Emergent Evolution and the Social

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EMERGENT EVOLUTION AND THE SOCIAL[1]

WHEN our thinking tends to congeal into two conflicting interpretations we naturally either devote our days to showing why the one must be true and the other false or we seek to escape from both by adopting a new position from which we can view each of the alternatives as a mixture of truth and falsehood. The theory of emergent evolution (Morgan), also called "evolutionary naturalism" (Sellars), "creative synthesis" (Spaulding), "emergent vitalism" (Broad), and "organicism" (L. J. Henderson), is an example of the latter tendency since it is an endeavor to avoid the "nothing but" attitude of naturalism *versus* supernaturalism, determinism *versus* freedom, continuity *versus* discontinuity, mechanism *versus* vitalism, the many *versus* the one. It corresponds in philosophy to the resolution of the more special conflict between preformation and epigenesis in embryology. Experimentation on the development of living and study of the phylogeny of living and extinct organisms have demonstrated that there is both genetic continuity and discontinuity, or the production of novelty in organisms; in other words, that evolution is not only a repetitive but also a creative process. With the increasing tendency to extend the concept of organization, in the sense of the French "agencement," also to the physical, chemical, psychological and social domains, there arises a strong probability that the various antitheses above mentioned may be resolved in somewhat the same manner as they have been in biology.

But this is all somewhat vague. A more specific statement, applicable to each empirical instance of novelty, has been formulated by the American and British realists, Holt, Spaulding, Sellars, Alexander, C. Lloyd Morgan, H. C. Brown, Conger, Jennings, Gordon, C. K. Ogden and G. H. Parker, who maintain that the unique qualitative character of organic wholes is due to the peculiar non-additive relations or interactions among their parts. In other words, the whole is not merely a sum, or resultant, but also an emergent novelty, or creative synthesis. This conception was long ago advanced by J. S. Mill, G. H. Lewes and Wundt, and since the various sciences are

[1] Address given at the Sixth International Congress of Philosophy, Division A, Cambridge, September 14, 1926, and published with its permission.

concerned with the investigation of wholes of different degrees of complexity, it is, perhaps, implicit in Comte's hierarchy of the sciences, to which we still adhere, and in our various chemical and biological classifications. According to Spaulding *"certain specific relations* recognized, named and *technically formulated in special sciences, organize* parts into wholes, and there are states of affairs resulting [we should now say "emerging"] that are identical with new properties, and that are different and distinct from the individual parts and their properties. Therefore the *reduction* of these new properties to those of the parts *in the sense of identification,* and the finding of a *causal determination* also in this same sense is *impossible.* The properties of the whole are, at least some of them, new, and in just this respect *are a "law unto themselves"* and *in this sense free.* This does not mean that they are lawless, but only that their specific principles of "behavior" are not identical with those of the parts."[2]

[2] This matter has been more fully considered by Broad (p. 77):

On the emergent theory we have to reconcile ourselves to much less unity in the external world and a much less intimate connection between the various sciences. At best the external world and the various sciences that deal with it will form a kind of hierarchy. We might if we liked keep the view that there is only one kind of stuff. But we should have to recognize aggregates of various orders. And there would be two fundamentally different types of law, which might be called "intra-ordinal" and "trans-ordinal" respectively. A trans-ordinal law would be one which connects the properties of aggregates of adjacent orders. A and B would be adjacent, and in ascending order, if every aggregate of order B is composed of aggregates of order A, and if it has certain properties which no aggregate of order A possesses and which can not be deduced from the A properties and the structure of the B-complex by any law of composition which has manifested itself at lower levels. An intra-ordinal law would be one which connects the properties of aggregates of the same order. A trans-ordinal law would be a statement of the irreducible fact that an aggregate composed of aggregates of the next lower order in such and such proportions and arrangements has such and such characteristic and non-deducible properties. If we consider the properties of a given aggregate of high order we could then divide them into three classes. (1) Those which are characteristic of this order, in the sense that all aggregates of the order possess them, that no aggregate of lower order does so, and that they can not be deduced from the structure of the aggregate and the properties of its constituents by any law of composition which has manifested itself in lower orders. These might be called the "ultimate characteristics" of the order. (2) Those which are characteristic of this order; but which could in theory be deduced from the structure of the aggregate, the properties of its constituents, and certain laws of composition which have manifested themselves, in lower orders. These might be called "reducible characteristics" of the order. (3) Properties which aggregates of this order share with those of lower orders. These might be called "ordinally neutral properties."

