

# SCIENCE

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FRIDAY, APRIL 3, 1896.

EXPEDITION TO SERILAND.\*

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By the Spanish explorers and evangelists, most of the territory lying west of the Sierra Madre and south of Gila river, in what is now western Sonora and southwestern Arizona, was called Papagueria, or land of the Papago Indians. The eastern and northern boundaries of the area were fairly defined, but the western boundary was vague. Toward the mouth of Colorado river the Papago country was separated from the Gulf of California by an arid tract of volcanic debris known as Malpais, a tract too utterly barren for habitation, traversed by the Indians only on annual pilgrimages to the coast for salt. Toward the south, Papagueria was separated from the Gulf, midway of its length, by the land of the Seri Indians, a tract peculiarly protected from invasion by natural conditions and defended against invaders by a warlike people.

As exploration and evangelization grew into settlement, the Spaniards affiliated with the natives, and a Mexican population and culture pushed into Papagueria; and to-day most of the valleys occupied of old by the Papago Indians are given over to Mexican villages, ranches, and stock ranges, only scattered groups of the aboriginal landholders remaining in Sonora, though their tenure is better maintained in Arizona. With the conquest of Papagueria, explorers

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pushed over the Malpais and a difficult trail was laid to California, then essentially a part of Mexico; and later, as American enterprise pushed toward the Pacific, another trail was pushed out, in part along the older one, and trod by pioneers until better routes were found along the Gila and further northward. The trails, Mexican and American, pass by the only known waters of the Malpais; and knowledge of the few widely separated tinajas\* and springs was bought at the price of many lives. But while the Malpais was thus explored, albeit at great cost, Seriland was protected by a barrier desert and its savage owners so completely that the tide of exploration was practically checked; and Seriland remained unknown, save as to its coast, and except in a vague way as the home of a blood-thirsty tribe from time immemorial.

During the autumn of 1894 an expedition was conducted by the Bureau of American Ethnology through Papaguera and into the border of the Seri country for purposes of ethnic and collateral research; during the past autumn an expedition of related aim was conducted along other lines through Papaguera and into Seriland, which was thus for the first time explored and surveyed with some degree of thoroughness. The primary purpose of the later expedition was the making of collections representing the habits and customs, and especially the maritime life of the Seri Indians; but so far as practicable, advantage was taken of the opportunity for observation in other directions, not only in the Seri country, but throughout Papaguera. Some of the lines of observation may be indicated briefly.

\*Tinaja, as used by Spanish Americans, is a natural bowl or bowl-shape cavity, specifically the cavity below a waterfall, especially when partly filled with water; in a more general way it is extended to temporary pools, springs too feeble to form streams, etc. In its specific application it has no equivalent in, and would be a desirable addition to, the English language.

#### GEOGRAPHY AND GEOLOGY.

The territory traversed by the two expeditions may be conceived as a great plain sloping southwestward from the foothills of the Sierra Madre to the Gulf of California, relieved by occasional rugged mountain ranges generally trending parallel with the high Sierra which divide the plain into a succession of lesser plains or broad valleys; and the great plain must be conceived as undulating somewhat, the chief irregularity being the subcontinental divide coinciding approximately with the international boundary.

The region is extremely arid, the annual rainfall averaging probably less than five inches, and perhaps less than two inches throughout the western half of the area. Streams gather in the mountain gorges, and those heading in the Sierra unite to form a few rivers; but as the waters push out over the plain they are partly evaporated, partly absorbed by the dry earth, so that even the highest freshets never reach the sea; and most of the streams flow only a few miles or at most a few scores of miles, and this only during the rainy seasons or after sporadic storms.

The mountains, especially the minor ranges of the Sierra, are notable for ruggedness and steepness of profile; they are remarkable also in that they usually rise from the plain abruptly or with relatively inconspicuous intermediate slopes—as a clever writer expresses it (picturesquely, but mistakenly, except in appearance) they are ‘as men buried to the neck.’ The mountain ranges are either naked rocks or steep talus slopes of coarse debris, supporting a scant sub-desert vegetation which increases in abundance toward the summits; the rocks being either metamorphic sedimentaries probably of Mesozoic age, or somewhat younger volcanics, a few nucleal ridges being granitoid. The broad intermontane plains are made up in part of alluvial or

torrential debris, fine at the lower levels, coarser toward the bounding foot-hills and ranges, though it is remarkable, and indeed paradoxical, that they consist in large part of the planed edges of hard rock strata such as form the adjacent mountains; the surface of the plain, whether built or carved, being sparsely dotted with trees and shrubs of sub-desert habit. Toward the coast the plains lie but little above and in some cases apparently below sea-level, and are composed of marine sediments, sometimes abundantly charged with recent shells; when the surface is usually a succession of playas and sand dunes.

