radioactive element, similar calculations can be made for beta-emitting and alpha-emitting isotopes. Using the number of calories released per hour by 1 g of radium and its decay products (*7*), one can show that for alpha-emitting Po^{210}, for example, 1×10^{-8} curie of radium is equivalent to 0.6×10^{-8} curie of Po^{210}. Since 0.02 μc of Po^{210} is accepted as the maximum permissible amount per 70 kg of body weight (*8*), this again demonstrates how close, under the mentioned generalizing assumptions, the radioactivity of the human beings may come to the permissible amounts.

It must be emphasized in this connection that our present knowledge and experience are not great enough to justify making final statements. This becomes evident from recent studies in such a relatively simple field as the incorporation of radon by mouth as well as by inhalation. The role of the daughter-products connected with the decay of radon and/or thoron has surely been discussed frequently and thoroughly in the past (radontherapy, uranium mines, radium factories). However, it was not until 1951 that Bale and his coworkers (*9*) showed and discussed the role of the daughter-products, present in the air in a more or less general equilibrium with the radon, in considering the total dose delivered to the lungs and the body after incorporation of radon. Calculations as well as experimental studies by Shapiro (*10*) with rats, dogs, and models for the human being showed that these daughter-products constitute an effective dose many times higher than expected. Rats, breathing an atmosphere containing 10^{-9} curie/liter of radon, showed an average effective dosage received by the lungs from inhaled radon daughter-products amounting to about 330 mrem/hr, whereas the dosage from the inhaled radon and from the daughter-products of the radon molecules decaying in the lungs amounted to only 9 mrem/hr. Similar conditions hold, as reported by Aurand and Schraub (*11*), for orally incorporated radon in aqueous solutions, since, depending on the conditions, the solutions, as well as the naturally occurring waters, contain the daughter-products of radon in equilibrium in greater or smaller amounts.

The impact of these findings, not only on radon tolerance problems, but also on the question of the radioactivity of the human being, is obvious. In order to promote knowledge in the field the following studies may be recommended:

1) Measurement of the radioactivity of as many people as possible from different regions of the globe with the modern total-body activity measuring devices.

2) Measurement of the kinds of radioactive substances in the body, especially with regard to alpha-emitting, beta-emitting, and/or gamma-emitting elements.

3) Detailed invesigations of the radioactive materials incorporated daily by human beings from air, water, and food.

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Detection of M-Regions in Geomagnetic Data

The detection of 27-day recurrent geomagnetic disturbances, generally attributed to charged corpuscles ejected from the solar surface, has occupied the attention of many authors. Most have ascribed the source of these corpuscles to hypothetical stable regions of the solar surface that have a synodic rotation period of about 27 days (*1–4*). Bartels (*5*) earlier gave the name "M-regions" to such unidentified regions because of their geomagnetic effect.

We have recently undertaken studies (*6*) of the correlation between trends of geomagnetic disturbance ratings K_p and the locations of regions of bright coronal line emission around centers of heightened solar activity. Our work will be reported separately. We found, for a marked period of recurrent geomagnetic activity from July 1952 through June 1953, confirmation of the results of Allen (*1*), Bruzek (*3*), and others which suggest that the M-regions are to be identified with extensive undisturbed areas of the solar disk where the coronal emission intensities are low, and that the effect of the coronal maxima and other phenomena of moderate or weak active centers is to diminish geomagnetic disturbance activity 3 days after central solar meridian passage of these regions.

We interpret this diminution an denhancement of geomagnetic disturbance as modification of the density of flow of the responsible corpuscular streams by the physical conditions around the active center. The active centers, we suggest, divert the corpuscular flow

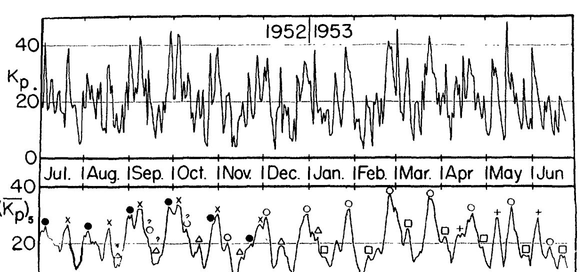

Fig. 1. In the upper graph the index K_p is plotted as a function of time throughout the period studied. The lower graph shows the 5-day running mean K_p for the same period. The different symbols represent the different M-regions. Question marks refer to dubious members of recurrent series.

from the radial direction above the active center and produce, in such directions, a "cone-of-avoidance" in the corpuscular streams with a width of about 4 to 5 days of solar rotation, or about 60°.