And, paraphrasing the dictum that to be determined by one's own nature is to be free, he adds *"Freedom consists, therefore, of action in accordance with those characteristics which subsist at a certain level of organization* but do not exist at other (lower) levels, yet is quite compatible with law and determination both at this higher level and at lower levels. Freedom of this kind subsists *at each level* of reality in the universe, not only in the mental but also through the physical and the merely subsistent realms." It is perhaps unnecessary to point to the essential similarity between emergence as thus understood and the *Gestalt* of the configurationists, Wertheimer, Koehler, Koffka, Drexler, etc.

There is evidently danger of conceiving the emergents in a fashion too schematic, too rigid and too static. The whole constituted by the organized and integrated parts need not be regarded as novel in its entirety. The novelty is variable and may be evident only in certain functional aspects of the whole. Since wholes have a manifest cumulative tendency to combine and recombine to form ever more complicated wholes, the ascending hierarchy of emergents has been much stressed. It is far from being universal, however. By loss or simplification of parts or suspension of some of their interactions, there is also an "Abbau," or unbuilding, productive of simpler emergents. This is clearly seen in the many recessive mutations of plants and animals and in the numerous secondary simplifications in such forms as parasites and other highly specialized organisms which are demonstrably descended from more complicated and nevertheless more primitive and generalized ancestors. There is, therefore, an evolution by atrophy as well as an evolution by increasing complication, and both processes may be going on simultaneously and at varying rates in the same organism. We must also remember that most authors artificially isolate the emergent whole and fail to emphasize the fact that its parts have important relations not only with one another but also with the environment and that these external relations may contribute effectively towards producing both the whole and its novelty. This tendency to abstraction has led Professor H. C. Brown to remark that "the whole is then physically more than the sum of the parts *we have taken account of,* although these may be legitimately abstracted as sufficient for correlation with the consequences of the integration. The ex-

traordinary sense of mystery some seem to feel about the process seems to me to arise from forgetting this interstitial filling that is as real as the selected elements and renders technically false the literal interpretation of the appealing paradox of the whole that is something more than the sum of its parts."

If all wholes of which the parts are organized, or exhibit those relations which we call integration, differentiation ("division of labor"), interactive accumulation, etc., among themselves and with the environment, are emergents, we must agree with Morgan that "it is beyond the wit of man to number the instances of emergence." Since no two events are identical, every atom, molecule, organism, personality and society is an emergent and, at least to some extent, a novelty. And these emergents are concatenated in such a way as to form vast ramifying systems, only certain ideal sections of which seem to have elicited the attention of philosophers, owing to their avowedly anthropocentric and anthropodoxic interests. These sections have been called levels. The word is not very apt since it conveys a spacial and static metaphor, whereas emergents must be regarded as intensively manifold spaciotemporal events. Naturally no two authors agree in their lists of levels. Metaphysicians and epistemologists like Alexander and Morgan are mainly interested in space-time, matter, life, mind and deity as successive emergent levels. To the biochemist, biophysicist, biologist, and physiological psychologist, however, life and mind are so amazingly complex and comprise so many heterogeneous processes that their blanket designation as two emergent levels can not seem very illuminating, and to the observer who contemplates the profuse and unabated emergence of idiots, morons, lunatics, criminals and parasites in our midst, Alexander's prospect of the emergence of deity is about as imminent as the Greek Kalends.

Our knowledge of organisms and their development will hardly permit us to accept such levels as life and mind as having been established *uno ictu*. Emergence must be more ambulatory, or at any rate less saltatory. If the naturalist is to accept both genetic continuity and novelty in evolution, the viable novelty at each emergence must be very small indeed.[3] This is attested both by the extraordinary slowness of phylogeny and the very subtle transitions in even the most rapid ontogenies. Even metamorphosis in organisms is only superficially saltatory. Novelties such as life and mind, conceived in wholesale fashion, are of such magnitude that we can regard them only as representing the final accumulative stages of very long series of minimal emergences. The insistence on levels becomes, therefore, largely a matter of descriptive emphasis and should not conceal the necessity for detailed scientific knowledge of every emergence and the peculiar constellations and interactions of the parts which immediately determine it.

