that change of location of stimuli is insufficient to elicit the optomotor reflex; unless movement is perceived, circling will not occur. Our results indicate that there are two stages in the optokinetic reflex, namely (i) the perception of rotation of the stripes and (ii) the circling or pursuit of such phenomenally moving stripes. If the conditions are not right in (i), (ii) will not occur.

We believe that the response to apparent movement will also prove to be innate in human infants. It does not follow, however, that experience cannot also play a role in the mature organism; the two factors are not mutually exclusive.

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Geological Interpretation of Aeromagnetic Profiles

In "Genesis of the Arctic Ocean Basin" (*1*) King, Zietz, and Alldredge relied upon aeromagnetic data to arrive at their main conclusion, "that at least one part of the Arctic Basin is underlain by continental rocks. . . ." The method used to interpret these data was to compare segments of magnetic profiles over the Arctic Ocean with magnetic profiles obtained over oceanic and continental crustal sections. If a magnetic profile from a region of the Arctic Basin was more similar to a profile over a continental crustal section than to one over an ocean basin, they concluded that that region of the Arctic Ocean was continental in geological structure, and vice versa. The bases for these comparisons were grouping and frequency of occurrence and amplitude of anomalies. Apparently comparisons were made by visual inspection.

One of the examples given is a comparison of a "typical low-level profile over [the] Central Magnetic Zone" with a "typical profile off Cape Mendocino, California." With reference to the latter magnetic profile the authors say: "These true oceanic profiles all look much alike, except over isolated features such as seamounts, and over regions of probable thick sedimentary accumulation near the continental margins." It is concluded that these two magnetic profiles do not compare favorably, whereas another profile, flown at 30,000 feet (9000 m) above the Alpha Rise, resembles profiles flown at 500 feet above a Precambrian shield and 10,000 feet above basement over the United States stable region. They therefore say that the "Central Magnetic Zone" is "underlain by continental rocks."

Can a conclusion of such sweeping geologic importance be justified by the presented evidence? The answer to this question can be approached in three ways: First, do the profiles being compared differ and, if so, in what respect? Second, are the differences real or apparent? Third, do the differences have any geologic relevance and, if so, to what extent?

The only very convincing dissimilarity between the compared profiles over the "Central Magnetic Zone" and off Cape Mendocino is the difference in overall amplitude, that of the Cape Mendocino profile being approximately one-half that of the "Central Magnetic Zone." The difference in amplitude of anomalies between these two profiles could be explained in a number of ways, such as by differences in susceptibility of the rocks, differences in depth of burial, and remanent magnetism.

It is not necessarily diagnostic of geologic differences contrasting continental and oceanic crustal structure. For instance, the Geophysical and Polar Research Center, University of Wisconsin, has completed more than 20 aeromagnetic flights over the "Central Magnetic Zone." The profile shown in King, Zietz, and Alldredge's Fig. 4 is from one of the earlier flights (*2*). Many of the profiles show amplitudes no greater than those observed over the Pacific Ocean off Cape Mendocino. The similarity among the three flights shown in their Fig. 5 cannot be very convincingly envisioned at elevations ranging from 500 feet to 30,000 feet above the sources of the anomalies.

However, accepting for the sake of argument that the similarities or dissimilarities of the profiles have been positively established, consider now the second aspect of the problem: whether the profile differences are real or apparent. Take for example the region off Cape Mendocino itself, which has been surveyed in great detail by the U.S. Coast and Geodetic Survey (*3*). A contour map of the residual total magnetic field, after Raff (*4*), is shown in Fig. 1.

The most obvious feature of this map is the lineation of magnetic anomalies. The strike of the profile used by King, Zietz, and Alldredge across this area is unknown. However, it is obvious that the character of magnetic profiles constructed across the region will vary appreciably with both azimuth and location. To illustrate this point graphically, three profiles are shown below the contour map. Profiles 1 and 2 were constructed along the 41°N and 40°N parallels, respectively; profile 3 was constructed along the 128°W meridian. The difference in character among these, resulting solely from variations in orientation and location, is striking.

