Beagle" Galapagos has been a name with which to conjure up vistas of weird reptilian life, giant tortoises, strange marine lizards, of finches and hawks unaffrightened by man and of a marine life brilliant and varied such as only the tropics can produce. Expeditions have come and gone from these volcanic wastes and have reported their biological finds with elaborate technical detail and an ever-increasing confusion of interpretations as to the species limits and relationships of the isolated faunas of the various islands of the archipelago. Save for the herpetologist, ornithologist, coleopterologist or other specialist or for the student of the many problems of evolution, geographical distribution, isolation and animal behavior, these analytical reports make dry reading, not so Mr. Beebe's "World's End."

This entertaining work is the outcome of an expedition on the private yacht "Noma" to several islands only of this large archipelago in 1923. In all less than one hundred hours were spent in exploration, mostly on five of the smaller islands of the group, Eden, Guy Fawkes, Daphne, Seymour and Tower. Excellent use was made of the time, however, and the story of adventure amidst the turbulent breakers, lava cliffs and slopes, cactus and thorn and shelly beaches loses nothing of interest at the hands of this facile, brilliant and sympathetic interpreter of nature and life.

The author is keenly alert to the biological problems involved in the adaptations exhibited by the species of animals inhabiting these waste and desolate desert islets and islands. The margin of existence is narrow, and liable to temporary and local interruptions by slight disturbances in the balance of nature. Man and the animals introduced by him have been the great disturbers. The giant tortoises are even now partially exterminated and will not long survive unless protected. On the other hand, the absence of marauding mammals in the native fauna has exempted the birds from the selective action of this factor operative on their mainland relatives.

The reviewer well remembers his impressions of the finches on Chatham Island in 1905 when the U. S. S. *Albatross,* then en route on the Agassiz Expedition to the Eastern Tropical Pacific, lay at anchor at Wreck Bay. In the thorny scrub which covers the lower slopes of that blackened, lava-strewn island the most conspicuous objects are the numerous black finches, recalling in color though not in size our own crows and blackbirds. Every vestige of protective coloration in their plumage is eliminated. Add to this the astounding lack of fear which they exhibit and the impression is overwhelming that the presence of mammals in the animal associations of any region is a potent factor in both the structure and behavior of the birds. Wild dogs ranged in the Chatham Island scrub, but they are so recent as apparently to have wrought no changes even in the behavior of the finches. One could call them up in great numbers. They would perch close at hand, even on his hat and shoulders, with freedom and seeming curiosity but without fear. Dr. Beebe notes the results of this cessation of selection in the abundance of other erratic features, such as the frequent irruptions of partial albinism and unusual behavior in breeding. Structurally one finds an orthogenetic development of bill in these finches of the Galapagos. The bill is already abnormally large in finches generally, but it is excessively large in certain species and is progressively developed among those of the Galapagos to extremes which far exceed the bounds of necessity and apparently of utility.

The book is rather sparingly illustrated but with fine taste and skill. The text likewise has esthetic qualities of rare value. The reader shares the zest of exploration, is spellbound by the tragedies of the tropic seas, with their teeming fish and bird life, and of the castaways of long ago from distant shores stranded on these desert islands.

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SPECIAL ARTICLES

THE INDUCTION OF GROWTH PROMOTING AND CALCIFYING PROPERTIES IN A RATION BY EXPOSURE TO LIGHT

In verifying the work of Goldblatt and Soames who observed that livers taken from rats irradiated with light possessed growth promoting properties—which were not possessed by livers taken from non-irradiated rats—it was found that a growth promoting property could be conferred upon muscle tissue by illuminating it after its removal from the body. It was also found in another series of experiments that irradiated rats put in the same cage with non-irradiated rats were able to induce growth in the latter.

Proceeding on the assumption that failure of growth on our basal synthetic rations without the effect of illumination was due to a condition fundamentally the same as rickets, experiments were initiated in which our basal synthetic ration of purified food materials was illuminated and then fed to rats. Here also illumination of the ration caused it to become growth promoting and, in addition, it was found that the ash content of the bones of rats receiving such a ration was increased percentagely over that of rats receiving the non-radiated ration. Later it was also found that irradiation of fats, otherwise inactive in preventing rickets, caused them to become active and that rations which ordinarily produced wide rachitic metaphysis in the shaft bones of rats became antirachitic and promptly effected a rapid and complete healing of the lesion.