Seriland is an exceptionally mountainous portion of the great westward-sloping plain, lying near the line along which it dips beneath the waters of the gulf; indeed a part of this staunch little dominion lies beyond the general coast line and is separated from the mainland by a narrow strait, itself the precise homologue of the upland intermontane valleys save that it is occupied by tide water and faintly sculptured by waves and tidal currents. The main insular portion of the territory is Tiburon Island, about 500 square miles in area; the continental portion is some 2500 square miles in area; and a few small islands adjacent to Tiburon and the Sonoran coast belong to the same natural district, and are held by the Seri Indians. Tiburon Island comprises half a dozen ranges, major and minor, the higher peaks rising from 3000 to 4000 feet above tide; in its principal interior valley there is a feeble stream, gathering among the higher peaks and wasting within a few miles, besides some half dozen tinajas and springlets. Sonoran Seriland is also mountainous, the culminating peak rising about 5000 feet above tide, and contains a feeble permanent spring and two or three water holes in which the water is brackish. Of the entire area south of Gila river and west of the Sierra, about four-fifths may be classed as

plain, one-fifth as mountains; but in Seriland more than two-fifths and probably three-fifths must be classed as mountains, leaving only a moderate fraction to be classed as plain. This mountainous tract is separated from Papagueria by a broad waterless zone of playas and sand dunes, abounding in partially fossilized shells.

It is to this desert barrier, 20 to 40 miles across, that the isolation, and apparently many of the characteristics, of the Seri Indians are due; for it is a natural boundary, one of the most trenchant and effective on the Continent, practically impassable without special training, and so conditioned as to be easily defended along the inner margin in case of invasion.

When the mountains and intermontane plains of Papagueria and Seriland are examined in detail, certain peculiarities appear: As already observed, the mountains are notable for ruggedness and the plains for flatness nearly or quite to the mountain bases; again, the parallel ranges are found to be occasionally united by cross bars, so that a common form of mountain plan may be likened to the letter H; still further, it is found that the larger arroyas and rivers seldom follow the axes of the valleys, but usually flow athwart them and frequently traverse the bounding ranges in narrow gorges opening toward the gulf, while many southward-flowing streams head on the northern sides of the cross-bar ranges through which they pass in youthful canyons. On assembling these peculiarities, they are found to point toward two successive sets of geologic conditions: The distribution of the minor ranges with their transverse connections, coupled with the fact that a large part of the area of the intermontane plains is planed, indicates that the region was formerly a plateau which maintained its altitude and attitude until the feeble sub-desert streams degraded the greater part of the mass, leaving only the

harder ledges and broader divides as remnantal ranges; while the incongruity of the modern waterways indicates that, after assuming this general configuration, the tract was tilted southwestward in such manner as to stimulate the streams flowing in this direction and paralyze those flowing northeastward, and thus to produce a general migration of divides. These indications may perhaps be misleading, or may have been misinterpreted; and the abrupt transition from rugged mountain slope to planed base-level is an attendant feature which requires explanation before the interpretation can be regarded as final. The researches relating to this subject are not complete, but both Mr. Willard D. Johnson, of the later expedition, and the writer have collected data bearing on the subject. Among other data may be mentioned an admirable section exposed along the gulf shore from Kino bay to San Miguel point (some 20 miles), in which the relations between rugged range, planed base-level, and torrential plain are clearly shown.

Mr. Johnson carried forward a planetable survey throughout Papagueria and Seriland, which will not only yield the first trustworthy map of the region, but will serve as a basis for the representation and interpretation of the geology. \*

#### METEOROLOGY.

Throughout the expeditions of 1894 and 1895, noninstrumental observations were made on winds, clouds, precipitation, frosts, etc., and noted with considerable care, with the view of determining the influence of these elements of the weather on geologic process, on the flora and fauna, and on the human population, native and introduced. These notes, made incidentally at a constantly shifting base and for short periods

only, would be of little value in a region adequately supplied with meteorologic stations, but acquire some value from the dearth of observations in the district to which they pertain, particularly since this district aids in shaping the weather conditions prevailing over a considerable area in southwestern United States. Prof. Cleveland Abbe has signified a desire to publish the notes in an early number of the *Monthly Weather Review* of the United States Weather Bureau, and the material will thus be made accessible to meteorologists. The notes acquire value also from the close relation between weather and life in this region.

