A LARGE new exhibition hall, devoted to comprehensive archeological and ethnological collections from the lands of Budda and other Oriental countries, has been opened at the Field Museum of Natural History. The museum already had important collections of Chinese and Tibetan material. The opening of the new hall, which is devoted to Korea, Siam, Siberia, India, Burma, Ceylon, the Ainu of Yezo, and the Andaman and Nicobar groups of islands in the Pacific, rounds out the representation of life in the Far East. The hall contains hundreds of objects, large and small, varied in character, including pieces remarkable for their beauty, for their ingenuity and for their extreme oddity. They have been gathered over a period of many years and come from various sources. One of the most striking features in the hall represents the ancient Siamese ancestors of the modern motion pictures—that is, the figures used in shadow plays. Mounted on glass and illuminated from behind, these are displayed much as they would appear in performances given in their place of origin.

ACCORDING to the Paris correspondent of the *Journal* of the American Medical Association, the drop in the birth rate in France as compared with the increase in the number of deaths is causing much anxiety. A committee was appointed several months ago by the Académie de médecine of Paris to study methods of checking the drop in birth rate. At the April 26, 1938, meeting Professor Lereboullet submitted the report of the committee. The chief causes of the decline in the birth rate were found to be contraceptive methods and the wide-spread use of abortifacients or induced abortion. There were only 630,000 births in 1937 as compared to a little over a million in 1876. From 1935 to 1937, inclusive, there were 57,117 more deaths than births in France, as compared to an excess of 950,000 births over deaths in Germany and of 775,000 in Italy during 1936 and 1937. The committee believed that the causes of the denatality in France were chiefly moral and economic. It made the following recommendations: (1) That the gravity of the denatality question be made known to the public by every possible method. (2) That an appeal be made to the moral and spiritual forces of the country to encourage the raising of large families by granting large subsidies which increase proportionately to the number of children. (3) That the danger of induced abortions be impressed on the women of the country and that the laws already in existence which entail imprisonment and heavy fines for abortionists be rigorously applied.

DISCUSSION

THE CORRELATION BETWEEN IONIZATION IN THE IONOSPHERE AND SUN-SPOT NUMBERS

STUDIES of the ionosphere over a period of years have indicated a close correlation between the ionization in the ionosphere and the Wolf sun-spot numbers. A detailed analysis of the National Bureau of Standards data by Smith, Gilliland and Kirby[1] shows that the relation is particularly striking when 12-month running averages of critical frequencies and sun-spot numbers are compared. In the period of 1934 to 1937, the average sun-spot number increased from 5 to 110, while the average f°_{F2} critical frequency at noon increased from 6.3 Mc/sec to 11.5 Mc/sec, corresponding to a range of electron concentrations from $0.38 \times 10^6/cm^3$ to $1.42 \times 10^6/cm^3$. Since noon values of electron concentration are nearly equilibrium values, the intensity of the ionizing radiation is proportional to the square of the electron concentration. Hence the intensity has increased about 14-fold, with an increase of 22-fold in the sun-spot number. In the same period the radiation producing ionization in the E layer and F_1 layer has increased by factors of 2.4 and 3, respectively. The correlation between sun-spot numbers and monthly averages of F_2 values is not so close, and Goodall[2] has shown that the solar characteristic giving the best correlation is the character figure for central zone calcium flocculi given in bulletins of the International Astronomical Union.

It is the purpose of this note to point out a possible reason for this correlation in the case of F_2 ionization. This ionization is variously ascribed to atomic oxygen, atomic nitrogen and molecular nitrogen,[3] but in all these cases the threshold wave-length for ionization is equal to or less than 910A. This is the Lyman series limit of hydrogen, and because the solar atmosphere is largely hydrogen in the normal state, its atmosphere will be extremely opaque for wave-lengths less than 910A. The light of a given wave-length comes from a depth in the solar atmosphere which varies inversely as the opacity at that wave-length, the average depth being such that the radiation is reduced to 1/e. Taking the atomic absorption coefficient as 0.6×10^{-17} it follows that the radiation occurs at a level where the hydrogen pressure is 3×10^{-3} dynes. The pressure at the photosphere[4] for visible radiation is roughly 300 dynes/cm² so the ionizing radiation comes from a level of the chromosphere several thousand kilometers above the photosphere.

[1] *Jour. Research*, NBS 21: 835, RP-1159, 1938.

[2] "The Solar Cycle and the F_2 Region of the Ionosphere." In press.

[3] Hulburt, *Phys. Rev.*, 53: 344, 1938; Wulf and Deming, *Terr. Mag. and Atmos. Elec.*, 43: 283, 1938.

[4] Unsöld, "Physik der Sternatumosphären," Julius Springer, 1938.

