quently on ganglion cells that branch in the middle third of the IPL, as well as on those branching in the outer third. Indeed, neurophysiological studies have indicated that, while all ganglion cells seem to have rod inputs, both rod and cone pathways converge on many ganglion cells (*8–10*). If, as reported in the cat (*10, 11*), some ganglion cells do not receive input from cones, it is likely that their dendritic ramifications occur in the inner third of the IPL.

It has been proposed that bipolar cells convey sustained and simple center surround properties to ganglion cells, while amacrine cells are responsible for transient activity in ganglion cells, as well as complex receptive field properties, including directional selectivity (*2a, 12*). It has been suggested further that a high ratio of amacrine to bipolar synapses in the IPL (*2a, 12*) and on individual ganglion cells (*13*) is the substrate for the "complex" behavior of ganglion cells in submammalian vertebrates, as well as lagomorphs and some rodents.

In the rod-dominated retina of the cat most of the ganglion cells receive both rod and cone input (*9, 10*). We have shown that in the cat, rod bipolars require internuncial amacrines, while cone bipolars synapse directly on ganglion cells. One might then expect that a change from light-adapted to dark-adapted conditions would result in a corresponding shift in ganglion cell responses to more transient activity and to more complex receptive field properties. Actually, the receptive field surrounds of ganglion cells are diminished, if not absent, in the dark (*9, 10*). Moreover, under the same conditions the sustained component of their responses becomes more prominent (*14*). Of possible importance in this regard is the recent discovery of sustained amacrine cells (*15*).

Thus, in the dark-adapted eye, amacrine cells of the cat must not only permit an increase in sustained activity but also convey to ganglion cells simple receptive field "center" properties. We suggest that the type II amacrine cell, because of its narrow-field morphology and stratified connections, is a good candidate for conveying dark-adapted receptive field center properties to ganglion cells in the retina of the cat.

HELGA KOLB
E. V. FAMIGLIETTI

National Eye Institute,
National Institutes of Health,
Bethesda, Maryland 20014

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3. After ocular decompression, retinas of cats were fixed by intracardiac perfusion of two aldehyde mixtures [T. Reese and M. Karnovsky, *J. Cell Biol.* **34**, 207 (1967)]. Tissue was postfixed in osmium tetroxide and block-stained in uranyl acetate during ethanolic dehydration. Serial thin sections stained with lead citrate were examined on Formvar-coated grids. Samples were taken from area centralis and "paracentralis," as identified in 50-μm Epon sections, and then in 1-μm sections of the reembedded thick sections. We also examined by light microscopy retinas of cat, dog, and monkey prepared after glutaraldehyde-osmium fixation, by the rapid Golgi or Golgi-Kopsch-Colonnier techniques.
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7. We have found narrow-field, bistratified amacrine cells similar to those of the cat, both in dog and in rhesus monkey (*5*). Thus it is likely that the pathways which appear to depend upon the type II (rod) amacrine cell may also be found in other mammalian species, notably in the order Primates.
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31 May 1974

Earthquakes and the Rotation of the Earth

Abstract. *A correlation exists between long-term variations in the length of the day, Chandler wobble amplitudes, and global seismic activity. These variations may be partially due to climatic changes and ultimately to explosive volcanic activity.*

The cause of the long-term (~ 10 years) variations in the length of the day are still unknown, but they are generally attributed to processes in the core (*1*). Short-term and seasonal variations can be confidently attributed to variations in zonal wind velocities (*2*). These short-term variations are generally of the same order of magnitude as the long-term ones—the so-called decade variations in the length of the day—so it is not out of the question that long-term climatic variations may also be responsible for the decade variations in the rotation rate of the earth. In this report I would like to point out an interesting correlation between the length of the day, Chandler wobble amplitudes, and the incidence rate of great earthquakes (Fig. 1). In particular, the large deviation in the length of day around the turn of the century correlates well with the worldwide increase in global seismic activity at the same time. Smaller peaks in the length of day and seismic activity occur in the 1830's and 1940's (Fig. 1). There is, as yet, no indication of increased seismic activity associated with the upswing in length of day starting about 1960.

The correlation coefficient between earthquake energy and length of day is 0.78 for unlagged 5-year means and 0.90 for sliding 20-year means taken at 5-year intervals. The correlations with volcanic activity and global climatic

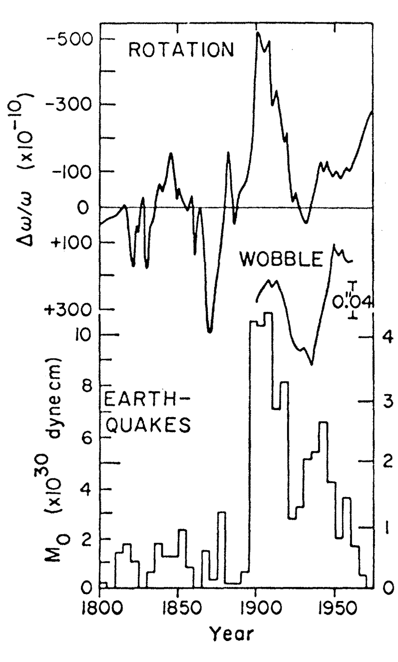

Fig. 1. Changes in rotation rate of the earth ($\Delta\omega/\omega$), Chandler wobble amplitudes, and 5-year means of earthquake energy (E_S) or moment (M_0) (*10*).

patterns are also good, and this will be discussed elsewhere (*3*).