It may be observed in brief that the chief weather characteristic of the region is aridity, the rainfall being limited in quantity and irregular in distribution; there are two nominally rainy seasons, in July-August and January-February, respectively, but rains sometimes occur at other times, while precipitation often fails during these seasons; but whether rain falls or not, these are seasons of greater or less humidity of the air, so that the flora is vivified semi-annually, whereby many species are undoubtedly enabled to survive the seasons of drought. The second weather characteristic is heat, especially at lower altitudes; the summers are oppressive for men and animals, the winters no more than pleasantly cool—the weather in Seriland may be inferred from the fact that, while these Indians have words for rain and hail, they have none for ice, snow, or frost. Another characteristic is the dearth of clouds, and the consequent intensity of light and fervidness of insolation by which the skins of men and animals are undoubtedly, and the habits of certain plants apparently, affected. Toward the coast, fogs are not uncommon in the autumn, and are said to occur at other seasons; this weather condition appears to affect the flora for 10 to 50 miles inland, according to the local configuration. The

\* A preliminary impression of the Seriland portion of the map will appear in *The National Geographic Magazine* for April, 1896.

relations between weather and the life of the region, human and sub-human, are thus manifold—indeed not only the superficial but the fundamental characteristics of the living things, the very laws of individual and collective development, are largely traceable to weather conditions; but in a summary statement it is impossible to do more than suggest the bearing of the researches relating to this subject.

#### ARCHÆOLOGY.

During the earlier expedition it was ascertained that prehistoric works abound throughout much of Papagueria; during the later journeys the observations on this subject were extended. In almost every valley containing sufficient water to support a population howsoever limited, ruins of ancient villages, remains of irrigation works, etc., are found; the only exceptional valleys being those in which modern civilization is so extensive as to destroy the more conspicuous traces of earlier culture. Moreover, the prehistoric ruins are in general more extensive than the modern villages, while the ancient irrigation works and fields are carried further up the valley-sides than the modern acequias and farms, indicating that the ancient agriculture was the more extended. The artifacts found in the ancient villages prove that the prehistoric people were potters and that their fictile ware was somewhat finer in quality than that manufactured by the modern Papago; that they were a peaceful folk, using stone axes, mortars and pestles, hammers, foot-balls, etc.; that they had temples or other dominant structures more elaborately furnished than their ordinary dwellings; and there is fairly clear indication that they corralled a small domestic animal, but that they were without larger stock such as was later introduced by the Spaniards. Associated with these ancient relics of well-known kinds there is a distinctive class of

ancient works known generally among the Mexicans as '*las trincheras*' (entranced mountains), usually found in the immediate vicinity of fertile valleys and especially characteristic of portions of these valleys now, as in prehistoric times, especially adapted to settlement. Commonly the site is a steep-sided butte or isolated mountain several hundred feet high, and the work itself is a rough and rather irregular wall of loose stones circumscribing the butte near its summit; sometimes the walls are multiplied or built out into bastions, particularly on the gentler slopes, and they may be interrupted where the slopes are precipitous. The walls support either narrow pathways or broad terraces on which house-circles are sometimes found; and along and within the walls the ground is frequently sprinkled with potsherds and wasters of foreign rock. No granaries or reservoirs have been found within the enclosures, nor is there anything to indicate permanent or long-continued occupancy.

Specially noteworthy examples of this class of works were carefully surveyed during the recent expedition, near San Rafael de Alamito, in Magdalena Valley, 35 miles southeast of Altar; the two principal buttes being known specifically as '*Las Trincheras*,' or as '*Trinchera*' and '*Trinchera*.' The larger butte, nearly a mile long and 650 feet high, is terraced from bottom to top half way round, and on the other side is walled and terraced in part; the smaller is similarly terraced most of the way round. The retaining-walls or revetments are massive and in some cases fully 20 feet in height, and are usually carried from two to five feet above the terrace in the form of breastworks, while free walls of equal height are distributed over the gentler slopes; and fragments of pottery and stone artifacts, as well as spalls and cores of transported rock, besprinkle the ground and might be collected in tons. These

works are conspicuous because of magnitude; the prehistoric works of Papagueria in general are noteworthy in extent, and in that they appear to indicate the existence of a more numerous population than that of historic times who stored and controlled storm waters and thus occupied a higher culture-plane than the modern Indian, Mexican and American inhabitants of the same region.