The purpose of this communication is to point out that, if this interpretation is correct, the process of using a running mean of perhaps 4 to 5 days in geomagnetic disturbance ratings will not adversely affect the detection of the M-region response in geomagnetic data, but it will decrease the sharp, irregular, and possibly accidental or local fluctuations in geomagnetic disturbance ratings that tend to mask the important features of the active region influence. As Fig. 1 shows, the use of a 5-day running mean simplifies the identification of the individual peaks of the trend curve that reveals the 27-day recurrence. For the period shown, practically every significant peak can be fitted into a recurrent series, members of the same series being represented by similar symbols. Moreover, the whole curve can be fairly well synthesized by adding curves for individual series, and these individual curves show reasonably smooth systematic trends in amplitude corresponding to the lifetimes of the recurrent series. Recurrent periods of other than about 27 days cannot similarly be fitted to the data.

Our work suggests that the use of 3- to 5-day running means as an index of the intensity of the hypothetical corpuscular beams has merit, at least for years of low solar activity, and may assist in other geophysical studies.

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Visual Receptor Lamellation and Active Rhodopsin

The paper by Wald (*1*) reconciling large changes in visual sensitivity with minute changes in concentration of photopigments apparently marks the end of an epoch. For more than 30 years the effort was made to explain various functions of vision by the reaction-kinetics of visual purple. This interpretation has appeared incompatible with the data of many workers, summarized in Wald's paper. The chemistry of mass-action can hardly operate as a measure of sensitivity, in terms of thresholds or of quantum demand, in the microlamellar environment of Wald's hypothesis. It will be interesting to see whether the formal deductions of the visual-kinetics school can find any *mechanism* in this new molecular-compartment theory.

Whether visual thresholds can be shown to depend solely on the properties of single receptors is also an open question. The photochemical approach frankly invokes the logical principle of parsimony in the attempt and tentatively denies other retinal mechanisms a role in this regard. Thus it excludes from the visual threshold mechanism considerations like receptors-per-fiber, receptive fields changing with adaption, and bipolar thresholds. With our increasing knowledge of retinal physiology, one wonders whether this logical principle is not a misleading guide.

Wald has now incorporated some of the data on receptor structure into visual theory, by relating the number of rhodopsin molecules to the number of Sjöstrand's submicrolamellae, and thence to the shifting quantum demand. His hypothesis, however, does not incorporate the striking major lamellation clearly demonstrated by M. Schultze in 1867, analyzed optically by W. J. Schmidt (*1*), but destroyed by the reagents used in Sjöstrand's technique. This coarser structure (*2*) has been shown alternately aqueous and lipid by chemical methods (*3*) and roughly periodic at 400 to 700 mμ (*2*). It interrupts the continuous stack of 1400 to 2800 microlamellae 4 to 8 mμ thick (as postulated by Sjöstrand) each contributing equally to vision in Wald's proposal. The coarser organization would give those protein microlamellae that contact the thicker lipid layers a special local sensitivity occurring at 400 to 700 mμ as proposed 10 years ago by Wald (*1*). Roughly each hundredth layer of rhodopsin protein would thus become the site not only of quantum absorption but of electric excitation—a hypothesis (*2*) based on several optical and electrochemical aspects of this interface. The thickness of the coarser lipid layers, yet unknown but lost in Sjöstrand's method, becomes a critical datum in the theory of excitation.

It would be interesting to have Wald's hypothesis related to several important details:

1) What is the electric trigger? That is, how can rhodopsin, after absorbing a quantum, create a local electric impulse by a known neuro-excitatory mechanism? The electric asymmetry required for depolarization of the stack (*2*) is not accounted for by "membrane breakdown" alone; nor is the considerable voltage and energy generated in the whole outer segment.

2) How do the protein microlamellae of Sjöstrand relate functionally to the coarser *lipid* layer and *its* microstructure shown by Schmidt?

3) How incorporate the unique geometric (*2*) and chemical relationship of rhodopsin molecules to the thick lipid segments that separate the aqueous segments composed of approximately 100 protein microlamellae? That is, Wald's key proposal of 1944 deserves further exploration. If this is true, the relationship of total rhodopsin to molecules used in stimulation would be much more than 6 to 1—the main point at issue.

Now that Wald's unflagging and admirable series of investigations has begun to take quantitative ac-