One might then logically question whether such geometric ambiguity can be avoided by comparing contoured sections rather than individual profiles. In answer to this one need but consider the marked difference between the northern half and the southern half of the contoured residual magnetic field in Fig. 1. This was one of the type areas used by King, Zietz, and Alldredge to conclude that the central portion of the Arctic Ocean Basin is "underlain by continental rocks!"

Differing magnetic character over a single geologic province is not necessarily confined to oceanic crustal structure. Take for example some aeromag-

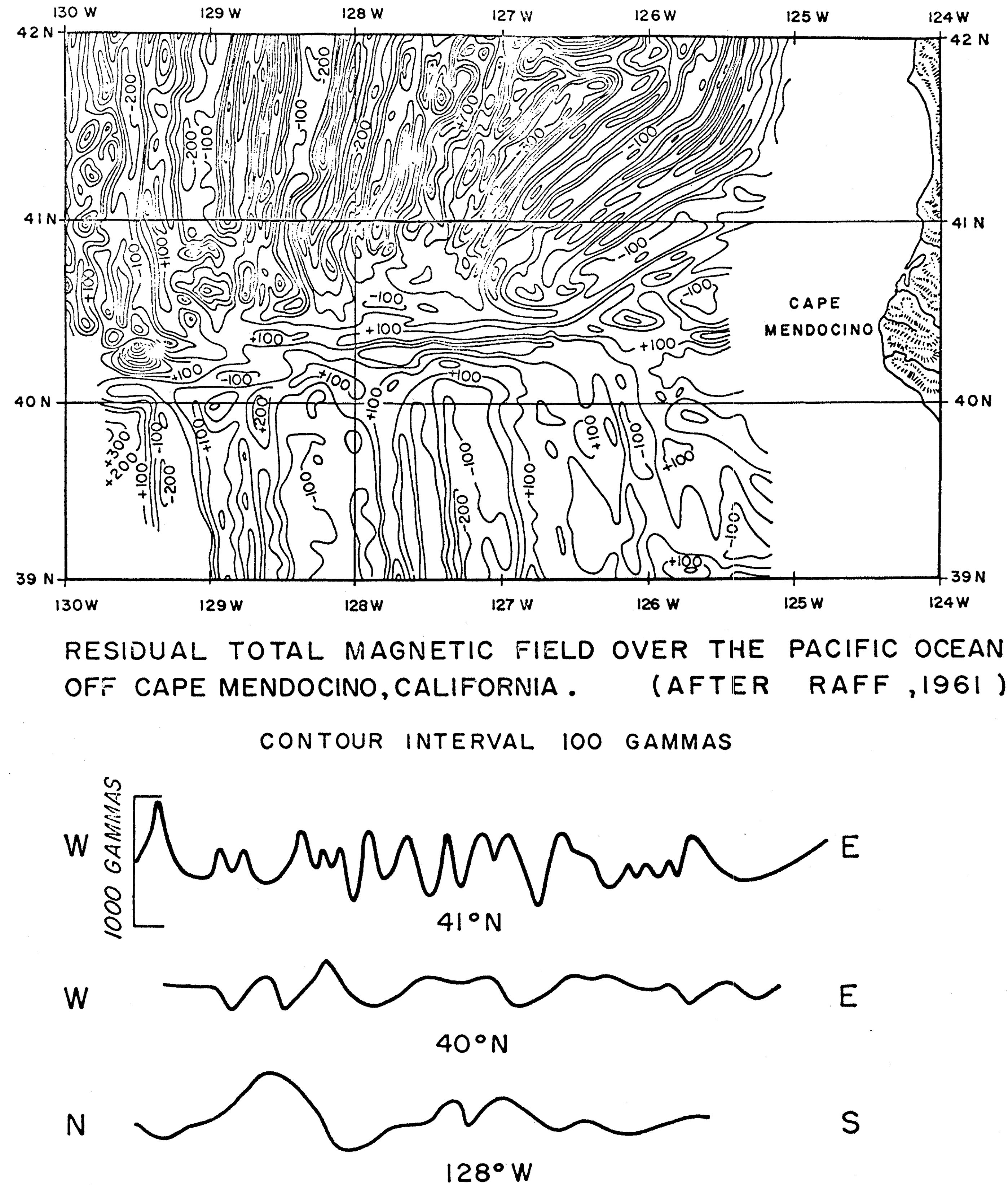

Fig. 1. Contour map of the residual total magnetic field over the Pacific Ocean off Cape Mendocino, California, after Raff (*4*). The magnetic profiles were constructed from the contour map along the 41°N and 40°N parallels and 128°W meridian.