During the recent expedition it was ascertained that, while the prehistoric works of Papagueria stretch to the southwestern boundary of that territory they do not extend into Seriland, where no ancient works were found except shell heaps, cairns, etc., such as the Seri now accumulate. Some of the shell heaps are, however, of great volume and extent, and so situated as to prove that they have survived considerable geographic changes; thus a mound built almost wholly of clam shells (belonging to a series covering several acres) is some 60 feet high and over 300 feet in diameter, and is located on a part of the shore where there are now no clam flats, which the waves have invaded until a considerable part of the mound has been swept away—the section thus exposed revealing typical Seri potsherds and stone hammers from top to bottom. So Seriland appears to be an archæologic as well as an ethnic unit, and there is nothing to indicate that the territory was ever held by other people than the ancestors of the modern tribe.

#### BIOLOGY.

During the earlier expedition it was observed that the flora and fauna of Papaguará display certain characteristics which were ascribed to the influence of a peculiar environment; and during the later expedition further notes relating to this subject were made, and a small collection of plants was gathered and placed in the hands of Professor J. W. Toumey, of

the University of Arizona, for identification and study. While the observations on plants and animals were in a measure casual and were not guided by expert knowledge, they proved particularly suggestive in their bearing on the relations between the human inhabitants of the same region and their environment. These biotic studies indicate that, in sub-desert regions, the development of the individual and the species is determined primarily by a rigorous environment; so that the course of development tends at the same time toward pronounced individuality and toward a complex system of coöperation among diverse organisms, whereby each immediately antagonizes, but ultimately serves, its contemporaries. Some of the inferences from the observations of the earlier expedition have already been stated\* and need not be repeated; but many new examples, congruous with those previously collected, were noted.

Among the most interesting observations are those pertaining to the coöperative interrelation between animal and vegetal organisms, whereby each depends on the other for existence; this being the stage of vital coöperation called commensality. The best known examples of commensality are those of the fig and fig insect and the yucca and yucca moth, in which the relation was established by Riley; though a still more striking example, in which, however, the relation has not yet been demonstrated, is that of the saguaro, or giant cactus (*Cereus Giganteus*) and its insect mate. During the recent trip two distinct plants were found apparently to represent a still more complex miscigenesis: The cina (*Cereus schottii*), one of the most abundant cacti of southern Papagueria and Seriland, seems not to flower or fruit under what would commonly be considered normal conditions, but only

(\* 'The Beginning of Agriculture,' American Anthropologist, Volume VIII., 1895, pp. 350-375.)

after attack and injury by a certain insect (not yet identified). Normally the young cactus sends up half a dozen or more massive stems, usually 5 to 10 feet high and 3 or 4 inches in diameter, beset with thorns along each of the 5, 6, or 7 ribs; subsequently branches spring from these stems, and the plant gradually expands into a clump or colony a dozen feet or yards across. Thus far the plant remains an individual; the product of a single seed; and the period of individual development undoubtedly covers a long term of years, since the younger branches remain vigorous long after the original stems have died and decayed. Now, so far as the observations go, they indicate that the plant does not necessarily or normally fructify during this term of individual development, but that if its insect enemy and mate chances to deposit eggs in the pulp toward the extremity of branch or trunk several changes supervene. In the first place the eggs develop and in due time the larvæ emerge and feed on the pulp; then the branch shrivels, losing a quarter or third of its diameter, and a pilage of slender spines or stiff bristles springs and soon covers the shrunken portion, which may be a foot or more in length; next, under the protection of these spines, a bright-colored flower is put forth, and this in time is followed by the fruit. It is of course to be borne in mind that this sequence has not been studied as a succession of stages in the same plant, but only as an unbroken series of stages exhibited by many plants, so that the sequence may not be regarded as established; but, so far as the observations go, they tend in that direction.

Essentially parallel to the behavior of the *cina* is that of the dicotyledonous bush called by the Mexicans *torotito* (not yet identified), the geographic distribution of which is about the same as that of the *cina*. For a long time this plant was a puzzle because no indication of the mode of repro-

