If γ^ν denotes the matrix operating on the first column ϕ of Φ and corresponds to the linear quaternion function associated with ∂_ν in (5), we can replace (5) by the equivalent equation

$$\gamma^\nu\partial_\nu\phi=\mu\phi^*.$$

As $\gamma^\nu\phi$ corresponds to $(\beta^\nu\Phi)^*$ in the 2×2 representation it follows from (1) that the matrices γ^ν satisfy Jehle's commutation relations

$$\gamma^{*\lambda}\gamma^\nu+\gamma^{*\nu}\gamma^\lambda=-2g^{\lambda\nu}.$$

Further, under a time reflection $x_0\rightarrow -x_0$ we have $\Phi\rightarrow\Phi f_1$, hence $\phi\rightarrow\gamma^2\phi$.

Kilmister's equation reads

$$(i\partial_0+f^n\partial_n)\Phi=\mu f^2\Phi^*,$$

where Φ again is a real quaternion in its 2×2 complex matrix form. By use of Eq. (4) we can write

$$(i\partial_0+f^n\partial_n)\Phi=\mu\Phi f^2. \tag{6}$$

Operating by $-f^2(\ \ )f^2$ on (6) then taking the complex conjugate of both sides, we also get

$$(-i\partial_0+f^n\partial_n)\Phi=\mu\Phi f^2.$$

Hence $\partial_0\Phi$ vanishes. The two columns of (6) equated separately give rise to a pair of equations of Jehle's type differing by the sign of their first terms only. Equation (6) is related to Watson's form of Dirac's equation which can be put in the form

$$(i\partial_0+f^n\partial_n)\Psi=\mu\Psi^*f^2$$

where a 4×4 real representation is used for each f^n. This corresponds to the following "realization" of the operators β by linear quaternion functions

$$\beta^0\Psi=i\Psi^*f^2,\quad \beta^n\Psi=-f^n\Psi^*f^2.$$

In this representation Ψ changes into Ψ^* under a time reflection. Hence the solutions left invariant under $x_0\rightarrow -x_0$ are given by Kilmister's Eq. (6).

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A Correlation between Ionospheric Phenomena and Surface Pressure*

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RECENTLY, we reported[1] the existence of tidal effects[2] on the ionospheric F layer. We are now able to show with some degree of reliability that the oscillations in the F layer are approximately in opposite phase to the oscillations of the air at the surface of the earth as measured by the variation in surface barometric pressure. The inverse correlation is evident in the mean curves of Fig. 1.

This is not the first time that an ionospheric characteristic has been correlated with the variations of the surface pressure.[3] However, the correlations observed in the past were usually for day to day or hour to hour variations and were seldom verified by investigators in other localities. We believe that attempts at verification were unsuccessful because the real correlation existing is one between the tidal movements at the two levels of the atmosphere. Such a relation between hourly or daily values would often be masked by large local changes due to disturbances other than tidal forces. Thus, if mean values are taken over an interval sufficient to eliminate random daily variations, tidal movements are evident in the mean curves, and the correlation existing between the curves is actually a comparison of the phases of the tidal movements at the two levels. We should expect a relation between the tidal movements at the various levels of the atmosphere to exist since all the tidal movements associated with the earth's atmosphere are attributed directly or indirectly to the tide raising forces of the sun and moon.

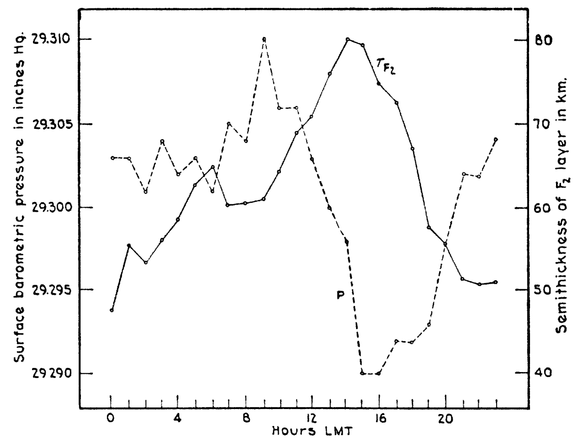

FIG. 1. Mean curves of semithickness τF_2 of the F_2 layer (College) and of surface pressure P (Fairbanks) for October, 1948 through March, 1949.

At College a mean over an interval of 6 months must be used, according to Bartels'[4] reliability test, to obtain fairly persistent pressure solar diurnal and semidiurnal waves. The same interval is sufficient for similar persistent waves in the oscillations of the semithickness of the F layer.

For further comparison of the tides at the two levels of the atmosphere, the mean variations were submitted to harmonic analyses. The harmonic components of the oscillations relative to solar time are presented in Table I.

TABLE I. Harmonic components of atmospheric oscillations.

	Diurnal component	Semidiurnal component
Surface pressure (amplitude in inches mercury)	$0.0041\sin(t+14°)$	$0.0036\sin(2t+124°)$
F layer semithickness (amplitude in kilometers)	$11.5\sin(t+256°)$	$5.6\sin(2t+323°)$

We feel that the inverse correlation demonstrated is reliable. The probabilities that the 24 and 12 hour waves in the F layer are due to chance are approximately 10^{-2} and 10^{-1}, respectively, while the probabilities for the corresponding pressure waves are 0.3 and 10^{-2}.

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Coercive Force *vs.* Temperature in an Alloy with Zero Crystalline Magnetic Anisotropy

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KITTEL,[1] Néel,[2] and Stoner and Wohlfarth[3] have shown that one expects high coercive forces in very fine powders of ferromagnetic materials. This is because each particle acts as a single domain, and work must be done against the total magnetic anisotropy when the magnetization of a particle is reversed, since the dipole moment of the whole particle must be reversed as a unit. The total magnetic anisotropy in general is the sum of contribu-