The opacity at 910A is comparable with the opacity in the strongest solar absorption lines. The atomic absorption coefficient of Hα is roughly 10^4 times that at the Lyman limit, but since less than 10^{-8} atoms per cm^3 are in a state to absorb Hα the opacity at Hα is much less than at 910A. The opacity in the K line of Ca^+ is estimated[4] to be roughly 4,000 times the opacity near the center of Hα and is comparable in order of magnitude with the opacity at the Lyman limit.

A spectroheliogram made with the K line of Ca^+ gives a photograph of the solar atmosphere near the pressure level for emission of radiation beyond the Lyman limit. The picture is complicated by Doppler effect and by variations in chemical composition of the atmosphere, but primarily it gives a picture of the temperature distribution over the sun at the given pressure level. The spectroheliogram is characterized by bright flocculi in the region of sun-spots, while most of the disk is relatively dark. This contrast would be enormously enhanced in the far ultra-violet for a spot 4 times as bright as the solar disk at 3,900A would be 400 times as bright at 910A.

Roughly quantitative considerations show that nearly all the ionizing radiation must come from bright spots rather than the disk as a whole. It has been shown[5] that if the disk radiated as a black body at 6,000°, the quanta of wave-length less than 910A could account for the F_2 ionization, but there is no reason to assume that the solar atmosphere at these low pressures is at 6,000°. The temperature as measured by the brightness at the center of a strong absorption line is less than 5,000° and the radiation at 5,000° can not account for 1 per cent. of the observed effect. However, if less than 1 per cent. of the solar disk is at a temperature of 7,500° or more, these bright spots could account for the observed ionization. The hypothesis that nearly all the ionizing radiation comes from the flocculi normally associated with sun-spots can well account for the type of correlation found between F_2 ionization and sun-spot numbers. The average intensity over long periods of time will be nearly proportional to the number of spots, simply because flocculi are associated with spots; but because of variation in brightness of flocculi, the day-to-day values will vary in a random way. A similar correlation is found between the "character figures" giving the number and brightness of K flocculi and the sun-spot numbers.

Ionization of the E layer probably comes from molecular oxygen[6] with a threshold near 1,000A, and bright line emission of Lyman lines in the flocculi may be an effective source of ionization. There is no basis for predicting the relative effectiveness of the radiation of the solar disk and the flocculi in this spectrum range, but the variation of E-layer ionization with sun-spot number indicates that at sun-spot maximum more than half the effect comes from flocculi, while at minimum most of the effect comes from the disk as a whole. The origin of F_1 ionization is quite uncertain, but the rate of variation with sun-spot number suggests that the threshold is at a wave-length greater than 910A.

It is well recognized that bright chromospheric eruptions produce radio fade-out,[7] but the disturbance seems to come from ionization below the E layer with little or no change in the F layer.[8] The radiation from normal flocculi rather than from these transient eruptions must be invoked to explain F_2 ionization.

The above considerations indicate that F_2 ionization can not be maintained by the temperature radiation from the solar disk as a whole. The hypothesis that the ionizing radiation comes from bright flocculi accounts for the observed correlation between ionization and sun-spot numbers, but it will be a difficult problem to show whether or not the continuous radiation from these bright spots can quantitatively account for the ionization.

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[5] Hulburt, *Phys. Rev.*, 53: 344, 1938.
[6] Wulf and Deming, *loc. cit.*

[7] Dellinger, *Jour. Research* NBS, 19: 111, 1937.
[8] Dellinger, *Phys. Rev.*, 50: 189, 1936.

A WHALE SHARK IN THE HAWAIIAN ISLANDS

IT is interesting to note that the whale shark, *Rhineodon typus,* can be said almost to abound in both the western and the eastern waters of the Pacific Ocean. But it has been so sparingly reported from the Central Pacific, that it might be thought almost absent from those vast reaches. Hence definite information of its occurrence in the Hawaiian Islands seems worthy of record.

Of its relative abundance in the western Pacific from the eastern coast of Japan to that of New South Wales in Australia, I have brought together all the evidence as of December 31, 1934, in an article on the geographical distribution of this greatest of the sharks.[1] As of that date 26 specimens were listed from the Western Pacific, and 15 of these were from Philippine waters. This abundance and the fact that it had been known (but not described) in these waters since 1800 (first record, 1816) lead me to believe that *Rhineodon* originated in the Philippine-Sulu Sea region and was distributed thence by ocean currents to all parts of the three great central oceans. This article was illustrated with maps showing all recorded occurrences.

Interestingly enough, *Rhineodon* seems almost as abundant in eastern Pacific waters—along the shores of the Americas from Lower California to Callao in Peru. I produced records for 23 specimens, of which 14 are listed from the lower part of the Gulf of California—

[1] E. W. Gudger, *Proc. Zool. Soc., London,* pt. 2, 863–893, pl. and 2 charts, 1934.