duction was perceived. It grows in a clump of two or three or a dozen stems springing from a single root, and the colony or clump retains vitality much longer than individual branches, which apparently spring up, attain full growth, die, and decay, while yet the colony survives, so that, as in the case of the *cina*, the term of individual existence is manifestly long. At length it was noted that the extremities of the separate stems or branches occasionally present an abnormal appearance—tumescent, gnarled and twisted, with leaves or petioles attached; and on dissection it was found that such diseased twigs contain eggs or larvæ. Then, as the season progressed, it was found that the tumescent twigs—and these only—sometimes bear small flowers and, quite rarely, a nutty fruit. So in this case as in that of the *cina*, the flowering appears to depend on the development of an abnormal condition resulting from ovaposition by an insect (which was not seen in the imago form; but it seems not to be a necessary stage in the history of any individual, since in many cases the tumescent twig withers and falls off without flowering and of course without fruiting, while only a small proportion of the flowers appear to produce nuts. In this case, too, the observations are suggestive, though not demonstrative, of an ontogenic sequence; yet it is to be observed that the sequence is in precise accord with the biotic relations prevailing in this district, under which the tendency is to perpetuate species by prolonging the life of the individual rather than by multiplying progeny, under which all living things tend to enter a solidarity of remarkable perfection, and under which phylogenetic development is either forced and intensified or cut off by the pressure of an adverse inorganic environment. Granting the sequence, or even admitting only the indubitable interrelations found in the region, it follows that the living things of the desert conserve

much of the energy commonly expended in reproduction, and thereby approach the plane occupied by the higher animals, with man at their head, among which progeny are reduced in number and improved in the perfection of their adjustment to environment—the plane of solidarity founded on conscious or unconscious altruism, whose occupants, sometimes erroneously classed as sexually degenerate, are the socially regenerate of the earth in that they are fitted to the fulness of life in all its forms.

During the earlier expedition it was found that the plants of Papagueria, "howsoever divergent phylogenically, are notably convergent in a certain group of characters, including leaflessness, waxiness, hairiness, thorniness, and greenness";\* during the later trip these inferences were verified and corroborated, and it was also observed that still other features are common among genetically diverse plants. Thus, there is a series of trees and woody shrubs, including a half dozen desert forms known as torote, torotito, etc. (not yet identified), which are characterized by swollen trunks and squat forms, in which the woody tissue is pulpy in texture and saturated with watery or slightly viscid sap. When trunk or branch is wounded the sap exudes and quickly heals the wound, either by coating it with lacquer or encrusting it with gum; and when the plant dies the sap escapes and the wood shrinks and gapes widely, even before the bark decays, so that decomposition is rapid and the dead crop quickly makes way for the rising generation. This pulpiness of stem among ligneous plants is like unto the pulpiness of the cactus and agave, which appears to be a device for the storage of water; and while a few of the desert trees (ironwood, cat-claw and paloblanca) are characterized by firm woody tissue, most of the arboreal forms consist largely of water-storing tis-

sue, which may be inferred to represent phylogenetic adjustment to an arid environment. Commonly these water-filled trees, with certain lesser shrubs abounding in viscid juices and gum, are acrid, astringent or ill-flavored, and some are alleged to be poisonous; others are pungent or noisome in odor (*e. g.* the yellow torote has a penetrating cedar-like odor which is highly offensive to many animals). Associated with these sappy and juicy plants there is a variety of spicy shrubs which in the settled districts are used as condiments and even as substitutes for salt in curing meat. Many of these plants are used medicinally; after describing in detail the virtues of thirty-six medicinal plants, the anonymous author of the 'Rudo Ensayo' (Sonora's classic, written in 1763), adds, "Among the great variety of plants found at every step there is hardly one that has not healing qualities;"\* and there is reason to anticipate substantial additions to the pharmacopœa as the flora is studied systematically. Now it is noteworthy that the high-flavored and strong-odored plants are without thorns or other mechanical protective appurtenances; and, in view of all the relations, it seems almost necessary to infer that the flavors and odors are protective and the product of phylogenetic development under the local conditions. If this be so, it would appear that the mechanical and chemical devices for individual protection are related reciprocally; and this corollary finds direct support in the characteristics of the cacti, for the juice of the scant-thorned cina is offensive to herbivores, while the well-thorned cholla and nopal are eaten by stock when the thorns are burned off by the vaqueros, and the bisnaga, thorniest of known plants, yields a nearly pure water which has saved the lives of scores of explorers (indeed the work of the last expedition was greatly facilitated by the supplies

\* Op. cit., page 362.

\* Am. Cath. Hist. Soc., of Philadelphia, Vol. V., 1894, p. 164.



drawn from this natural well of the desert).

Other relations among the plants and between the flora and fauna were noted, but in a summary statement it must suffice to indicate only a few leading lines of observation.

