} activity between $t=t$ and $t=\infty$ *vs.* t. $T_{\frac{1}{2}}=23$ sec.

The complexity of the Ag^{110} decay makes a determination of the separation factor difficult. A direct comparison of the ratio of the counting rates (observed with a 3.5-mg/cm² counter window) of the separated 24-sec. activity and the 270-day activity in solution gave an efficiency of about 25 percent using Siegbahn's estimate of three percent for the intensity of the 24-sec. branch.

It is probable that the silver tetraphenylporphin can be used for preparing high specific activity samples by a Szilard-Chalmer's process.

* Research carried out under the auspices of the AEC.

[1] K. Siegbahn, Phys. Rev. **77**, 233 (1950). M. Goldhaber and A. Sunyar private communication).

[2] We are indebted to Professor G. D. Dorough of Washington University for supplying the tetraphenylporphin used in the preparation of the silver compound.

A 5.7×10^{-9}-Sec. Isomeric State in $_{77}Ir^{191}$

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June 7, 1950

AN excited state in Ir^{191} with a half-life $(5.7\pm0.5)\times10^{-9}$ sec. has been observed with a delayed coincidence scintillation spectrometer. In Fig. 1 the number of delayed coincidences is plotted as a function of delay time obtained with a source of Os^{191} (32 hr.). The solid portion of the curve for delay time $T\geqslant2.5\times10^{-8}$ sec. represents the decay of the short-lived isomeric state which has been produced by the β^--decay of Os^{191}. Both the end point of the β^--spectrum announcing the formation of the isomeric state and the energy of the radiation emitted in the decay of the metastable have been determined.

The delayed coincidence scintillation spectrometer consists of the usual delayed coincidence unit[1] employing anthracene with Type 5819 multiplier tubes as detectors. In addition, a small portion of the signal from either detector is fed to a linear amplifier equipped with a differential pulse-height selector. This analyzer selects all pulses with amplitudes lying between E and $E+\Delta E$. The output pulses of the analyzer and the fast delayed coincidence pulses are fed into a relatively slow coincidence circuit. In this way only those pulses from the analyzer are selected that give rise to a delayed coincidence. When the detector feeding the analyzer channel is used to detect the radiation announcing the formation of the isomeric state, a measurement of the spectrum of the radiation preceding the metastable state is obtained. Similarly, when the detector is used to detect the delayed radiation, a measurement of its spectrum is obtained.

Curve (1) in Fig. 2 is the spectrum of the radiation resulting from the decay of the short-lived isomer in Ir^{191} obtained by counting delayed coincidences in a small height interval against pulse height. The internal conversion electron peak corresponds to 52 kev. The scale of pulse height was calibrated in energy units using internal conversion electron lines of γ-rays whose energies are well known from magnetic spectrometer measurements. Curve (2) shows the internal conversion electron lines at 65 and 122 kev of the 132-kev transition from the decay of the 22-μsec. metastable state of Ta^{181*} which announces the formation[2] of the 1.1×10^{-8}-sec. metastable state of Ta^{181*}. In addition, L internal conversion electrons of the 85- and 80-kev transitions following the β^--decay of Tm^{170} and Ho^{166}, respectively, were used for calibration.

Measurements of the radiation of other isomeric transitions with similar energy and lifetime have shown that the amount of internal conversion in the L shell is comparable to that in the K shell. Since only one internal conversion line appears in the spectrum of the decay of Ir^{191*}, the peak probably corresponds to L shell internal conversion. The energy of the transition is then (65 ± 5) kev which is less than the K shell electron binding energy (76 kev).

The spectrum of the radiation announcing the formation of the metastable state (not shown) appears to be a single beta-ray distribution whose maximum energy determined from a Kurie plot is 1.05 ± 0.03 Mev.