The motion associated with individual earthquakes is apparently incapable of maintaining the Chandler motion of the poles (*4*), although this is a matter of current spirited debate (*4, 5*). Preseismic and postseismic deformations, however, may be adequate (*3*). The large amount of elastic energy stored in the crust and upper mantle (*6*) due to rotational processes suggests that a small perturbation in the rotational parameters of the earth may trigger global seismic activity.

The main source of length of day variations appears to be related to changes in the zonal wind circulation patterns (*2*). Climatic changes, in turn, are affected by solar radiation modulated by volcanic dust in the atmosphere (*7*). A major volcanic eruption can lead to climatic variations that survive for periods of the order of 5 years or more (*7*). Explosive volcanic eruptions, more common in the last century than in the present one (*7*), may be the ultimate cause of the large change in the length of day at the turn of the century. The turn-of-the-century length of day peak also correlates well with the interval between the great decoupling and lithospheric earthquakes in Sanriku, Japan (*8*). After a great decoupling earthquake, the lithospheric plate motions can be expected to accelerate and to trigger earthquakes in adjacent portions of the arc. On the other hand, explosive volcanism in the 1830's and 1880's apparently triggered climatic changes, particularly atmospheric circulation patterns, that led to changes in length of day and may have triggered the global seismic activity that also occurred in these intervals. If the correlation between the length of day and the eccentric dipole motions is accepted (*9*), the lag in the magnetic field, if climatic changes are the causal phenomena, can be attributed to inertial and core viscosity effects, in addition to mantle electromagnetic phenomena.

DON L. ANDERSON

Seismological Laboratory, California Institute of Technology, Pasadena 91109

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Thermal Blanketing: A Case for Aerosol-Induced Climatic Alteration

Abstract. *Long-term temperature records at Phoenix, Arizona, indicate the existence of a post-1946 warming trend that may be attributed to the buildup of pollution in the lower layers of the atmosphere. The causative mechanism appears to be an enhancement of the so-called "greenhouse effect," induced by the interaction of aerosol with long-wavelength thermal radiation in the lower atmosphere.*

In recent years there has been considerable discussion of the possibility of climatic alteration due to the particulate pollution of the atmosphere's lower layers by human activity. The most widely considered mechanism of alteration has been the interaction of aerosol with solar radiation. Several of the recent reports on this aspect of the problem have been rather indecisive, however, concluding that particulates in the lower atmosphere may either warm *or* cool the earth, depending upon the specific absorptive and scattering properties of the aerosol and the characteristics of the underlying surface (*1, 2*).

A second mechanism of alteration, one that has been seriously propounded only recently (*3*), deals with the interaction of aerosol with long-wavelength thermal radiation. It postulates that particulates in the lower atmosphere will always exert a warming influence at the earth's surface via an enhancement of the well-known "greenhouse effect." Neither one of these two mechanisms, however, has ever, to my knowledge, been demonstrated to have produced a real temperature trend on a localized scale that could definitely be linked to aerosol effects. Thus, in this report I attempt to fill that void by presenting evidence for a real aerosol-induced temperature trend at Phoenix, Arizona, that appears to be caused by the second of these two mechanisms, herein termed "thermal blanketing."

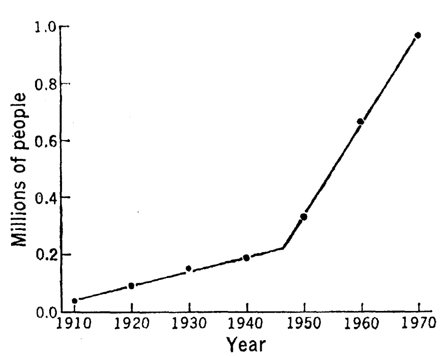

Fig. 1. Population of Maricopa County, Arizona, for the census record years 1910 to 1970.

Census figures for Maricopa County (composed preponderantly of the metropolitan Phoenix area) are plotted in Fig. 1. Two basically linear trends that meet at 1946 are indicated. Because of the sharp inflection point in population growth at 1946, that year was chosen as the pivotal point for the analysis of temperature trends.

Although several stations presently record temperature data in the Phoenix area, only two could be found that had continuous stationary-site records extending back as far before 1946 as between 1946 and the present. One of them, Litchfield Park, was located on the western edge of Phoenix and the other, the University of Arizona Experimental Farm, was located on the eastern edge.

The available records of both of these stations consisted of mean monthly values of maximum and minimum temperatures from 1918 to the