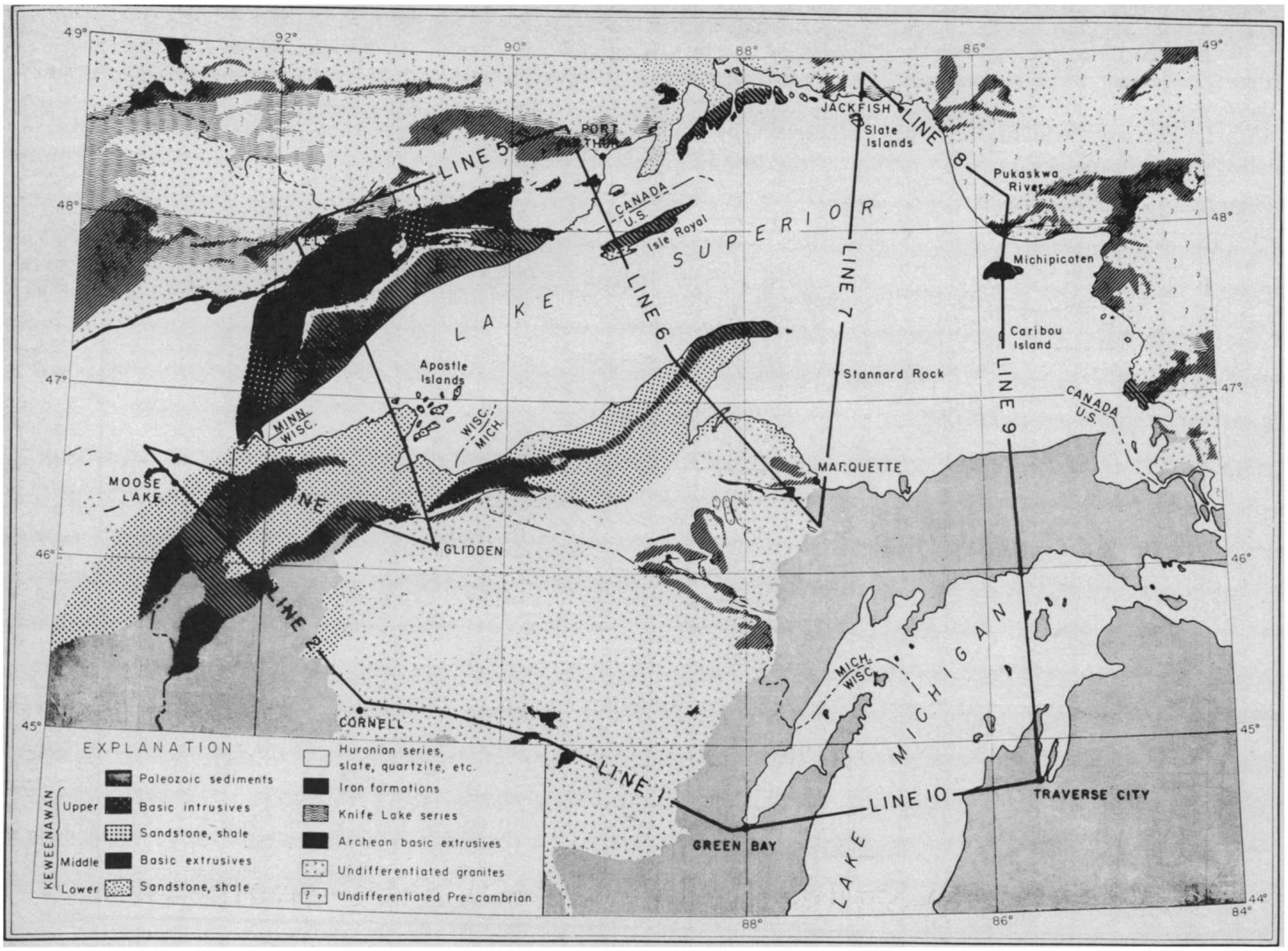

Fig. 2. Schematic geologic map of the Lake Superior region showing the aeromagnetic flight lines completed in 1959 by Thiel (*5*).

