1920 in honor of his friend, the present Hope professor, with the purpose of promoting the study of evolution.

THE League of Nations has accepted the proposal of the Brazilian Government to erect, at Rio de Janeiro, an international institution for the investigation of leprosy.

THE buildings of the Medical Faculty at Seville have been almost entirely destroyed by fire entailing a loss of about two million pesetas.

DISCUSSION

GARDINER ON CORAL REEFS

AFTER "thirty-five years of interest in the problems of coral reef formation," including "five years' work on the actual reefs," the author of the great monograph on the Maldive and Laccadive archipelagoes has at last given the hoped-for summary of his views concerning reefs, structures which are important not only in themselves but even more for their relation to the physical properties and history of the earth as a whole.[1] While making the essentials of the subject clear to any educated reader, this admirable volume is full of meat for professional biologists and geologists. Most of its pages are devoted to giving a remarkably complete picture of the marine and dry-land biology. The present note does not attempt an abstract of the wealth of observations made by the distinguished professor at Cambridge on reef organisms, but is limited to an outline of his conclusions specially significant to geologists.

(1) While Professor Gardiner agrees that nullipores are essential to reef-strength, he points out that the dominant builders below the depth of four to six fathoms are corals, and therefore considers the old name, coral reef, quite justified, especially for the Indo-Pacific region.

(2) The islets of atoll and barrier reefs are chiefly composed of organic material deposited below sea-level and became dry land through a relatively recent, general, negative shift of sea-level. This was not greater than about 20 feet, but probably varied somewhat from region to region in the tropical belt.

(3) True reefs are geologically young. "There is no proof of any atoll or barrier reef having originated previous to the Pleistocene" (p. 151) or "late tertiary" (p. 115). The indigenous fauna and flora of atoll islets "give no support to the idea that they were ever increased from those of larger lands, which have disappeared. . . . Indeed, there is not a single constituent of the fauna and flora of atoll islets that gives evidence for their existence for more than a few hundred years" (p. 44). Like Mayor, Professor Gardiner is convinced that reefs grow rapidly enough to permit belief in the late-Glacial or post-Glacial origin of those now visible (p. 66).

(4) Atoll reefs rest on plateaus that had been prepared at depths of fifty fathoms, or somewhat less, below sea-level (pp. 143–144). They "form over 90 per cent. of coral structures in island groups of the Indo-Pacific" (p. 16).[2]

(5) Some lagoons show moderate enlargement by solution of their calcareous walls.

(6) Those basins are not being filled at an important rate by detritus washed over the encircling reefs. "There is no such general filling in of lagoons by coral growth and by sediment as suggested" by the Darwin-Dana theory of subsidence—a fact that "kills" the theory (p. 146). Nor, in the reviewer's opinion, does it favor Molengraaff's explanation of atolls by the independent, isostatic sinking of volcanic cones.

(7) The fronds of the shallow-water *Halimeda*, dredged from depths of hundreds of fathoms, had been dragged thither by wave, current and gravity, and do not indicate subsidence of adjacent reef structures. This statement should give pause to those who believe that the discovery of shallow-water foraminifera in the deeper part of the bore-hole inside the Great Barrier Reef of Australia proves subsidence for the Australian shelf.

(8) After much study of the core of the famous Funafuti boring, Professor Gardiner concludes that it penetrated talus, not a sunken reef of corals in place, and hence does not prove subsidence.

(9) Though the origin "of the isolated mountains and of the mountain ranges of the Indo-Pacific is still left beyond the limits of our knowledge" (p. 159), he adopts the prevailing theory that the "atoll-crowned mountains of the Pacific" are volcanoes (p. 162).

(10) The Glacial-control theory "accounts for the underlying Indo-Pacific reef-platforms even to details."

(11) But, he adds, "If we regard the question of

[1] "Coral Reefs and Atolls," being a course of lectures delivered at the Lowell Institute at Boston, February, 1930, by J. Stanley Gardiner (*xiii* + 157 pages of text, 15 plates, 33 text figures). Price in the United States (The Macmillan Company), $4.25, too high for ready sale!

[2] Professor Gardiner does not mention the relatively recent evolution of the reef-building species of corals. Before this late epoch in earth-history, perhaps as far back as Archean time, volcanic cones and other lands, emerged, one after another, in the tropical belt of the ocean and suffered wave-planation during many millions of years. The reviewer knows of no fact that forbids one to assume such pre-Cretaceous abrasion as important in the formation of many atoll-bearing, submarine plateaus, especially those of the Pacific region.

the formation of the foundations of coral reefs honestly, we are forced to admit that all our theories and considerations are mere camouflage for our lack of knowledge" (p. 160).