One of the levels in which the situation, as it appears to me, is most open to investigation, is the social. Unfortunately the subject has been passed over by writers on levels with only a few vague remarks. Unfortunately, also, the science of comparative sociology has remained undeveloped. It has, in fact, fallen between two stools, because the sociologists have left the study of animal and plant societies to the biologists and the latter have been much less interested in these societies as such than in the structure or individual activities of their members. Apart from Forel and myself only a few investigators, like Espinas, Waxweiler, Petrucci and Deegener, have evinced a keen interest in nonhuman societies. Yet these, no less than human society, are as superorganisms obviously true emergents, in which whole organisms function as the interacting determining parts. Owing, moreover, to the loose and primitive character of the integration and the size of the components even in the densest societies, it is possible to ascertain the behavior of the parts and to experiment with them more extensively than with chemical and organismal wholes, since the parts of the latter are either microscopic or ultramicroscopic and are always so compactly integrated that analysis becomes very difficult and involves a considerable amount of statistical inference. Experiments in subdividing, compounding, castrating and grafting, and in introducing foreign elements with a view to observing their effects on animal and plant societies as emergent wholes, can be carried far beyond the limits of such experiments on the single living organism. For this reason, for the reason that there is a much greater wealth of emergents at the social level than is commonly supposed, and because the peculiarities of social emergence bear an interesting analogy to those of mind, you will pardon me if I descend to a rapid review of a number of biosociological details.

Social aggregates—if we employ the term "social" in its broadest sense—may be divided into two great groups, the heterogeneous and the homogeneous, the former comprising the associations of organisms belonging to different species, the latter of individuals of the same species and therefore of common genetic origin. In either group the simplest associa-

[3] I have used the word "viable" intentionally because monsters and other extreme unadapted mutations are also emergents.

tion obviously obtains between two interacting individuals, the combined behavior of which may be said to form an emergent pattern different from, though depending on, the functional peculiarities of the two component organisms. Among the heterogeneous associations we can distinguish the innumerable cases of predatism, parasitism, symbiosis and biocœnosis, which constitute a vast series of emergents varying from those of very low to those of very high integration. In predatism, the predator becomes structurally and behavioristically adapted to the prey and the latter to the predator, at least to the extent of modifying its habits of flight, concealment, defense or fecundity. In these cases we can hardly speak of association in the social sense, but it may be noted that if the predatory species indulges in too great an extermination of the prey, it must either adapt itself to some other form of prey or automatically cease to exist. In parasitism this danger is the greater because the association of host and parasite is so close as to be usually one of actual bodily contact. Moreover, the parasitic association which is exhibited, either temporarily or permanently by many thousands of animal and plant species, tends to ever greater definiteness through the selection of specific hosts by the parasites. This type of association is unilaterally aggressive like predatism, but tends in turn to lapse into a relation of mutualism, or symbiosis between the interacting individuals, again giving rise to innumerable emergents exhibiting such diverse behavioristic wholes as the helotism of alga and fungus in the lichens, the association of bacteria or *Micorrhiza* with the roots of higher plants, the singular associations of pollinating insects with flowers, between the yeasts or bacteria and the tissues of Homopterous and other insects, between ants and certain tropical trees and shrubs, the cultivation of fungi by beetles, ants and termites, etc. Finally there are the biocœnoses, or associations of plants and animals that live in particular edaphic situations, such as swamps, deserts, rain-forests, etc.—veritable welters of organisms of many species, all interacting with one another in complex predatory, parasitic and symbiotic relationships, but forming wholes in which the experienced field-naturalist can readily distinguish general adaptive patterns, though their adequate description may be impossible. In the tropics a single species of tree may harbor and nourish more than a hundred species of insects peculiar to itself and these may, in turn, be the prey of many predatory insects, reptiles, birds and mammals and the hosts of innumerable fungus, protozoan, vermian and insect parasites. We may truthfully say that there is not on the planet a single animal or plant that does not live as a member of some biocœnose.