netic flights over the Lake Superior region (Fig. 2) completed in 1959 by the late Edward C. Thiel (*5*). Lake Superior extends more than 100 miles northward from the southern boundary of exposed Canadian Precambrian Shield. The maximum water depth within the lake is less than 1000 feet. This change in bedrock elevation beneath a constant flight elevation could account for an attenuation of anomalies by only approximately 20 percent. Obviously this in itself could not explain the abrupt change in magnetic character of the profiles over Lake Superior (Fig. 3). The ten aeromagnetic profiles shown in Fig. 3 exhibit the complete spectrum of possible general characteristics, from featureless flat fields to high-frequency, high-amplitude anomalies, despite the fact that they were nearly all flown over a single geologic province.

The basic question then is: Does the method of interpreting magnetic data by profile comparison used by King, Zietz, and Alldredge have any geologic relevance? It appears that lithologic heterogeneity and geologic structure are commonly too complex to be so simply generalized. Consider only one variable, that of magnetic susceptibility.

Variations in susceptibility by an order of magnitude within many rock types have long been known (*6*), and differences of a factor of two or more between specimens taken from the same outcrop are not unusual. Superimpose upon this the variables of sedimentation, tectonic deformation, secondary mineralization, remanent magnetism of various sorts, and so forth, and an exceedingly complex picture emerges. In light of this, the validity of arriving at any conclusion based only upon similarities or dissimilarities of magnetic profiles observed many hundreds or thousands of miles from each other is highly questionable. In fact, the examples given show that attempting such an interpretive technique over even short distances is hazardous.

Finally, the "Central Magnetic Zone" encompasses the Alpha Rise and portions of the Canadian and Central Arctic Basins (*7*). It seems unlikely that these three physiographic provinces could be included in a single geological generalization. Indeed, from additional geophysical data (seismic and gravity) other investigators have suggested that the basins are oceanic in structure, whereas the Alpha Rise is underlain by a thicker column and may be considered intermediate or continental in structure (*2, 8*). King, Zietz, and Alldredge discount these data which contradict their conclusion by the statement, "It should be emphasized that all the geophysical interpretations are based on empirical methods or on arbitrary initial assumptions about densities and layering." Such a sweeping disregard for other data hardly seems in order.

Unfortunately, geological data are too speculative to aid appreciably our understanding of the structures and genesis of the Arctic Ocean Basin.

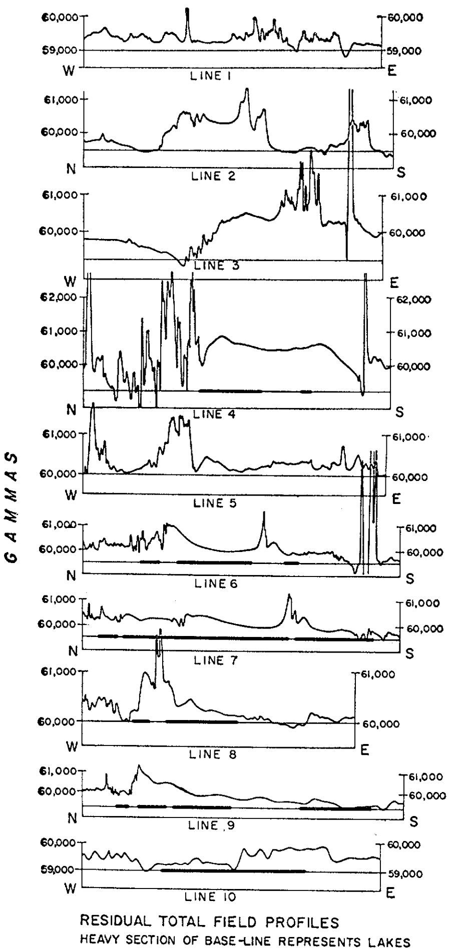

Fig. 3. Thiel's (*5*) aeromagnetic profiles over the Lake Superior region. Line numbers refer to Fig. 2.

