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.

mainly around Cape San Lucas. Since that date, Dr. William Beebe has found them almost abundant and almost tame in those same waters. And more recently (1938), I have recorded that whale sharks are so abundant on the outer coast of Lower California from Hippolito Point to Cape San Lucas and so entirely unafraid as to be almost a nuisance to the tuna fishermen.[2]

From the Central Pacific but two whale sharks have ever been reported so far as I know—and these interestingly enough from the same group of islands. In 1929, Rougier[3] described a *Rhineodon* skin in the little museum in Papeete, Tahiti. This had come from a 17.3-foot specimen taken at Takaroa, Tuamotu Archipelago, in 1928. The second record is one I made in 1937 of a whale shark about 40 feet long impaled on the bow of a steamer near Tikehau Atoll in the Tuamotus.[4]

To these two records, I am now fortunate in being able to add a specimen of the whale shark, found in Hawaiian waters. These data came to me through the courtesy of Captain G. S. Bryan, hydrographer, U. S. Navy Department. This is but the last of many accounts of the wide-spread occurrence of this great fish communicated by the Hydrographic Office—to which my debt is heavy. This excellent account, sent in by Second Officer R. C. Willson, of the S. S. *Mapele* of the Matson Navigation Company, San Francisco, has been forwarded to me, and from it the following data on coloration and behavior are put on record.

On September 4, 1938, the *Mapele* was moored off Kukuihaele Landing on the north coast of Hawaii in Lat. 20° 08′ N. and Long. 155° 33.5 E. At 2:30 P.M. local time, a whale shark was seen slowly and fearlessly swimming around the ship among the sweepings and larger debris thrown overboard. The shark, seen by all hands, was about 25 feet long and about 4 feet wide across the broad blunt head. The description of the markings indubitably identify this fish as a whale shark. The head was covered with many white spots varying from one to two inches in diameter. These were scattered in random fashion over head and neck region. On the other hand, the body was covered with white spots in vertical rows separated by vertical white stripes. These extended from the back down the sides as far as the curve of the belly permitted sight. The rows of spots were about 6 inches apart, and the white stripes were about 2 inches wide. Spots and stripes both decreased in size from above downward and from the neck region toward the tail. The dorsal fin was about 18 inches high and had on it 7 distinct spots.

At about 3:30 the shark disappeared, but at 6:00 P.M. it was again seen swimming about under the stern amid slops and scraps thrown overboard from the ship's galley. "It swam leisurely around for about 20 minutes, bumping into the mooring lines a number of times. Once as it was swimming over one of the lines to a buoy the ship lifted, throwing the shark partly out of the water. Then it swam slowly off toward the west and was seen no more."

This behavior tallies almost exactly with the actions of another whale shark in swimming around a steamer in the harbor of St. Marc, Haiti, in 1937.[5] It is also very like that described of various specimens off the outer coast of Lower California. This great fish has no enemies and seems entirely unafraid of vessels and of men.

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[2] E. W. Gudger, *Calif. Fish and Game*, 24: 420–421, 1938.

[3] Emm. Rougier, *Bull. Soc. Etudes Oceanogr.*, Papeete, 3: 318–319.

[4] E. W. Gudger, SCIENCE, 85: 2204, 314, 1937.

[5] E. W. Gudger, *Copeia*, 1: 60, 1937.

TOXICITY OF THE SODIUM SALT OF DINITRO-o-CRESOL TO VENTURIA INAEQUALIS

POSSIBILITIES of direct chemical attack on fungi that cause certain types of plant disease now combated chiefly by repeated applications of protectant fungicides have been studied by the writer and associates.[1] It is sought by an eradicant fungicidal treatment at a vulnerable stage in the life-history of the pathogen to reduce the primary inoculum to a level at which the disease may be more surely and economically controlled. A preliminary report on further experiments with the apple scab pathogen, *Venturia inaequalis* (Cke.) Wint., follows.

In small-scale experiments in the spring of 1938, overwintered apple leaves bearing abundant mature ascocarps of *V. inaequalis* were sprayed with Elgetol, a proprietary preparation containing 12 per cent. by weight of the sodium salt of dinitro-o-cresol with a supplement to aid its penetration. Similar leaves sprayed with water served as controls. Studies of treated and untreated leaves indicated that Elgetol in water at 1 per cent. by volume reduced ascospore discharge by 99.7 per cent. (average of 3 trials).

Toximetric studies with agar plate cultures by a method reported by Palmiter and Keitt[2] indicate that the lethal concentration of Elgetol to the 2 isolates of *V. inaequalis* tested was near .05 per cent. by volume.

These small-scale experiments show that Elgetol has a high degree of eradicant effectiveness against *V. inaequalis*. Conclusions regarding its practical adap-

[1] G. W. Keitt and D. H. Palmiter, *Jour. Agr. Res.*, 55: 397–438, 1937.

[2] D. H. Palmiter and G. W. Keitt, *Jour. Agr. Res.*, 55: 439–452, 1937.