#### DEMOLOGY.\*

In the course of the earlier expedition it was found that if the plants, animals and men of the desert be compared with respect to individual or physiologic (*i. e.*, purely biotic) characters "the stationary plants have suffered greatest modification, the environment-driven animals less, and the environment-molding humans least of all;" but that "when they are compared with respect to collective or demotic modification, it becomes manifest that the moveless plants are least, the moving animals more, and prevising men most profoundly modified."† It was found also that the collective modification tends through coöperation to the development of a solidarity in which the several organisms unconsciously or semi-consciously combine against the rigorous environment. Finally it was found that there are three stages in the coöperation of plants, animals and men, viz.: communal, in which the organisms stand together for mutual protection yet retain undiminished individuality; commensality, in which unlike organisms unite to the end that one or both species may be perpetuated; and agriculture, or the state in which intelligent organisms (especially ants and men) regulate the course of common development by exclusion of the perverse. Thus the earlier researches indicated not only that there is a reciprocal relation between biotic and demotic characters, but that, in a rigorous environment, the latter charac-

ters are found among nongregarious animals and plants as well as among men and gregarious animals. The researches also supplemented historical records proving that agriculture began in desert regions by showing the manner in which intelligent organisms are unavoidably forced into this highest grade of coöperation by desert conditions.

During the later expedition the researches concerning collective or demotic relations were continued. The observations among the Papago Indians were extended not simply to the relations between the human group and the sub-human assemblage, but also to the relations among the individuals and sub-groups of the human assemblage. The details noted are many and of a diverse character, and it must suffice at present to indicate their sum. In general, it was found that the continual struggle for existence under adverse conditions has tended to strengthen character among the human units, and to render each individual strong, self-reliant, resourceful, decisive, just as the plants and sub-human animals have been rendered long-lived and vigorous; but that this tendency toward the development of individuality is accompanied by an altruistic tendency under which the human units are brought into sympathy and union of exceptional closeness. In nomadic desert life individuals and small groups are constantly exposed to the risk of death by thirst, and occasion frequently arises for other individuals or sub-groups of the same assemblage or tribe to relieve the sufferers, and if this is done the assemblage is strengthened, while if it is not done the assemblage is weakened. So also isolated individuals are in danger of starvation, of attack by predatory animals, of poisoning by animals and plants, or of death in other ways, in a larger ratio than when several are in company; yet the character of the country is such that hunters, warriors and

\*This term is used as a synonym of sociology in its widest sense, but with still wider meaning. It may be defined as the science of organizations, whether spontaneous or purposive, among organisms.

†'The Beginning of Agriculture,' *op. cit.*, p. 374.

other travelers must journey far and in limited groups, and hence there is an incentive toward grouping by physical parity which is more or less independent of kinship or biotic affinity. Other tendencies also enter; but individually and conjointly they make for altruism, and eventually for a humanity and charity transcending family ties and gentile bonds. Now the characteristics of the Papago, as recorded by different observers during the last 350 years, comprise dignity and courage, docility and virtue, humanity and intelligence, hospitality and integrity; and these characteristics, which are akin to those of civilization, are among those toward which his hard environment tends. Thus it would appear that these people of the desert have been forced by environment toward civilization; and it would appear also that, just as the plants and animals have been hurried into the higher stages of phylogenic development by physical pressure, the Papago have been forced into civilized relations before acquiring civilized culture. The course of human development may be divided into two great stages characterized by distinctive modes of expression. The first is the prescriptorial stage in which ideas are thrown into crude and incongruous classes for mnemonic purposes; the second is the scriptorial stage in which ideas are expressed by arbitrary symbols, graphic and phonetic; and these stages are none the less veritable because the transition from one to the other has taken place gradually among many peoples; this transition being perhaps the most sweeping and important in the whole course of development of mankind. During the earlier stage, in which incongruous things are connoted, there has been among many peoples, notably the various American families, a custom of connoting kinship with tribal law; indeed tribal law is memorized and perpetuated largely through terms of relative position of individuals in the

family, in the clan or gens, and in the tribe; so that among these peoples tribal law tended toward the perpetuation of kinship systems, and remembered kinship crystallized and perpetuated tribal law. Thus the basis of prescriptorial society ever smacked of nepotism and made for egoism rather than altruism. But in Papagueria, where the conditions led to the development of an altruism transcending filial, paternal and fraternal feeling, the consanguineous system seems to have weakened and the system of law bound up therewith seems to have dropped into desuetude, and the people seem to have risen to the moral plane of civilization without making the usually parallel transition from the prescriptorial to the scriptorial stage in the art of expression. It is impracticable now to develop this line of research in detail; it must suffice to note in passing that the observations and inferences indicate that civilization, no less than agriculture, must be reckoned among the products of the desert.