Meanwhile, it is important that we evaluate all available and forthcoming geophysical data with objectivity and caution.

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27 November 1964

Ostenso's comments emphasize the impossibility of demonstrating conclusively the oceanic nature of a particular region on the basis of the magnetic data alone. However, we believe the magnetic data can be used to indicate, although not establish conclusively, the presence of continental rocks where they are predominantly mafic in character, as most shield areas tend to be. In other words, an area of low-amplitude magnetic anomalies is ambiguous and could be either oceanic or nonmagnetic continental material, but where the majority of the magnetic anomalies are very large in amplitude, we have a situation which, up to now at least, we have not observed except in continental areas. This conclusion is independent of the widely varying magnetic susceptibilities for both continental and oceanic rocks that have been measured in the laboratory, because the magnetic profiles are a measure, *in situ*, of the total magnetic effect of the entire mass distribution in the area traversed. Thus a region where the amplitudes are double those of another region must be significantly different lithologically, if the comparison is made between two areas observed at approximately the same height above the magnetic material. Since in our article we did not spell out the implications of the high magnetic amplitudes, we are glad of this opportunity to clarify this important point.

Our conclusions are based upon empirical criteria developed by examining hundreds of thousands of traverse miles of magnetic data, not only for land areas but for large areas in the oceans as well. We probably have not seen all the existing data, and there are still large areas for which no data exist, but, to date, we have not found a true oceanic area in which the magnetic amplitudes are comparable to those in the Central Magnetic Zone. If such an area is subsequently found, we will, of course, have to modify our conclusions. In our article we have endeavored to make clear how we arrived at our conclusions so that the reader may not be mislead into accepting them for more than our best estimate based on all the present available information.

Turning to the specific points raised by Ostenso, it should be noted that his two examples of oceanic and continental regions fulfill the criteria we have observed. It is difficult to make comparisons between profiles that do not have a consistent relationship between their vertical and horizontal scales. In our article, 1000 gammas and 160 miles are always equivalent in length, no matter what the scale of the illustration, so that comparison of the gradients and characteristic shapes, as well as of the amplitudes, is permitted. In Ostenso's Fig. 1, 1000 gammas is equivalent to roughly 95 miles, which means that the gradients appear somewhat smoother than those in our Fig. 4 for the same area. In his Fig. 3, although the horizontal and vertical scales vary considerably from line to line, we presume the relation of gammas to miles is consistent and estimate that 1000 gammas is equivalent to about 12½ miles, so that even a 500-gamma anomaly shows up as only a gentle ripple. If amplitude alone is considered, the Cape Mendocino anomalies, no matter how traversed in relation to magnetic trend, do not exceed 500 gammas. The relation of the traverse to trend does have an obvious effect on the shape of the anomalies in areas such as this. Although we could not include this in our short article, we were able to make some estimate of probable trends of the anomalies in the Central Magnetic Zone and have used profiles which most nearly crossed these trends at right angles.

It should be noted that we used one of the University of Wisconsin profiles in Fig. 4 in order to show data obtained in each case at a comparable distance from the ocean bottom. (Figs. 1, 5, and 6 show the high-level data obtained under the auspices of the U.S. Coast and Geodetic Survey.) The similarities between the three profiles of Fig. 5, two of which are over continental crystalline rocks, do depend heavily on the shapes and grouping of the anomalies as well as on their high amplitudes, but Fig. 6 shows that comparable high amplitudes are observed on a continuous profile over both the Central Magnetic Zone and the Canadian shield when flown at 20,000 feet above sea level.