True societies are possible only when the components belong to the same species, but the motives of their association may be very diverse. They may be said to belong to three main types according as nutritional, reproductive or defensive functions predominate in the emergent social behavior. Examples of the nutritional type are certain Cœlenterates, like the Siphonophores, corals, etc., the tunicates, tapeworms and the higher vascular plants. In all these cases the society, or colony, is formed asexually by repeated budding from a single individual and sexual reproduction is restricted to the dissemination of the species and the formation of the initial individual of the colony. Certain members of the colony may be specialized for the purpose of securing food, but this is shared by all the vitally interconnected individuals.

The sexual, or reproductive, type of society is more interesting. It starts with a peculiar temporary cooperation, or mating of only two individuals, the male and the female, and emerges with the growing up of the offspring in cooperative affiliation with the mother or with both parents. A more or less permanent family is thus formed, which may become very numerous either through the production of successive generations of offspring by the same mother or through the consociation of a number of genetically related mothers and their offspring. This is the type of society which we find among the insects, and I have been able to show that it has emerged at thirty independent points at least during the phylogeny of the class. Some of these colonies are very small and evanescent, or feebly integrated, but others are very stable, comprise many thousands of individuals (ants, honey-bees, social wasps and termites) and are very highly integrated, with so pronounced a social division of labor among the individuals that definite castes are produced (workers, soldiers, etc.) which are not only functionally, but may even be morphologically differentiated at an early stage of their post-embryonic development. Although the formation of the various castes is primarily connected with the functions of nutrition and defense the main activities of the colony center in reproduction, *i.e.*, in producing and rearing as many young as possible. That the social activities may present a very definite emergent pattern is most clearly seen in the nests of bees, wasps, ants and termites. These structures, though the result of the cooperative labor of most of the personnel of the colony, are nevertheless true *Gestalten*, being no more mere sums of the individual activities than is the diverse architecture of cities built by human hands. Not only does each species have its peculiar type of nest, but the nest of every colony of a species exhibits its own emergent idiosyncrasies.

The situation among the social insects may be com-

plicated in a very interesting manner by the tendency of their colonies to adopt alien insects as guests, or nest-mates. This is especially true of the ants and termites. These guests are really social parasites and are to be regarded as component members of the colonies in the same sense as dogs have for ages been effective members of human societies. But in the case of the social insects the behavior of the guests may produce veritable social diseases in the colonies that harbor them. As a result of their adoption even the structure and numerical proportions of the castes may be modified, although there is a demonstrable effort at social regulation on the part of the host, just as there is in the single organism whose tissues have been invaded by bacteria or other parasites. This tendency to consociation with strange organisms is carried even further in the union of whole colonies of bees, wasps and ants with colonies of alien species, and in these so-called "mixed colonies" one of the social components assumes a predatory or parasitic rôle, suppressing the fertile queen, or reproductive organ of the host colony, *i.e.*, indulging in what is known as "parasitic castration" among single organisms, and controlling the activities of the whole, so that a new emergent arises—a super-superorganism, or superorganism of the second degree.

The defensive colonies are represented by the schools, flocks, herds and bands of fishes, birds and mammals and consist of individuals, sometimes of only one sex or of the young, belonging to different families. While these congregations are usually based on sexual reproduction, their primary social function is nevertheless the protection of the individuals. There is often a vague differentiation of function as in the stationing of sentinels or of more vigorous or more formidable individuals in strategic positions when the herd is feeding or is otherwise exposed to danger. The bands of monkeys, anthropoids and primitive men constitute loose social aggregates of this pattern. We must, I believe, regard human societies above the level of the primitive savage horde as still higher emergents, *i.e.*, as super-superorganisms which not only have their reproductive bases in the consociation of numerous families, but have developed innumerable groups, or associations, all so inextricably interrelated that a single individual not only has multitudinous relations with the members of his own and other families, but may belong simultaneously to a number of different associations. The total emergent functional pattern is here so amazingly complicated that it altogether defies observation as a whole.[4] Whereas nearly all insect societies possess an ontogeny, since they have their inception in a single fertilized mother queen and exhibit a gradual growth, integration and differentiation as new individuals are successively added from the eggs of the queen till the colony attains a definite adult stature in a manner analogous to that of the ontogeny of the single organism by division and differentiation of its component cells, human society no longer possesses an ontogenetic stage but grows indefinitely by a kind of interstitial swarming, which resembles that of the honey-bee only when contingents of individuals are sent out as colonies, as occurred in ancient times among the Greeks and Romans and has been the practice of other European nations during more recent centuries.