Although in many respects antithetic to the Papago, the Seri Indians are interrelated with their environment in various ways. Seriland proper comprises a large island (Tiburón, about 500 square miles in area) and several islets in the Gulf of California, with a several times larger area on the adjacent mainland; the entire tract is mountainous and exceedingly arid, only one feeble streamlet and a few small springs or tinajas existing within it; and it is clearly set off from contiguous habitable territory by a broad desert zone. From time to time the Seri steal across their bounding desert in predatory forays or for petty trade, and during the early history of western Mexico they established nominally permanent settlements so much as 75 miles beyond their natural boundary; but it has been their custom, always in case of defeat and commonly in the event of ordinarily

manful opposition to their predation, to retreat to their stronghold, which they have stoutly defended against invasion. There they subsist on abundant and easily obtained sea food, on the game of the sub-desert mountain slopes, and in season on the fruits of cacti and other plants of the foot-hills; and since these sources of subsistence unfailing and easily reached through means shared with feral animals, the Seri tribesmen have ever been notably independent of other peoples and cultures, and this territorial dominion has remained an ethnic unit since the time of Coronado.

The Seri Indians display several more or less distinctive characteristics, both biotic or individual, and demotic or collective. Individually they are of superb physique, able to run down fleet game and capture half-wild Mexican horses without ropes or projectiles; able to run across the sand dunes and playas of their bounding desert, waterless and foodless, so rapidly as to escape pursuing horsemen; able to abstain from food and water for days; able habitually to pass barefoot through cactus thickets and over jagged rock slopes without thought of discomfort; able to gorge carrion and swill the reeking filth of shrunk tinajas without injury; typically they are trained athletes, strengthened against exercise, habituated against abstinence, hardened against pain, and inured against poison, all at the same time and all in remarkable degree. Considered as a demotic unit, the Seri are characterized by hereditary enmity toward alien peoples; for three and a half centuries they have been at war or on the verge of war with Spanish explorers and missionaries, with neighboring tribes, with Mexican pioneers, with American prospectors; they profess a passion for alien blood, always gratified save when they are deterred by fear; they are fiercely endogamous and the blackest crime in their calendar to-day is the infraction of this law; they

speak a distinct language, apparently representing a distinct stock; so far as can be ascertained, their mythology is distinct; save for a few simple arts that seem to have been acquired through imitation, their culture is primitive, protolithic as to stone, nascent only as to customary and house-building, unborn as to agriculture, and well advanced only in connection with their reed balsas and the cords of vegetal fibre or human hair used in making them; their grade of coöperation or order of solidarity is below that of the farmer ant, below that of the yucca moth, not even on a par with that of the seed-scattering bird that has aided in giving character to a flora, for (except that they have domesticated dogs) they merely destroy and never propagate or otherwise aid associated organisms; collectively they are bitterly inimical to men, animals and plants, and are parasitic on a peculiarly conditioned tract to which they have adjusted physique and tribal custom. Considered as a group composed of inter-related individuals and subgroups, the characteristics of the Seri Indians include strong family ties, manifested especially in maternal affection and in their little-understood kinship system; firm conjugal bonds (despite modern polygyny due to repeated decimation of the warriors), displayed in their endogamy and in a singular marriage custom; fixed tribal union (despite internal dissension in the intervals of external conflict), revealed in community of property and interests especially in relation to alien peoples; and rigid adherence to custom, as exemplified in the crudeness of their arts, in their habit of locating camps and habitations far from fresh water, in their amor patriæ, and in many other ways, *i. e.*, their intertribal characteristics, like their physical attributes, are strongly individualized and tend toward tribal integrity, independence and isolation. History and archæology indicate that the characteristics of the Seri

have persisted long; for three and a half centuries they have been known as fierce and powerful warriors, tumultuous in battle and swift in retreat; reputed as users of poisoned arrows and perpetrators of repulsive atrocities in their endless and relentless warfare; regarded as Ishmaelites harboring in the fastnesses of a desert island (for the insular and continental portions of Seriland have never been clearly discriminated by neighboring peoples), whose bestiality placed them all but beyond the pale of human kind. There are indeed records of attempted conversion and subjugation among the rancherias overflowed from Seriland proper, but the assemblage of records is either contradictory or indicates that the converted and subjugated tribesmen weakened and died under the yoke of a higher culture; an apostate Seri resides in Hermosillo, another in Altar, and a third is said to live in California, but no other trace of Seri flesh or blood was found outside of Seriland. The testimony of ancient works is accordant with that of the writings; outside of Seriland there are prehistoric ruins indicating a succession of more or less distinct populations extending over many centuries; in Seriland there are no works save such as the Seri now produce, though some of these are impressively ancient.

