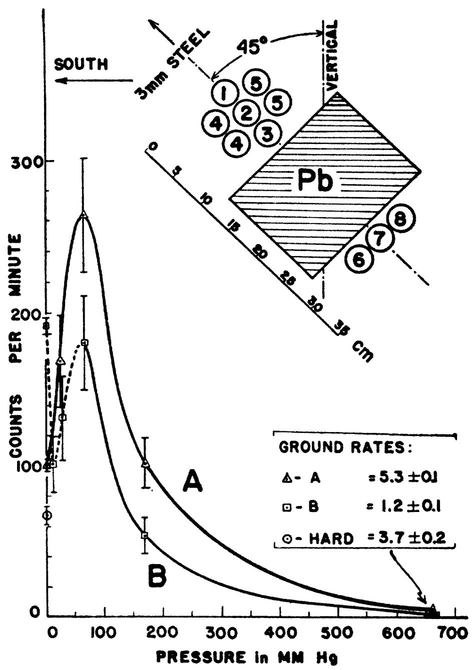

FIG. 1. Curve A, total intensity. Curve B, shower intensity. Circled points, intensity of penetrating component.

by anticounters 4 and 5 all operating in parallel. In a fourth channel, unprotected coincidences 1, 2, 3 were transmitted. The differences between these data and the similar, protected data give a measure of the showers.

The counters used had 0.8-mm brass walls. Resolving times for each channel were $\sim 5\times 10^{-6}$ sec. Data were transmitted to ground by the same radio system used in the previous flight. The altitude attained was in excess of 160 km.

The telescope axis pointed south at a zenith angle of 45° through a 3-mm steel "window." Both zenith angle and azimuth were preserved through the atmosphere, but the telescope axis precessed about the zenith in free space. "Free space" is taken as the region of less than 2 mm Hg pressure.

Curve A in Fig. 1 shows the altitude dependence of the protected total intensity. It is seen that the counting rate in free space (based on 252 counts) was about $\frac{1}{3}$ that at the maximum (based on 22 counts). For the hard component, however, the counting rate within the atmosphere was too low to permit drawing a curve. Only two points are shown; the ground point determined by several hours of calibration, and the point in free space for which 150.6 seconds of operation (63 counts) was used. It is seen that the penetrating component amounts to about 70 percent of the total radiation. The shower rate in free space (480 counts) was again high as may be noted by curve B which is the difference between the unprotected and protected coincidences 1, 2, 3. The validity of the dip in this curve at 12 mm Hg is questionable. Of the 63 hard counts in free space 13 were associated with showers below the lead.

In the experiment of Schein, Jesse, and Wollan,[2] it was reported that very few of the particles penetrating 4 cm of lead produced showers under 2 cm. The present results would appear to be consistent with that data if the non-penetrating radiation were fairly soft. Further experimental work is in progress.

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The Magnetic Field of the Galaxy

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THE force which galactic radiation pressure exerts on minute dust grains in interstellar space will give these grains a drift velocity of about 10^4 cm/sec. relative to the interstellar atoms.[1] On the average, this velocity should be directed away from the galactic center. The Coriolis force of galactic rotation will deflect these grains, and give them also a drift velocity at right angles to the direction of the galactic center. Thus the dust grains rotate more slowly about the galactic center than do the interstellar atoms and electrons. It is believed that each dust grain has an electric charge of roughly 100 electrons. Therefore, the differential rotation of the dust grains produces an electrical current circling the galactic center. This result requires that the number of dust grains per cm^3 be constant in the galactic plane along any circle of constant radius about the galactic center. While most of the observed galactic dust is concentrated in isolated clouds, present evidence indicates a "substratum" of more nearly uniform distribution.[2] On the assumption that the density of this substratum is 6×10^{-26} gram/cm^3, the primary galactic current, computed without regard to the important secondary effects discussed below, is about 10^{17} amperes. Since the effective radius of this circular current is between 5000 and 10,000 parsec., the magnetic field resulting is between 10^{-5} and 10^{-6} gauss.

This computed field is so large that secondary effects of the magnetic field on the primary galactic current must be taken into account. A field of 10^{-5} gauss would provide a deflecting force on the dust grains which would be about 10^6 times as great as the Coriolis force. A detailed study of this interaction is still in progress, but preliminary results indicate that the magnetic field in most of the galaxy will be no greater than is required to nearly cancel the Coriolis force, thus reducing the primary galactic current to a low value. Secondary effects on atomic ions must also be considered. The computations show that the resultant magnetic field is probably in the general neighborhood of 10^{-12} gauss. This tentative result is subject to very considerable revision as more complete information on the interstellar medium becomes available.