Now the various emergents which I have very briefly discussed indicate that there is something fundamentally social in living things, and closer scrutiny shows that this must be a characteristic of all life, since every organism is, at least temporarily, associated with other organisms, even if only with members of the opposite sex and with its parents, and every organism is at least implicated in some biocœnose. This statement holds good even of such supposedly unsocial creatures as lions, eagles, sharks, tiger-beetles and spiders. There are, in fact, no truly solitary organisms. We may say, therefore, that the social is a correlate as well as an emergent of all life in the sense in which Morgan speaks of mind as being both a correlate and an emergent of life. And like the more complicated mental emergents, such as the instincts and conscious activities, striking social emergents make their appearance sporadically and often in unrelated groups of species, as I have shown among the insects.[5] Indeed, the correlations of the social—using the term in its most general sense—even extend down through the inorganic realm to the very atom with its organization of component electrons. And since reality is given as classes of elements, each represented by innumerable similar, active entities, endowed with an irresistible tendency to cohere and organize themselves into more and more complex emergent wholes, association may be re-

[4] Only in certain cases, such as ceremonials and rituals, is it possible to observe emergent social patterns as wholes, or *Gestalten*. A fine example of such a pattern, covering a wide area and many activities and carried out by many individuals, though unperceived by the latter, is the *kula* among the natives in the archipelagoes of Melanesian New Guinea as described by Malinowski in his "Argonauts of the Western Pacific."

[5] This matter is fully discussed in my "Social Life among the Insects," 1923, and "Les Sociétés d'Insectes. Leur Origine. Leur Evolution," 1926.

garded as the fundamental condition of emergence. We are, I believe, bound to assume that the organization *is entirely the work of the components themselves* and that it is not initiated and directed by extraspacial and extratemporal "entelechies" (Driesch), "organizatory factors" (Eldridge), "deity" or "élan vital" (Bergson). Such agencies are conceived as possessing remarkable foresight, although the whole multimillennial course of evolution with its innumerable *impasses* and *culs-de-sac,* its abject and tragic failures, would seem rather to be one vast monument to their colossal and hesitating inadequacy, blindness and stupidity. The resort to such metaphysical agencies has been shown to be worse than useless in our dealings with the inorganic world and it is difficult to see how they can be of any greater service in understanding the organic. The tender-minded may still delight in assuming their intervention in the development and maintenance of unicellular and multicellular organisms, whose integration is so exceedingly complicated and opaque that we are probably still centuries removed from any adequate understanding of their functional composition, but on the next level, that of the very loosely organized social, or superorganisms, in which the actual play of the components is open to inspection, it is not so easy to tolerate these ghostly presences.

