against the corresponding scan areas of the bone. The lines showing the regression of scan area on dry fat-free weight ($Y = 18.3X + 118.3$) and the regression of scan area on ash weight ($Y = 13.0X + 44.3$) are superimposed on the plotted data. The correlation of the scan area, determined with flesh on the bone, with dry fat-free weight is 0.96, and the standard error of estimate is 114 mg. The correlation of the scan area with ash weight is identical, 0.96, but the standard error of estimate of 83 mg is slightly lower. The correlations are, to our knowledge, higher than any of those obtained on flesh-covered human materials, of whatever sort, as determined by previous roentgenologic techniques. Our data show a 6- or 7-percent error of estimate and a total experimental error of 8 percent. This contrasts sharply with the errors in other techniques. Studies of the humerus in cadavers by means of film densitometry have shown an experimental error of from 35 to 50 percent in determinations of bone mineral, and errors are greater still when the femur is studied (*3*). Even on the phalanges (*3*) and the rat femur (*4*), which have a minimal tissue cover, errors of from 15 to 30 percent or more are made with the densitometric method.

In our data the standard errors of estimate are sufficiently small to warrent the use of regression equations, and the regression lines intercept close to the origin, indicating correspondence of the theoretical and empirical relationships. This has also been our finding on excised skeletal bone. Similar scans made on bone phantoms, bones from a modern archeological site, and excised dry fat-free bones have resulted in equivalent or higher correlations (0.97 to 0.99). These findings indicate that the method used is accurate in determining bone mineral content in bones both with and without overlying tissue, and suggest that with further investigations and larger samples the method will provide an adequate means of osseous evaluation in vivo.

The radiation dose from the 5-mc I^{125} source is small in comparison to conventional roentgenography, and the dose is limited to a small area of the forearm (*1*). The method can be extended to areas of the body with greater absorption than the forearm by using I^{125} sources of greater activity, or by using sources with higher photon energies, such as Am^{241} (59.6 kev). Scan areas determined on excised bones, with Am^{241} being used as a source, gave correlations with bone mineral identical to those obtained when I^{125} was used.

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Radio Map of the Andromeda Galaxy

Abstract. *The University of Illinois radio telescope has resolved the 610.5 Mcy/sec disk component of radio emission from the large galaxy M 31 into several discrete concentrations. In two cases, these correspond to the crossing of the optical major axis by spiral arms. A spur of emission extends southeast from the galaxy near the minor axis.*

The earliest radio observations of the large galaxy M 31 in the constellation of Andromeda were made at Manchester, England, by Brown and Hazard (*1*) in 1951. They worked at 158 Mcy/sec. Since then, many groups have studied M 31. Among the most recent radio maps are the 408 Mcy/sec map made at Manchester by Large, Mathewson, and Haslam (*2*), who used a beam 40 minutes of arc by 56 minutes of arc to half power points, and the 1400 Mcy/sec map made at Ohio State by Kraus, who used a beam 11 minutes of arc by 40 minutes of arc.

These studies have shown that the radio emission from M 31 can be divided into two components, one called the disk component, which corresponds approximately with the visible galaxy, and the other a much larger component called the corona, which extends over 10 degrees along the major axis of the galaxy, and 6 degrees along the minor axis.

During the period November 1963 to January 1964, the region of the sky which includes M 31 was surveyed with the University of Illinois 400-foot (122-meter) radio telescope. The circular beam is 16 minutes of arc between half power points at 610.5 Mcy/sec and