A field of 10^{-12} gauss would have several interesting effects. Its value agrees with the 10^{-11} to 10^{-13} gauss which Alfvén has assumed[3] to confine most of the observed cosmic rays within the galaxy. Protons and electrons from outside the galaxy could not reach the galactic plane near the sun unless their energies exceeded about 10^{13} electron volts. The rotation of the galaxy in this magnetic field would produce a slight separation of electrical charges, with a resultant radial electrical field of about 10^9 volts per 1000 parsec.; this field would cancel the magnetic force on a charge revolving in a circular orbit around the galactic center. Since the interstellar ions have thermal motions superimposed on their revolution about the galactic center, their paths relative to axes rotating with the galaxy would be curved by the magnetic field; at a mean thermal velocity corresponding to about 10,000°K, the radii of curvature for electrons and protons would be 0.2 and 8 astronomical units, respectively. The rotation of interstellar clouds containing ionized gas would tend to be slowed down by the eddy currents generated, thus facilitating the formation of stars. While these effects require further study, there is little question but that the possible presence of a galactic magnetic field must be taken into account in discussions of interstellar phenomena.

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Discovery, Identification, and Characterization of 2.8*d* Ru^{97}*

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DURING the course of a series of investigations, which sought to disentangle many inaccuracies concerning the mass and element assignments of radioactive isotopes of Ru and Rh, a new Ru activity was discovered.

The observation of this isotope was made possible by examining deuteron and neutron-bombarded Ru samples after decay of the 4.5*h* Ru^{105} (i.e., formation of 36.5*h* Rh^{105} daughter activity) was practically complete (76 hours after bombardment) and after purification of Ru by distilling it as RuO_4 from fuming $HClO_4$ solution. This Rh-free Ru fraction showed a complex decay and graphical resolution of the decay curve gave 42*d* and ~3 day components. The 42*d* activity was shown in other experiments to be a Ru isotope, identical with the 45*d* Ru produced in fission.[1,2]

The characterization of the half-life and radiations of this short-lived activity was accomplished by using differential absorption-decay curve techniques. In these experiments, two families of decay curves, which used 25 different thicknesses of Al (from 0 added absorber to 1.51 g/cm^2 Al) and 8 different thicknesses of Pb (from 0.161 g/cm^2 Pb to 3.96 g/cm^2 Pb), were measured for a period of about 80 days. Each of the 33 decay curves was plotted and graphically analyzed into a 42*d* and a short-lived component. The average half-life value of the short-lived component was found to be 2.8 ± 0.3 days.

By plotting an isochron*** from data for the 2.8*d* activity and resolving this absorption curve into its components, intense $18._2$ kev x-rays (150 mg/cm^2 Al half-value thickness) weak 0.2 Mev electrons (6–7 mg/cm^2 Al initial half-value thickness, 40–60 mg/cm^2 Al range), and 0.23-Mev gamma rays (0.9 g/cm^2 Pb half-value thickness) were found to be present. The relative intensities of these three types of radiation at zero added absorber (~20 mg/cm^2 total absorber) were 26:24:6.

The assignment of this isotope to mass 97 was based on the following considerations. By slow neutron activation only radio-isotopes Ru^{97}, Ru^{103}, and Ru^{105} would be produced. The 4.5*h* Ru→36.5*h* Rh decay chain, which was formed in slow neutron and deuteron-irradiated Ru and which was found to emit only negatrons, was assigned to mass number 105, since no other mass assignment would permit chain decay by negatron emission. The assignment of the 42*d* isotope to mass number 103 was based; (1) on Livingood's observation[3] that a 46*d* activity in deuteron-bombarded Ru emitted only negatrons; (2) on our observation that these negatrons were nuclear beta-radiations; (3) on arguments concerning the observed gamma-ray intensity ratio, $I_{2.8d/42d}=\sim 2$, at the end of bombardment. Using the assumption that the activation cross sections for Ru^{96} and Ru^{102} did not differ greatly and that the bombardment time was effectively "indefinitely short," it was found that the observed and predicted ratios were in much closer agreement for the assignments 2.8*d* Ru^{97} and 42*d* Ru^{103}, than for the assignments, 42*d* Ru^{97} and 2.8*d* Ru^{103}.

From the foregoing facts, observations, and deductions, the most probable decay process for Ru^{97} appeared to be *K* capture since the x-ray/γ-ray ratio of ~4 and the presence of low energy electrons (~0.2 Mev) pointed to partial conversion of the 0.23 Mev γ-ray rather than low energy positron emission, which could be the alternate mechanism. Also, the $18._2$ kev x-ray energy corresponded to that expected for element 43 formed by *K* electron capture in Ru.

A search for the daughter 43 activity of the 2.8*d* Ru^{97} did not give conclusive results since 42*d* Ru^{103} contaminated the element 43 fraction, isolated as the tetraphenyl arsonium salt. However, the data indicated 43^{97} must be long-lived and from absorption measurements in a windowless counter there was evidence that a very soft beta-ray was present. It was considered likely that this radiation was due to the 0.097-Mev electrons from the 90*d* isotope discovered by Cacciopuoti.[4]

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*** The term, isochron, as used here, may be defined as an absorption curve obtained at any specified time from a family of decay curves through selected absorbers.

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