case of Sc spirals, their nuclei are too small for investigation by the same means, and it is possible to give results only for their main bodies, which rotate in periods ranging from 17 million years to more than 250 million years. Only in the case of M31, M33, and the Galaxy are there any rotation data for the outermost parts, whose periods range from 60 to 220 million years.

*Lick Observatory,
Mt. Hamilton, Calif.*

Menzel, Donald H. Theory of the ionosphere.

Some years ago Chapmann developed a theory of ionospheric-layer formation, on the hypothesis of an isothermal atmosphere. I have extended his theory to take account of a uniform temperature gradient in the layer. The critical frequency of a radio wave, which in turn measures the electron density follows the law

$$f = C (\cos Z)^p,$$

where C is a complicated factor related to various atomic and atmospheric parameters as well as to the intensity of solar ionizing radiation. Z is the zenith angle of the sun. The value of the exponent p is $\frac{1}{4}$ for an isothermal atmosphere, less than $\frac{1}{4}$ for an atmosphere whose temperature increases upwards and greater than $\frac{1}{4}$ for one whose temperature decreases upwards.

Application of the theory to observations indicates increasing temperature for the E layer and a decreasing one for the F2. Fitting the standard temperature curve at the lower ionospheric levels, Mr. John Wolbach and I have found that a maximum occurs between the two levels, where the temperature may reach 500°K.

An extended theory, taking account of possibilities of electron attachment and formation of negative ions, according to suggestions of Massey and Bates, does not fit the observational data. However, there are still quantitative difficulties with the more elementary theory.

*Harvard College Observatory,
Cambridge, Mass.*

Migeotte, Marcel V. New identifications in the infra-red solar spectrum.

Portions of the infra-red solar spectrum have been mapped, within the last six months, by using a new prism-grating spectrograph constructed by Dr. R. Noble, under the direction of Prof. H. H. Nielsen.

The spectral regions from 2.8μ to 5.1μ and

from 7μ to 11.7μ were recorded, under high resolving power, by using gratings having respectively 7200 and 3600 lines per inch.

These new observations have led to the discovery, in January 1948, of methane in the earth's atmosphere. The identification was determined by the appearance of the $3.4\mu^1$ band of CH_4 in the solar spectrum. Later on, the $7.7\mu^2$ band of CH_4 was also found in the solar spectrum.

In a paper published in May 1948, R. McMath, O. Mohler, and L. Goldberg³ have reported additional evidence of atmospheric methane.

The new solar spectrograms also disclosed the bands of N_2O at 3.9μ , 4.5μ , and 8.6μ . The atmospheric N_2O was first proposed by A. Adel⁴ in 1939 to explain a band appearing at 7.6μ in the prismatic solar spectrum. In 1941, the same author⁵ also claimed to have identified the fine structure of the 7.6μ band of N_2O in the solar spectrum. However, in 1943, Sutherland and Calendar⁶ pointed out that the evidence of N_2O , while very strong, was not entirely conclusive. Our observations prove without doubt the existence of the atmospheric N_2O .

Besides lines of CH_4 and N_2O , many other new lines have also been observed. Identifications are underway.

Because of the presence of methane in the earth's atmosphere, ammonia might also be expected, since the molecules CH_4 and NH_3 are found existing simultaneously in other planets.

One of the most intense bands of ammonia is situated in the 10.5μ region. The fine structures of the Q branches have been observed recently by R. Chapman, in this laboratory, by using the same spectrograph that was available for the solar work. A comparison has been made between the new laboratory data, the new solar spectrograms, and those obtained by A. Adel⁷ in Flagstaff, Arizona, in 1940. From this comparison, it may be concluded that there was no evidence of ammonia in the portion of the earth's atmosphere under investigation.

The work described in this paper was carried out, in part, under Contract W33-038-ac-14485 between the Air Materiel Command Wright-Patterson Air Force Base and the Ohio State University Research Foundation.

1. *Phys. Rev.* **73**, 519, 1948; *Ap. J.* **107**, 400, 1948.
2. *Phys. Rev.* **74**, 112, 1948.
3. *Phys. Rev.* **73**, 1204, 1948.
4. *Ap. J.* **90**, 627, 1939.
5. *Ap. J.* **93**, 509, 1941.
6. *Reports on Progress in Physics*, **9**, 18, 1943.
7. *Ap. J.* **94**, 451, 1941.