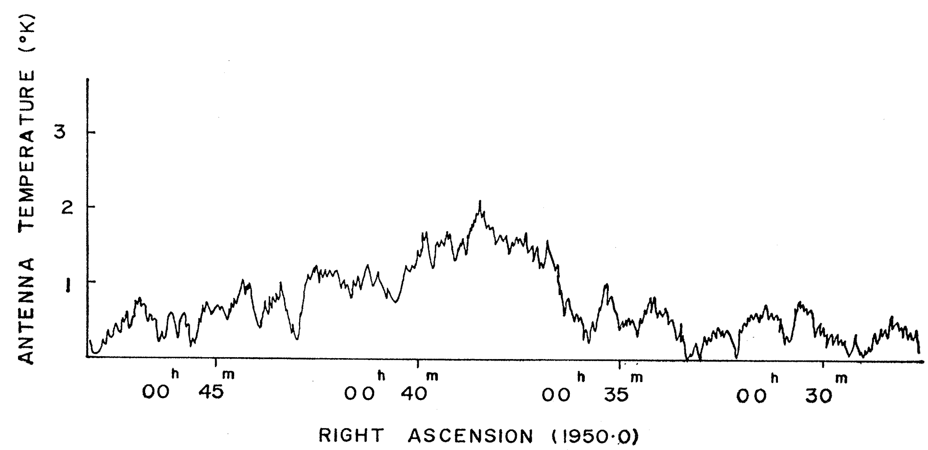

Fig. 1. A sample drift curve through M 31 at declination + 40°38′ (1950.0).