The decay curve of Fig. 1 was obtained with the analyzer gate accepting only small pulses corresponding to the 65-kev transition while the other channel was excited by the high energy β^--rays which gave rise to large pulses. Since the form of delayed coincidence resolution curves for originally simultaneous events depends essentially upon the distribution in amplitude of the original pulses, it is conceivable that the 65-kev transition is not metastable with respect to the β^--ray event. In order to rule out this possible instrumental effect on the resolution curve obtained with a coincidence system using amplifiers of finite rise time, a number of other sources were tested; namely, the 1.84-Mev β^--decay of Ho^{166} followed by a 80-kev internally converted

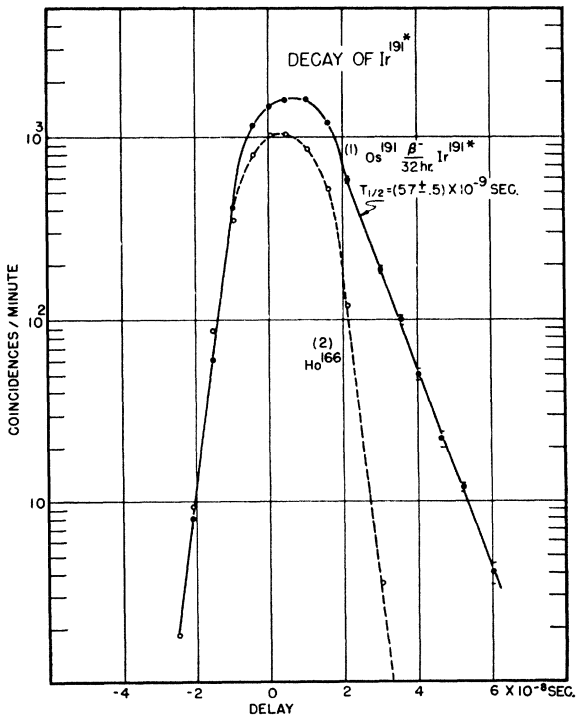

FIG. 1. Delayed coincidences as a function of delay time.

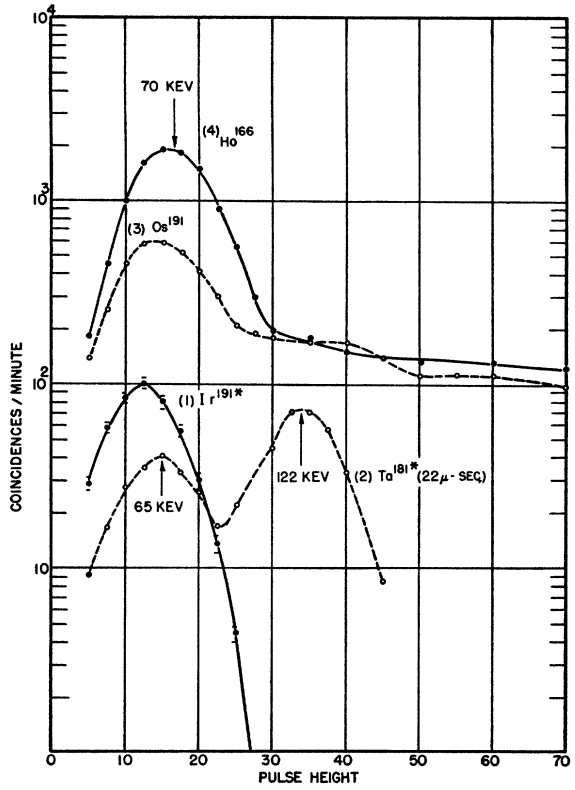

FIG. 2. Coincidence counting rate in a small pulse-height interval as a function of pulse height. Pulse-height interval was 2.5 pulse-height divisions.

γ-ray, the 900-kev β^--decay of Tm^{170} followed by a 85-kev internally converted γ-ray, and the 1.076-Mev β^--decay of Re^{186} followed by a 138-kev internally converted γ-ray. Curve (2) in Fig. 1 shows a typical resolution curve obtained with Ho^{166}. In each case the resolution curve obtained with the analyzer accepting only the low energy internally converted γ-ray was symmetrical with the leading and trailing edge being roughly exponential over three decades corresponding to a half-period 2×10^{-9} sec. In Fig. 2, curves (3) and (4), which are the low energy portion of the spectra of the simultaneous events from Os^{191} and Ho^{166}, respectively, show clearly the similarity of the two distributions in amplitude of the original pulses from the scintillation detector.