*Institut d'Astrophysique de Cointe,
University of Liege, Belgium,
temporarily at Ohio State University,
Columbus, Ohio.*

Nassau, J. J., and G. B. van Albada. A study of M-type stars in Cygnus.

This investigation is a continuation of our work in the infra-red spectra and magnitudes for M giants in the clear region of Cygnus. The primary additions to the observational data were derived by securing 2° objective prism spectral plates for our survey. The limiting magnitudes for which we believe our data to be complete is 13.5 infra-red, although a number of stars were classified down to 14.5.

The classification of the M stars was based solely on the *TiO* bands, while the carbon stars were identified from the bands of *CN*. A new band near λ 7950 has been utilized in the identification of S stars. A band in the same spectral region has been observed in several late M's, notably variables.

The search for M stars has been carried out in a relatively clear region in Cygnus at galactic longitude 43° and latitude $4^\circ 0'$. The area which is in the form of a rectangle, perpendicular to the celestial equator covers 2.28 square degrees. In this area 709 M stars were identified, four carbon stars and two S stars, among them several new variables. The number of M stars per square degree is 311, while at the galactic latitude of $9^\circ 2'$ and approximately the same longitude the corresponding number was 31. Even within the field itself a concentration toward the galactic plane is apparent.

The median apparent infra-red magnitude of the M0 stars at galactic latitude 4° is 13.1 which value decreases with advancing spectral type to 11.3 at M4. This is in agreement with the absolute infra-red magnitudes, derived from the Mt. Wilson spectroscopic absolute magnitudes, which give -1.1 for M0 and -2.9 for M4. For the later M types this relation does not seem to exist since the observed median magnitudes remain stationary after M4.

From our material it was possible to obtain the spectrum intrinsic color relation for all the M's, as follows: at M0 I.I. (photographic minus infra-red magnitude) equal to 2.8, at M5 I.I. equal to 4.3. The amount of interstellar absorption of the region was found to be equal to 0.10 mag./kpc infra-red, corresponding to about 0.22 mag./kpc in the photographic region. The unevenness in the surface distribution of M stars

indicates local regions of much heavier obscuration.

A density analysis has been made of 627 stars from M0 to M4. At a distance of 2 kpc from the sun the number of stars is 20×10^{-6} stars per cubic parsec. At 6 kpc a value of 8×10^{-6} is reached. These numbers vary slightly with different assumptions in absorption and absolute magnitude spread.

*Warner and Swasey Observatory,
Case Institute of Technology,
Cleveland, Ohio.*

Nininger, H. H. Research program of the American Meteoric Museum.

In addition to dispensing information on various phases of meteoritics through exhibits and lectures for visitors to this unique institution, the staff carries on a considerable program of research. This paper indicates the nature and scope of these investigations and summarizes in a progress report the results of two years of field explorations in the vicinity of the Barringer meteorite crater.

*American Meteoric Museum,
Winslow, Ariz.*

Omer, Guy C., Jr. A non-homogeneous cosmological model.

Non-static, non-homogeneous, relativistic cosmological models having spherical symmetry, zero-pressure, and co-moving coordinates have been investigated. If, as a first approximation, we assume that the observer is located near the center of the coordinate system, the following three relations can be obtained: the red-shift as a function of the radial coordinate; the total number of nebulae which are contained within a sphere as a function of the coordinate radius; and the apparent magnitude for a source of known luminosity as a function of its radial coordinate position. From these relations we can calculate the predicted nebular counts as a function of apparent limiting magnitude and the predicted red-shifts as a function of apparent magnitude. These are the observationally determined functional relationships.

We assume the average density in the neighborhood of the observer at the present time to be 10^{-29} gm./c.c. We take the cosmological constant to be 8.78×10^{-19} (lt. yrs.) $^{-2}$. We assign to the radius of curvature in the neighborhood of the observer, $1/R_0^2 = -10^{-20}$ (lt. yrs.) $^{-2}$. Then we find that the total time elapsed in the neighborhood of the observer since the beginning of