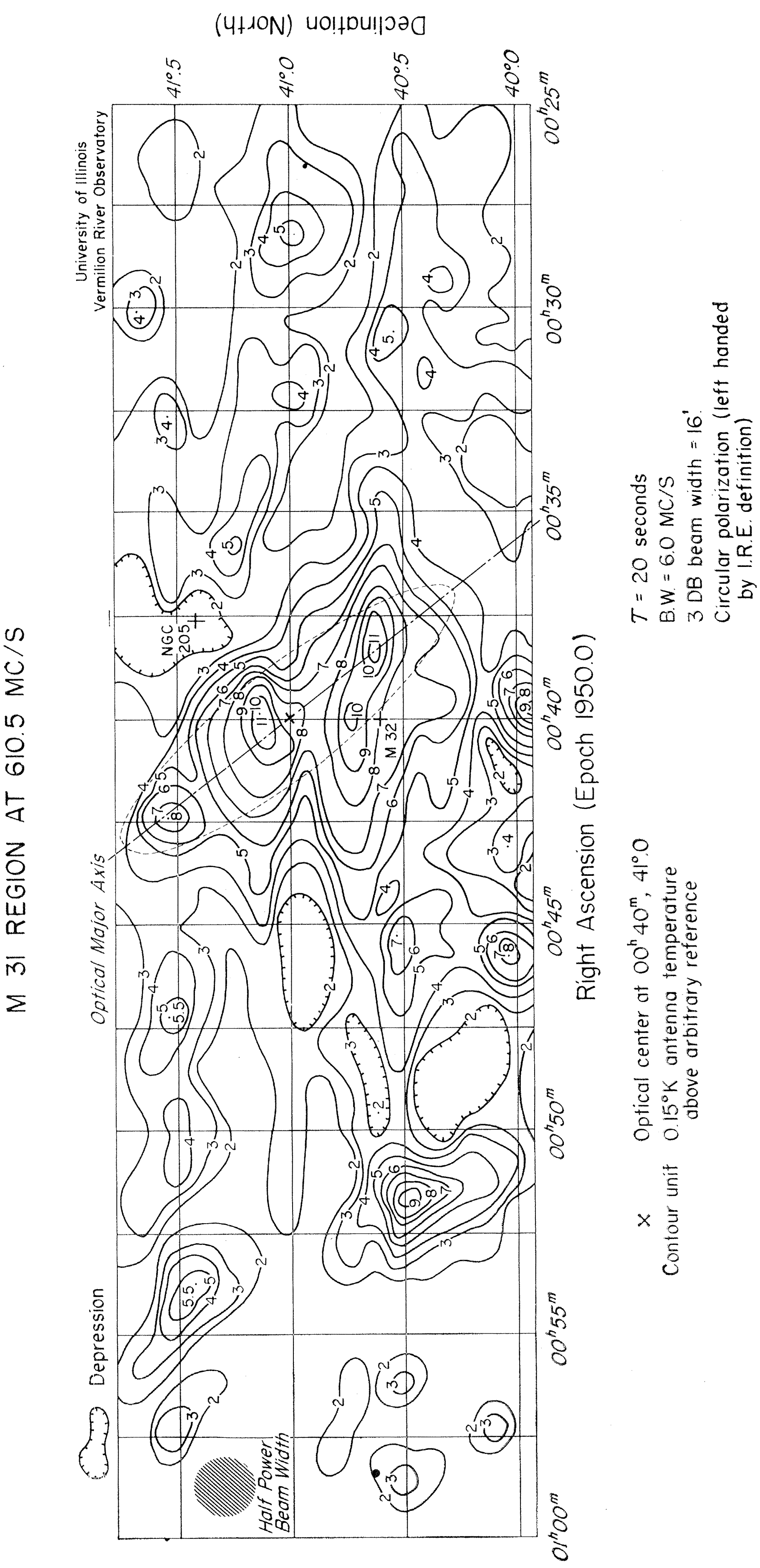

Fig. 2. Radio map of the galaxy M 31 in Andromeda, made at 610.5 Mcy/sec with the University of Illinois 400-foot radio telescope. The shape of the optical galaxy is indicated by the dotted ellipse, with the optical center located at "x". The contour interval is 0.15°K antenna temperature above an arbitrary reference.

therefore provides a higher resolution than used in the previous surveys of this galaxy.

An electron beam parametric amplifier (*4*) was used in conjunction with a Dicke-type comparison radiometer. The receiver noise temperature was 120°K, including losses in the solid-state comparison switch and in a circulator. The total system noise temperature was 330°K, the extra 210°K being chiefly due to losses in the transmission lines. With a 6 Mcy/sec bandwidth and a 20-second time constant, a single-scan root-mean-square output fluctuation of 0.06°K could be achieved in practice. After correction for transmission-line losses, this corresponds to 0.18°K antenna temperature. A sample drift curve through M 31 at declination + 40° 38′ (1950.0) is shown in Fig. 1.

The radio contour map, shown in Fig. 2, has been prepared by averaging three drift curves at each declination, except for seven declinations where only two drift curves were available.

The numbers on the contour map represent antenna temperatures in units of 0.15°K. The zero level is arbitrarily chosen to be that of the background in the vicinity of 01^h00^m right ascension. Our instrument receives left-hand, circularly polarized radiation, and as the polarization characteristics of M 31 are not known, antenna temperatures have not been converted to brightness temperatures.

The overall shape of the map contours corresponds roughly with that of the optical galaxy. However, the disk component of radio emission is resolved into several distinct features. The two regions with maximum height of 11 contour units correspond closely in position with the crossing of the optical major axis by two spiral arms. These two arms are called N 2 and S 3 by Baade (*5*), who notes that these are dust arms with a sprinkling of population I supergiant stars. The other source on the major axis does not correspond with a spiral arm, but is about 8 minutes of arc southwest of Baade's N 4.

A spur of emission extends to the

southeast of the optical center, roughly along the minor axis.

The disk component is assumed to lie within the fifth contour unit. If random polarization is assumed, its flux density, including both polarizations, is $S = 8.1 \times 10^{-26}$ watt $m^{-2}(cy/sec)^{-1}$.

There is no apparent radio source in the position of NGC 205, one of the two small companion galaxies of M 31. We can assign an upper limit of 0.6×10^{-26} watt $m^{-2}(cy/sec)^{-1}$ to any emission from this galaxy at 610.5 Mcy/sec. The other small companion galaxy, M 32, also has no source with flux density greater than 0.6×10^{-26} watt $m^{-2}(cy/sec)^{-1}$ associated with it.