These facts have now been correlated with what is known of the properties of the antirachitic vitamine and found in substantial agreement. As a result of this experimental work, the action of direct irradiation and the reported antirachitic action of irradiated air has also become understandable to us from a different point of view.

These experiments, which have been in progress since November, 1923, will be reported shortly in the *Journal of Biological Chemistry*. In the meantime, to protect the interest of the public in the possible commercial use of these findings, applications for Letters Patent, both as to processes and products, have been filed with the U. S. Patent Office and will be handled through the University of Wisconsin.

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ON THE EFFECTS OF VARIATION IN FREQUENCY OF STIMULATION ON STRIATED, CARDIAC AND SMOOTH MUSCLE[1]

DURING the course of an investigation carried out by one of us on the effects of variation in frequency and intensity of stimulation of the vagus nerve on the lower end of the esophagus, the cardia and the fundus et corpus ventriculi of the cat, concerning which a preliminary note has been published,[2] it became desirable to extend experiments of this kind to direct stimulation of the different types of muscle. Accordingly, we have chosen for investigation the m. gastrocnemius of the frog, the m. omohyoideus of the turtle, the apex of the turtle's ventricle, portions of the alimentary canal of the cat and the siphon muscle of the clam. The results, which have corroborated those obtained in the vagus experiments, are here reported in a second preliminary communication.

Considering first striated muscle, frequencies of interruption of the primary current of about 40 per second cause pronounced and well-maintained tetanus of the frog's gastrocnemius and the omohyoid of the turtle, but an increase in frequency to 100 per second or more causes more or less complete relaxation. If the higher frequencies are employed at the outset, the muscle responds with a rather brief initial tetanus, relaxation taking place thereafter. The effects are most clearly obtained from the omohyoid of the turtle, for it has much less tendency to enter into a state of contracture than the gastrocnemius. These results are obtained from the curarized as well as the noncurarized muscle.

In case the stimulation is long continued, the gastrocnemius begins to contract rhythmically. This occurs best with a frequency of about 40 per second. The contractions are slowed in frequency and increased in strength as the stimulation is maintained. An increase in frequency to 120 per second or more stops the rhythm and causes the muscle to relax to its contracture level. On decreasing the frequency to its excitatory value, the rhythmicity is resumed, often after a considerable latent period. These results, likewise, are given by the curarized and the noncurarized muscle.

Injection of atropine sulphate into the dorsal lymph sac greatly increases the tendency of the gastrocnemius to contract rhythmically in response to the tetanizing current, and accordingly a much higher frequency is required to stop the rhythm in the atropinized preparation. In one experiment, in which the muscle was both curarized and atropinized, a frequency of 560 per second was hardly sufficient to suppress it. The gastrocnemius of the other leg, which had been atropinized only, exhibited a strong and quite regular rhythm in response to a frequency of 640 per second. Atropine has shown repeatedly this ability to counteract the inhibitory effects of high frequency stimulation.

The results from the apex of the turtle's ventricle have been even more striking. A frequency of interruption of 2.5 per second usually establishes a regular rhythm of contraction. A moderate increase in frequency slows the rhythm and increases the magnitude of the contractions. With a further increase in frequency, the contractions cease and the muscle relaxes almost completely. In this relaxed state, the contractile forces of the muscle are recovered, as indicated by the character of the response obtained when the frequency is lowered again to its excitatory value. Surprisingly low frequencies are inhibitory. Ten interruptions or fewer per second are often sufficient to suppress the rhythm entirely. Atropinization, however, changes the results in a significant manner. Rhythmic contractions are set up by stimulation as before, but extraordinarily high frequencies are required to suppress them—760 interruptions per second often leave the rhythm in progress. It is of interest to note also that atropinization often leads to spontaneous rhythmicity of the apex of the ventricle, which is difficult to check by high frequency stimulation. Pilocarpine, as would be expected, counteracts the effects of atropine. By its application the relations of frequency to effect produced can be made

[1] From the Laboratory of Physiology in the Harvard Medical School.

[2] Veach, H. O., SCIENCE, 1924, LIX, 260.