Correlation of X-Ray Radiation (2–12 Å) with Microwave Radiation (10.7 cm) from the Nonflaring Sun. Sister Jean Gibson, O. S. B., and James A. Van Allen, Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa.—Absolute values of the x-ray flux in the 2–12 Å range, $F(2–12 \text{ Å})$, from the whole disk of the nonflaring sun are reported for 734 days during the period 1 July 1966 to 25 December 1968. The data came from University of Iowa equipment on the Earth-orbiting satellite Explorer 33 and the moon-orbiting satellite Explorer 35. The flux, essentially constant during a day, varies by a factor as great as 6 over time periods of the order of one month. The upper and lower bounds during the above-mentioned period are 0.4 and 6.8 m erg (cm$^2$ sec)$^{-1}$, respectively, and the monthly minima increase gradually from 0.4 to 1.0 m erg (cm$^2$ sec)$^{-1}$. A correlation study of $F$ and the radio power density flux $P$ at 10.7 cm (Algonquin Radio Observatory) yields $F = 2.73 \exp(-385.2/P)$ with $F$ in m erg (cm$^2$ sec)$^{-1}$ and $P$ in $10^{-22}$ W m$^{-2}$ Hz$^{-1}$. A simple, moderately realistic physical model leads to a theoretical relationship of $F$ to $P$ of the same form. Inferring temperatures $T$ are in the range $2.3–6.8 \times 10^8$ K and emission measures $\int N_e^2 \, dV$ in the range $8–34 \times 10^{48}$ cm$^{-3}$.

Nonaxisymmetric Instabilities in Magneto-hydrostatic Stars from Magnetic Buoyancy. I. Plane-Parallel Model. Peter A. Gilman, Advanced Study Program, National Center for Atmospheric Research, Boulder, Colo.—We show that magnetic buoyancy gives rise to a normal instability in fluids in magneto-hydrostatic balance whose diffusivity of heat is large compared to viscosity and magnetic diffusivity, such as in stellar interiors. In this first paper we present a simple model in plane geometry: an unbounded compressible fluid, acted upon by external gravity, containing a straight horizontal magnetic field. We find that the instability occurs with any strength field that decreases with height. The unstable modes are narrow cross-section loops of magnetic field and matter whose finite wave number $k$ along the unperturbed field lies in the range $0 < k^2 < -(g/S)^2 \delta \ln B$, where $\delta \ln B$ is the unperturbed field, $g$ is gravity, and $S$ is the isothermal sound speed. Thus, in a spherical star with a toroidal field, this is a nonaxisymmetric instability (analysis for spherical geometry is presented in Paper II). If the fluid is rotating, only the component of rotation perpendicular to gravity has an influence. Shear flow parallel to $B$ has no effect.

A detailed analysis is made of the especially simple case for which Alfvén and sound speeds are independent of height, to elucidate the role of magnetic buoyancy. In this case, rotation is shown to be stabilizing. The instability simultaneously releases potential and magnetic energy through downward mass transport and upward magnetic field transport, respectively.

Nonaxisymmetric overstability is also possible in the system, but this is harder to realize. It is more important in the spherical problem.

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The Composition of Interstellar Grains. Daya P. Gilra, Space Astronomy Laboratory—Washburn Observatory, University of Wisconsin, Madison, Wisc.—It has been suggested, in particular by Gilman (1969, Astrophys. J. 155, L185), that meteoritic silicate, silicon carbide, and graphite particles will be formed in the atmospheres of cool stars and expelled into interstellar space. Silicate particles have reportedly been observed. The preliminary results of our computations show that a mixture of grains of these three substances can explain all the observed phenomena in which the interstellar grains are participating, viz. interstellar extinction, interstellar polarization, diffuse galactic light, and reflection nebulae.

The observed hump at $\lambda^{-1} \approx 4.6 \mu m^{-1}$ in the interstellar extinction curve is attributed to small-sized graphite particles; meteoritic silicate particles are the chief contributor to the rapidly rising extinction in the far ultraviolet; and SiC is the major contributor to the extinction in the visual and infrared wavelength regions. It is suggested that the observed weak maximum at $\lambda^{-1} \approx 1.9 \mu m^{-1}$ in the interstellar polarization curve and the observed “kink” at $\lambda^{-1} \approx 2.3 \mu m^{-1}$ in the interstellar extinction curve have the same origin: in this mixture of grains, the size distribution of the SiC particles is such that the maximum in its own extinction curve is at $\lambda^{-1} \approx 2.5 \mu m^{-1}$. Hexagonal SiC is a birefringent crystal and can be responsible for interstellar polarization. With the same size distribution parameters and relative abundances the observations of diffuse galactic light and O'Dell's observations of backscattering in some nebulae in the Pleiades cluster are also explained very nicely. The albedo and $\langle g \rangle$, the phase parameter, are approximately 0.8 and 0.25, respectively, at $\lambda^{-1} \approx 2.5 \mu m^{-1}$. Furthermore, it is also possible to explain the "anomalous" extinction and polarization curves for stars in the regions containing hot, young stars if the smaller-size particles are removed.

X-Ray Heating of Interstellar H I. Donald Goldsmith, Institute for Plasma Research, Stanford University, and Harm Habing, Univ. of California,