* This document is based on work performed for the Atomic Energy Project at Oak Ridge National Laboratory.

[1] F. K. McGowan, Phys. Rev. **76**, 1730 (1949).
[2] W. C. Barber, Phys. Rev. **78**, 641 (1950).

Superconducting Bismuth Alloys*

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May 29, 1950

THE metal bismuth, noted for its anomalous electric and magnetic properties, is not known to be a superconductor down to about 0.05°K. It is, however, a curious fact that this substance when alloyed with other non-superconducting elements very often results in a superconductor.

The earliest discovered case[1] of the above is Au_2Bi. Subsequently the alloys[2–4] $NiBi_3$, $RhBi_2$, $RhBi_4$, and NaBi, all falling into the same category, have been reported. The experimental data on the above class of alloys are somewhat meager but, on the other hand, for binary alloys wherein one or both components is a superconductor the literature is very extensive. For the latter class the following properties are observed: (1) broad temperature transitions in zero field, often a degree or more, (2) large initial slopes of the magnetic threshold curves, (3) severe hysteresis in magnetic properties, and (4) incomplete Meissner effect. Pure elemental superconductors of the "soft" variety (e.g., Sn or Hg) have just the opposite behavior to that listed and are often, therefore, classed as "ideal."

Mendelssohn[5] has advanced a very plausible hypothesis to account for this "alloy" behavior and, on the basis of this, Shoenberg[6] in 1938 suggested that if an alloy of uniform composition throughout its volume could be prepared, it might be expected to show the characteristics of an ideal superconductor. The best chance of producing such an alloy would be to use "intermetallic compounds," i.e., those with the ingredients in stoichiometric proportions. Shoenberg investigated the stoichiometric alloy Au_2Bi and did indeed find a lessening of the alloy anomalies, although his results were not entirely conclusive, owing perhaps to impurities in his sample.

We have recently investigated two such alloys, (NaBi) previously reported[4] as superconducting, and (KBi_2) which, to our knowledge, has not previously been known to be a superconductor. For measurement we employed Webber's a.c. induction method[7]

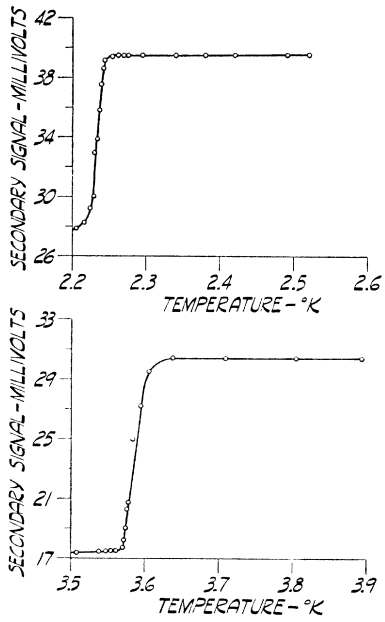

FIG. 1. The "zero field" transitions into superconductivity for NaBi (upper curve) and KBi_2. Mond (1949) vapor pressure tables are used.

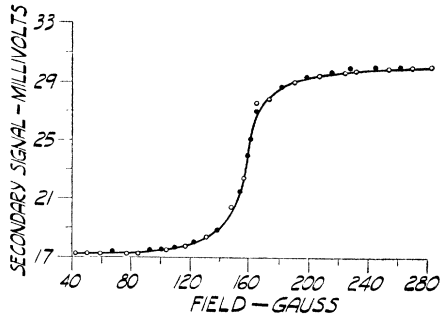

FIG. 2. Isothermal field transition for KBi_2 at 2.0°K. Black circles for increasing field and white circles for decreasing field.