It is not really proper to compare such a limited area as the Lake Superior region with the vastly greater area of the Central Magnetic Zone. In the latter case we have a well-delineated area of at least 400,000 square miles which gives rise to abundant anomalies of 1000 gammas or more even at 20,000 feet above sea level. No doubt there are areas within this zone which produce much lower amplitudes, as Ostenso says in his fourth paragraph, but so there are in continental areas, as he shows in the Lake Superior area, where areas of lower magnetic amplitude 50 miles across are observed.

Although "positive proof" of our conclusions has not been possible, we realize that progress is made by offering suggestions which are, at the least, interesting and provocative, and which will lead to useful discussion and to the acquisition of more data aimed toward the solution of the fundamental question of the essential differences between oceanic and continental crust. In no case do we intend to express a "sweeping disregard" for the data from other geophysical disciplines, although we do suggest that in a complex region, methods such as dispersion of earthquake waves and phase transmission studies may not be as helpful as magnetic data, which may be more diagnostic of the existing lithology of large crustal blocks.

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Note

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Hybrid Resistance Controlled by H-2 Region: Correction of Data

We have reported (*1*) that resistance of F_1 hybrids to parental C57BL/10 marrow grafts was associated with heterozygosity at the K region of the histocompatibility-2 (*H-2*) locus. The critical observations were made in F_1 hybrids between C57BL/10 ($H\text{-}2^b/H\text{-}2^b$) mice and mice carrying variant *H-2* alleles which resulted from crossing-over within the *H-2* locus and resemble the $H\text{-}2^h$ and $H\text{-}2^i$ alleles (*2, 3*). However, subsequent extension of this work with hybrids from crosses between $H\text{-}2^a$ instead of $H\text{-}2^b$ homozygotes and the same *H-2* variant mice gave results inconsistent with our earlier conclusion and prompted us to reexamine the protocols of the first set of experiments. At the time of our reexamination we realized that the genotypes of the hybrids between C57BL/10 and the two variant strains of mice had been misinterpreted during the course of our first studies because of a clerical error in decoding. Consequently, heterozygosity at the D region of *H-2*, rather than at the K region as erroneously reported (*1*), accounted for the expression of hybrid resistance. In the course of these initial studies, the mice were classified at the Jackson Laboratory for their *H-2* specificities by hemagglutination tests before being shipped to the Oak Ridge National Laboratory, where they were tested as coded unknowns for resistance or susceptibility to parental C57BL/10 marrow grafts. The results had, therefore, to be interpreted by communication between the two laboratories. In the exchange of data by mail, an error in decoding resulted in our confusing the variant *H-2* phenotypes with each other. Table 1 contains the corrected data that were mislabeled in Table 2 of our earlier report (*1*) and the more recent data that led to this correction. Both experiments indicate that the genetic factor (or factors) of hybrid resistance is situated within, or in close association with, the D region of the *H-2* locus, but not the C or K regions.

Table 1 [in substitution of Table 2, reference (*1*)]. Growth of parental marrow cells grafted into F_1 hybrids from crosses between congenic lines of mice differing for regions of *H-2*.

F_1 hybrid recipients*	Heterozygosis for *H-2* components	No. of mice	Splenic uptake of ^{131}IUdR (%)†	Classification
B10 × B10.A	D M C H K	10	0.03 ± .007	Resistant
B10 × H-2I-2Sg‡	D M C H	10	0.02 ± .008	Resistant
H-2H-2Sg × B10.A	D M	10	0.03 ± .005	Resistant
B10 × H-2H-2Sg§	C H K	11	0.73 ± .08	Susceptible
H-2I-2Sg × B10.A	K	10	0.53 ± .04	Susceptible
B10	None	10	0.80 ± .05	Susceptible

* Donors were females; recipients were of both sexes, exposed to 700 or 850 r of x-rays; description of the mouse strains, (*1–3*). † Mean uptake values for spleens of mice injected with marrow are given as the percentage of the total ^{131}IUdR (5-iodo-2′-deoxyuridine) radioactivity administered (± standard error of the mean) *above* the level in irradiated control animals not injected with marrow. ‡ Data from Table 2, reference (*1*), in which the recipients were incorrectly labeled as "recombinant type 2." § Data from Table 2, reference (*1*), in which the recipients were incorrectly labeled as "recombinant type 1."

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