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TREE TWIST

ON reading the query on tree twist in SCIENCE, the idea struck me that I was particularly well situated to observe this phenomenon. This is due to the fact that in north China (1) burial grounds are planted with trees symmetrically arranged, resembling an orchard, (2) these burial grounds stand out in the plain as islands at sea with no shelter for rods to miles about them (3) that most of them are planted with one species of tree: the oriental white cedar or Arbor Vitae (*Thuya orientalis*). The advantages thus secured are that of isolation, so that only meteorological and edaphic forces would affect the trees. There is no slope, the substratum being an alkaline plain. The trees are equally spaced so that if the wind is a factor in causing twist, the corner trees should be most twisted and the central ones least, while the others would be progressively less twisted. The soil in these small plots (the largest observed was about 20 by 37 yards) would be the same, being loess with a depth of ten to twenty or more feet. In places this loess is interrupted by beds of conglomerate which would then affect the entire ground as a unit. The species of tree is so "thin skinned" and the bark so striped as to make twist in the wood, and in the "insertion" of the branches, easily observable. The climate is semiarid with heavy summer rainfall and very little rain the rest of the year. Throughout the spring there are high winds blowing from the south and southwest for one to three days' duration. These winds are so strong and dry and hot as to cause all trees of the region to develop to the northward. The Arbor Vitaes thus have the boles bent often very strongly to the north. This bending is most accentuated in the taller trees and at their tops.

Unfortunately such a plantation does not usually develop uniformly. The trees which die out are later replaced. Moreover at times of financial stress, a tree here and there will be taken down and some time after replaced by young trees. However, these factors can be taken into consideration and due allowance made, or observations in such groves can be checked by observations in groves that have had no such interference.

The present notes are based on charts plotted for four such burial grounds lying three quarters of a mile south of the Shantung Christian University campus (Tsinan, Sung.) near the village of Djang Djia, as well as on several isolated trees and a double row of fourteen trees.

The twist in *Thuya orientalis* of this region is to the left. In *T. occidentalis* reported in SCIENCE for May 22 it is to the right. Of 438 trees observed: 272 had the boles twisted to the left, 157 were not twisted, six had only the lowest two feet twisted, one was twisted in different directions every three or four feet and two were twisted to the right. There was no correlation whatever with exposure. Similarly there was no correlation with the lean or inclination of the tree. Some had a slight twist at the lowest two feet but were straight the rest of the way. Large old trees were usually free from twist! Is twist then a hang-over of seedling development, which carries over more strongly in some individuals than in others? Certainly it is not related to wind or other obvious environmental factors.

In one of the groves the two south rows and two north rows consisted of *Juniperus chinensis*. Of the 38 trees standing, 20 had the boles twisted to the left, 16 were straight and two were twisted to the right. There was correlation with neither exposure nor sex.

The charts of these groves are to be deposited with Professor Nichols at the Osborn Botanical Laboratories of Yale University.

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MARINE TERTIARY IN ARIZONA[1]

IN April, 1931, while studying the geology and mineral deposits of southern Yuma County, Arizona, the writer found a fossiliferous Tertiary formation that hitherto had not been recognized. This formation outcrops from beneath later silts, sands and gravels, as several areas in the broad, terraced, dissected plains that border the Colorado River north of latitude 33° 10′. It consists of well-stratified, weakly consolidated conglomerates, sandstones and marls, alternating with chalky and dense limestones to make up a total maximum apparent thickness of approximately 1,000 feet. Fossils from its calcareous members were submitted, through Dr. John C. Merriam, of the Carnegie Institution of Washington, to Dr. W. P. Woodring, of the U. S. Geological Survey. Dr. Woodring[2] identified the following forms: Cerithid, *Pisidium* (?), *Corbicula* (?), barnacle, ostracode, calcareous algae, and *Chara* (?) encrusted with algae (?). These forms, he states,[2] show that brackish waters once reached the region, but do not determine the age. He further states:[2] "Perhaps this marine invasion is the same as the one recorded in the southwestern part of the Colorado Desert, (California) which I regard as Miocene, but which most

[1] Published with permission of the director of the Arizona Bureau of Mines, University of Arizona.
[2] Written communication.