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Genetics of Isoniazid Metabolism in Caucasian, Negro, and Japanese Populations

Abstract. *Trimodal frequency distributions for isoniazid inactivation were found in Caucasian and Negro populations. The frequency of "rapid" and "slow" alleles in Caucasian and Negro populations was similar and differed from that of a Japanese population.*

A bimodal distribution of Caucasian and Japanese populations with respect to isoniazid (INH) inactivation was found previously (*1*) by means of a serial dilution bioassay method. Other investigators (*2*) confirmed these results by the use of chemical tests for INH. Sunahara (*3*) employed a vertical diffusion bioassary for INH and found a trimodal distribution of INH inactivation among Japanese and other races from the Far East. He postulated (*4*) that "rapid" and "slow" inactivators were homozygous, that "intermediate" inactivators were heterozygous, and that neither allele was dominant.

We have now used a somewhat different vertical diffusion test (*5*) for measuring the concentration of biologically active INH in the serum of 116 Negroes, 105 Caucasians, and 209 Japanese. Serum specimens were obtained 6 hours after an oral dose of 4 mg of INH per kilogram of body weight. Each serum was assayed independently in this laboratory and by Sunahara. The results obtained in both laboratories were highly comparable. A trimodal frequency distribution was found for these three racial groups (Fig. 1).

The serum concentrations of biologically active INH used to segregate phenotypes into "rapid," "slow" and "intermediate" inactivators were as follows: "rapid" inactivators, 0.11 μg/ml or less; "intermediate" inactivators, greater than 0.11 μg/ml and equal to or less than 0.8 μg/ml; and "slow" inactivators, greater than 0.8 μg/ml. This phenotypic segregation was analyzed for agreement with the Hardy-Weinberg law of random mating without dominance. Table 1 shows the results of this analysis. The frequency of "rapid" and "slow" alleles among Negro and Caucasian populations is similar, but a marked difference exists in the frequency of the alleles in these populations and in a Japanese population.

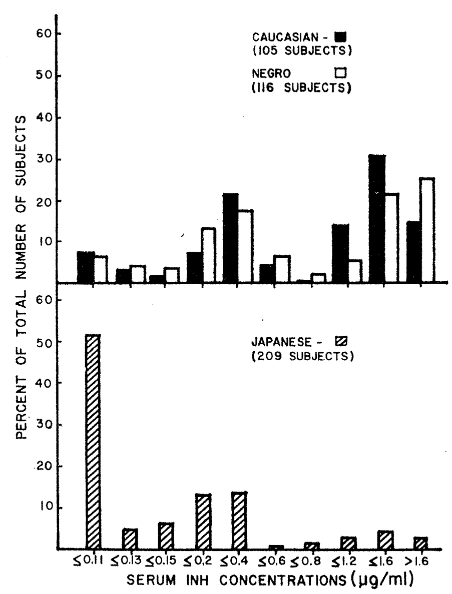

Fig. 1. Frequency distribution of INH concentrations in the serum of Caucasians, Negroes, and Japanese.

In Negroes and Caucasians the "slow" allele is approximately three times more frequent than the "rapid" allele. This instance is reversed in the Japanese, in whom the "rapid" is three times as frequent as the "slow" allele. There is good agreement between the number of observed and the number of expected phenotypes in these three racial groups.

These data confirm Sunahara's hypothesis that "rapid" and "slow" inactivators are homozygous, that "intermediate" inactivators are heterozygous, and that neither allele is dominant.

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Table 1. Analysis of isoniazid inactivation phenotypes.

Phenotypes observed*			Gene frequencies		Phenotypes expected			χ^2	p Value† (%)
R	RS	S	"R"	"S"	R	RS	S		
Caucasian (N = *105*)									
7	37	61	0.2429	0.7571	6.19	38.61	60.18	0.184	50–70
Negro (N = *116*)									
6	51	59	.2716	.7284	8.65	45.90	61.53	1.341	20–30
Japanese (N = *209*)									
108	81	20	.7105	.2895	105.5	85.98	17.51	0.702	30–50
Caucasian and Negroes (N = *221*)									
13	88	120	.2579	.7421	14.69	84.59	121.7	0.356	50–70

* R, rapid; RS, intermediate; S, slow. † Degrees of freedom = 1.

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