While several of the characteristics of the Seri Indians are unusual and some (*e. g.*, their fleetness and endurance, their unique marriage custom, etc.) so singular as to challenge belief, the assemblage of characters is remarkably consistent and harmonious. The physical perfection of the warriors and their vigorous wives and fleet-footed children is in harmony with their mode of life and militant habit, as with all other characters; indeed they would be unable to survive, to capture strong swift and alert game, to traverse the long waterless stretches in their domain, to cross their bounding desert, without exceptional physique, which

may thus be ascribed to survival of the fittest during the generations of development and adjustment to a peculiar environment. Their hereditary blood-thirst is consistent with their enmity toward animal and plant, with their primitive art, with their endogamy, with their linguistic independence, and with their physical characteristics; indeed warfare against other peoples is but an expression of disposition and habit manifested in many other ways. Their rigid endogamy and rigorous marriage custom are consistent with each other, with the long isolation of the tribe attested by history and archaeology, with their linguistic distinctness, with their continuous warfare, with their abstemious habits, and with all their other characteristics; indeed their marriage custom would be inexplicable and incredible except in conjunction with their endogamy, while their conjugal relations taken collectively would appear incongruous among a more advanced people. Thus the leading characteristics of the tribe are mutually consistent and interrelated in such manner as to form a definite assemblage, of which no one could be modified without affecting the integrity of the whole. So, too, when the characteristics are considered in sequence or phylogenically, it would appear that each stimulates and combines with all the others in such manner as to render the development cumulative; and also that each feature and the assemblage of features are such as might normally result from the survival of the fittest in a peculiar environment. Finally it would appear that all of the characteristics of the Seri Indians, biotic and demotic alike, are adjusted directly or indirectly to an arid, mountainous land, bordered with a fruitful coast, and protected by a strong natural boundary, *i. e.*, to the actual Seriland, and that they could hardly have been developed under a different environment.

On contrasting the Papago and Seri In-

dians, it is found that many of their characteristics and their respective courses of development are widely diverse. The former are habitually at peace; the latter habitually at war. The former coöperate with men, animals and plants; the latter antagonize men, slay animals and destroy or neglect plants. The former developed the highest attributes of humanity to the extent that they met the Spaniards as peers; the latter remained robbers and assassins. The former produced arts, rose into agriculture, and at one time made conquest of the waters; the latter are perhaps the most primitive of American peoples. The former tribe is populous and probably increasing in number, despite the invasion of their territory by white men; the latter has been reduced to a handful and is destined to disappear, probably within a decade, almost certainly within a generation, perhaps within a year or two. In a few characteristics the tribes are similar, in certain respects their courses of development have been parallel; but the differences are more striking than the resemblances. Both peoples have been subjected to hard conditions with unlike, but not necessarily incongruous results; as among fishes the darkness of the deep sea may lead either to development or elimination of the eyes, so among men stress of circumstance may lead either to the growth or to the decay of humanity.

In considering the relations between tribes and their environment it is desirable to avoid a common and natural misconception to which attention has been directed by Powell. There is indeed a direct relation between the physical characteristics of the individuals composing the tribe and their environment, in virtue of which the hard environment tends, through survival of the fittest, to produce excellence of physique among men as among the lower animals; but among mankind this direct re-

lation is overshadowed by an indirect relation passing through the institutions, arts, etc., of the human animal. The importance of this indirect relation is indicated by the generalization that the moveless plants are most, the moving animals less, and demotic mankind least affected by environment so far as purely physical or biotic characteristics are concerned; while the converse is true of the demotic characteristics. The same law is well illustrated by the Papago and Seri tribes. The Papago Indians were enabled to survive desert conditions by organization and by an assemblage of arts growing into agriculture; while the Seri, albeit of fine physique, have been enabled to survive only by tribal union, endogamy, a consistent system of warfare, and an assemblage of arts all adjusted to their habitat even more closely than the striking Seri physique is adjusted to desert-bound Seriland.

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*NOTE ON THE PERMANENCE OF THE RUTHERFURD PHOTOGRAPHIC MEASURES.*

ONE of the most interesting questions confronting practical astronomers at the present day is the question of how long the photographs which are now being accumulated in such great numbers will remain fit for measurement. To throw some light on this matter, I have caused some of Rutherford's Pleiades plates to be remeasured with the new Repsold measuring machine of the Columbia College Observatory. The present note is published in advance of the detailed account of the observations and their reduction, as the matter seems to be of immediate interest to astronomers. The measures have been carried out with great care by Mrs. Herman S. Davis and Mrs. Annie Maclear Jacoby. As measures of these same plates were made under Mr. Rutherford's direction by Miss Ida C. Mar-