I fail to understand why Alexander and Morgan select deity as the supervenient level next to mind, since their general scheme of emergent evolution most naturally demands the social as the next level in ascending order. Were prophecy in order we might ask what level may be expected to emerge beyond the social. Perhaps this may be the end of the series, with supervenient extinction, also to be accepted by the race with good cosmic manners if not with Morgan's "natural piety." It would seem, however, that the present very imperfect state of our society may allow for not a few successive emergents in the form of greater solidarity and higher ethics. But here we touch on a consideration which even Herbert Spencer felt to be ominous. Will this prospective, more intensive socialization be analogous to that of the highest social insects, a condition in which specialization and constraint of the single organism are so extreme that its independent viability is sacrificed to a system of communal bonds, just as happens with the individual cell in the whole organism? Within the groups of social insects, as we pass from the socially primitive to the more specialized, or in the ontogeny of the single colony as we pass from its earlier to its later stages, we actually witness a notable and increasing degeneration of the individual. Holmgren has shown that the supraœsophageal ganglion or brain in old kings and queens of termites shrinks to one third, while the sympathetic ganglia increase to three times their original size. And von Rosen finds that the eyes and optic ganglia of aged royalty among termites also undergo marked degeneration. Furthermore, the eyes, brain, thoracic structure and often also the pigmentation of the workers in the most highly socialized ants are less developed than they are in the workers of small primitive societies, which are more like the original solitary Vespoid ancestors. There may even be a complete suppression of the worker caste and a return, or dedifferentiation to what is, to all intents and purposes, a nonsocial life in certain ants, bees and wasps (*Anergates, Psithyrus, Vespa austriaca,* etc.) which behave as parasites in the colonies of other ants, bees or wasps. We also notice a concomitant degeneration in pigmentation and other structures as we pass from primitive forms like *Mastotermes, Archotermopsis* and *Hodotermes,* with their small colonies, to *Termes* with its huge colonies of highly specialized individuals. Many more examples might be cited but these will suffice to show that evolution by atrophy certainly accompanies an advance in social integration in the insects. Turning to man we notice a similar regressive development of the individual as civilization proceeds. There is a decline in the sense-organs (witness the number of people with congenital or acquired defects of vision, hearing and smell), anomalies in the epidermal structures (teeth, hair and pigmentation), the absence of any demonstrable improvement in the brain cortex and intelligence during historic time (possibly even some deterioration!), the greater activity of the visceral nervous system and endocrine glands as shown by the higher emotivity, increasing insanity, criminality and mob-psychology in our larger cities, etc. Add to all this the atrophy or subatrophy of our organs and tissues brought about by the ever-increasing specialization in our activities, and we can hardly fail to suspect that the eventual state of human society may be somewhat like that of the social insects—a society of very low intelligence combined with an intense and pugnacious solidarity of the whole. Even the intensification of nationality witnessed in existing human society has its counterpart in the hostility of every colony of social insects towards every other colony, even of the same species. A society of the type towards which we may be drifting might be quite as viable and quite as stable through long periods of time as the societies of ants and termites, provided it maintained a sufficient control of the food supply. Intersocietal hostility undoubtedly has its roots in the mutual hostility of the individuals, both of the cells or tissues of single

organisms and of the individual organisms composing superorganisms, and this "hostile symbiosis" is the foundation on which Morley Roberts has recently erected a very interesting theory of evolution. The primitive predatism and parasitism from which symbiosis has emerged is not lost by the individuals composing organisms or societies but merely abides in latency, as the most casual observation of our species demonstrates, ready to flare up under certain conditions with the most disastrous results, such as the death of the individual (cancer) and other malignant growths and variations, or the dissolution of society (revolution). It follows from such considerations that the optimistic conception of progress as an unceasing process in the human race may be illusory. Roberts suggests that our enlarged fore-brain, the "specific organ of civilization" (C. J. Herrick), with its ninety-two hundred million neurons, of which we are so proud, may really have originated as a malignant overgrowth (tumor), and he remarks that "in discussing the factors of evolution objections to our regarding the encroachments of the fore-brain upon the animal function of the human body as perpetual approximations to and recessions from a state of morbid over-growth, on the ground that to this we owe human progress, are wholly irrelevant. Progress, whatever it may be, is obviously relative and a healthy Neanderthal or Cromagnon man, who might as easily dispose of a modern athlete as any gorilla, could be held excused if he thought his bald and almost jawless successor to be in the highest degree degenerate. There can be no doubt that what we, perhaps in our blindness, call the upward progression of the human race, has always been accompanied, especially when advance seemed most rapid, by an increase in disease, and it would in no way be surprising if we learnt at last that the remarkable increase in the fore-brain was not only one of the causes of malignancy but was to be in the end one great cause of the extinction of man. If that proved to be a fact, such a result would but class man as one of the many races of animals which perished of special over-growths and a possible lack of fertility."[6]

[6] The degenerate or pathological character of civilization has been emphasized by many authors, including Ruskin and Carpenter. The following is from Schiller ("Ueber die ästhetische Erziehung des Menschen," 1795) and is quoted by Jung in his "Psychological Types," p. 91: "I do not ignore the advantages which the present generation, regarded as a whole and measured by reason, may boast over what was best in the by-gone world; but it must enter the contest as a compact phalanx and measure itself as whole against whole. What individual modern could enter the lists, man against man, and contest the prize of manhood with an individual Athenian? Whence then arises this unfavorable individual comparison in the face of every advantage from the standpoint of the race?" In the writings of Stärcke (Psychoanalysis and Psychiatry, Internat. Journ. Psycho-Anal. 2, 1921, p. 361–415), who actually dubs the disease of civilization "metaphrenia," I find the following remarks: "Civilization seems then to be a disease which is imposed on a certain portion of society in order to obtain a certain extra gain whereby all profit. . . . Civilization from the individual point of view belongs to neurotic phenomena. . . . We see the civilization of a people or a race built up in cycles according to the mechanisms of the obsessional neurosis, until it becomes no longer bearable; then there comes about a limitation of the useful effect through the return of the repressed material in disguised form, and a breaking through of forbidden things in war and revolution, according to the principles of the manic psychoses, while various 'isms' analogous to the paranoid fields are not lacking. . . . Civilization demands regression," etc.

The prospect is by no means pleasant. You will be delighted, I am sure, that I refrain from further comment.

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William Morton Wheeler

THE TONGA EXPEDITION OF 1926

The primary object of the expedition was to make such progress in the investigation of the geologic and biotic history of the Tonga archipelago as might be possible during the months of June, July and August. The personnel of the expedition consisted of J. Edward Hoffmeister, of the University of Rochester (geology and corals), J. M. Ostergaard, of the University of Hawaii (mollusks) and Harold Ernest Parks, Mrs. Setchell and myself, of the University of California (botany). Hoffmeister and Ostergaard were directly under the patronage of the Bernice P. Bishop Museum, and the expedition as a whole was under the auspices of the same institution.

The delay of a week at Suva, Fiji, was utilized in making studies of the barrier reef and the geology and botany of the vicinity, in close sympathetic cooperation with Harry S. Ladd, Bishop Museum Fellow, who had been at work in Fiji for several months. From May 31 to August 23 our work lay in southern Tonga. Hoffmeister and Parks devoted most of their time to investigations on Eua, the remainder of their time being spent on Tongatabu, where the rest of the party were located during their entire stay. Particular attention was given to collecting corals, mollusks, foraminifera and nullipores, both living and fossil, since these constitute the bulk of the organisms preserved in the emergent reefs and are likely to be of the greatest importance as indicators of time and temperature relations. The distribution of land plants was also determined, both from the ecologic and floristic standpoints, as being likely to show similar and corroboratory relations.

Returning, our party spent a profitable day in the vicinity of Neiafu, the port of the island of Vavau, about three days at Apia, in western Samoa, and about three days again at Suva. In regard to the biotic data obtainable, it is pertinent to state that our observations were confined entirely to the winter (cooler and usually drier) season, and is lacking in material and data peculiar to the summer (warmer and moister) season. A very considerable amount both of data and material was accumulated, but detailed reports must await its study and coordination. Here may be briefly outlined, however, the main trends of our work.

Brief Report of Botanical Work

(By William Albert Setchell)

The island of Tongatubu presents a very simple plan of plant distribution. In many places along the steep, high windward side (the liku) is a wind-swept forest formation bordered towards the ocean by a dense Pandanus association and with a low herbaceous or prostrate undershrub formation to the edges of the lower or higher cliffs. This liku forest varies somewhat in the outer associations but within is typically a Myristicetum (with *Myristica hypargyraea* as a strong dominant) over the higher portions of its range. The low leeward shore shows chiefly a succession of sandy beaches, bordered seaward by a dead fringing reef and landward by a beach standing several feet (usually about ten) above mean low water mark. Along this beach are herbaceous formations with typical Polynesian strand trees and shrubs. Between the liku forest formation on the windward ridge and the leeward formations, the gently sloping agricultural land is covered with plantations of coconuts, bananas, taro, sweet potatoes, yams, etc., interspersed with larger and smaller patches of secondary forest or bush. Through this area are scattered a few low conical hills and the surface is deeply indented on its northern edge with one