and an anthropological work on the Eskimo, both of which he left unfinished. Besides this, he wrote a popular account of Eskimo life, which it is hoped will be published at an early date. When the first expeditions to the rescue of Greely were prepared, he strongly advocated that a well-equipped expedition be sent out at once. During this period he wrote his valuable contributions to the history of the American polar expeditions. He died while on a visit to his friends in Germany. His amiability will be remembered by all his friends. His valuable contributions to science will make scientists regret that he was not allowed to complete the numerous works he had begun, which would have secured to him one of the most prominent places among modern scientists.

THE COURSE OF HUMAN PROGRESS.[1]

THE course of human events is not an eternal round. In the wisdom of the ancients there are many proverbs to the effect that that which is, has been before and will be again. So far as human experience extends, unaided by reason, days and nights come and go, winter follows summer, and summer follows winter, and all the phenomena of nature seem to constitute an endless succession of recurrent events. But there is a higher knowledge which observes a progress by steps so minute that it was left to modern science to discover it. In the history of humanity the changes which result in progress are more readily perceived; and the aphorism of the ancients, that "there is nothing new under the sun," is but a proverb of ignorance.

Every child is born destitute of things possessed in manhood which distinguish him from the lower animals. Of all industries he is artless, of all institutions he is lawless, of all languages he is speechless, of all philosophies he is opinionless, of all reasoning he is thoughtless; but arts, institutions, languages, opinions, and mentations he acquires as the years go by. In all of these respects the new-born babe is hardly the peer of the new-born beast; but, as the years pass, ever and ever he exhibits his superiority in all of the great classes of activities, until the distance by which he is separated from infancy is so great that he seems to live in another realm. These activities that separate the man from the babe are the humanities. In like manner the human race has been segregated from the tribes of beasts by the gradual acquisition of these humanities, by the invention of arts, the establishment of institutions, the growth of languages, the formation of opinions, and the evolution of reason.

The road by which man has travelled away from purely animal life is very long; but this long way has its landmarks, so that it can be divided into parts. There are stages of human culture, and they have been denominated savagery, barbarism, and civilization.

All the grand classes of human activity are inter-related in such manner that one presupposes another, and no one can exist without all of the others. Arts are impossible without institutions, languages, opinions, and reasoning; and in like manner every one is developed by aid of the others. If, then, all of the grand classes of human activities are interdependent, any great change in one must effect corresponding change in the others. The five classes of activities must progress together. Art-stages must have corresponding institutional, linguistic, philosophic, and psychic stages.

Stages of progress common to all the five grand classes of human activities may properly be denominated culture-stages, and such culture-stages should be defined by characterizing all these activities in each stage. This I shall attempt to do, but in a brief way. [The lecturer then described savagery with regard to its arts, institutions, language, philosophy, and mind, and summed up his description in the following way.]

The savage has invented rude arts by which he obtains food, clothing, and shelter. He has invented a rude system of kinship society, with descent in the female line. He has spoken language, gesture-speech, and picture-writing, but is without hieroglyphic, syllabic, or alphabetic writing. He has a philosophy which informs conspicuous and important inanimate objects with spirit-life, and which deifies the brute; and a mind whose perceptions are so slightly developed that conventional characters do not convey ideas, and his arithmetic is yet counting. Such, in general, are the characteristics of all savage people that have been carefully studied by anthropologists.

How was this savagery transformed into barbarism, and what is that barbarism? [The lecturer began his answer to these questions by considering the change in arts.] There are two arts, intimately associated, the invention of which causes a radical change in all the departments of humanity; viz., agriculture and the domestication of animals. Agriculture began in savagery. Many savage tribes cultivate little patches of ground, and thereby provide themselves with a part of their subsistence. This petty agriculture does not of itself result in any radical change; but when the art has developed to such an extent that the people obtain their chief subsistence therefrom, and especially when it is connected to the domestication of animals, so that these are reared for food and used as beasts of burden, the change for which we seek is wrought. It seems that extensive agriculture was first practised in arid lands by means of artificial irrigation. In more humid lands the supply is more abundant and the incentive to agriculture is less. On the other hand, agriculture is more difficult in humid lands than in arid lands. The savage is provided with rude tools, and with them he can more easily train water upon desert soils than he can repress the growth of valueless plants as they compete for life with those which furnish food. The desert soil has no sod to be destroyed, no *chaparral* to be eradicated, no trees to be cut down with their great stumps to be extracted from the earth. The soil is ready for the seed. Throw upon that soil a handful of seed, and then sprinkle it with a few calabashes of water once or twice through the season, and the crop is raised; or train upon a larger garden-patch the water of a stream, and let it flood the surface once or twice a year, and a harvest may be reaped.

Petty agriculture, such as I have described as belonging properly to savagery, has been widely practised in the four quarters of the globe among savage people, quite as much in humid as in arid regions; but the art seems not to have indigenously extended beyond that stage in any but arid regions. The earliest real agriculture known to man was in the valley of the Nile, an almost rainless land, but the floods of the Nile were used to fertilize the soil; again, in the land of Babylon, along the Tigris and the Euphrates, extensive agriculture grew up, but it was dependent upon artificial irrigation; still farther to the south-east, in the Punjab, another system of indigenous agriculture was developed by utilizing the waters of the five great rivers; still farther to the east an indigenous agriculture was developed on an extensive scale, all dependent upon artificial irrigation, as the Chinese use the waters of the Hoang-ho and the Yang-tse-kiang; in South America the first system of agriculture was developed in Peru, all dependent upon artificial irrigation; and, finally, to the north of the Isthmus of Panama, in Central America and Mexico, agricultural art was highly developed, and here also they were dependent upon artificial irrigation. From these six examples of high agricultural art, all the agriculture of the world has been developed; from these centres it has spread. The petty agriculture of humid lands never went beyond the utilization of little patches of ground in the forest glades, until it was borrowed in a higher state from arid lands. Everywhere with the development of agriculture in the arid lands the art of domesticating animals was associated, and everywhere such animals were raised for food, and to a large extent they were used as beasts of burden.

[The lecturer, in continuation, showed how changes in the arts wrought changes in institutions, changes in language, changes in philosophy, and psychic changes during the transition period from savagery to barbarism, and summed up this portion of his discourse as follows.]

From the foregoing brief characterization it will be seen that barbaric culture implies a somewhat high state of agriculture and the domestication of animals, one or both; it implies that patriarchal institutions have been organized, that descent is in the male line, that ranks in society have been established, and that new laws regulating property have been enacted; it implies that the people use hieroglyphs; it implies that domestic worship is ancestral worship, that tribal worship is based on physitheism, and that the phenomena of the universe are attributed to nature-gods; and, finally,

[1] Lecture delivered May 5, by Major J. W. Powell, in the course of free lectures under the auspices of the Philosophical, Biological, and Anthropological Societies of Washington.

it implies that men can perceive meanings in conventional signs, and that arithmetic has been invented.

[The change from barbarism into civilization was next described.] In barbarism there are tools, but no machinery; metallurgical processes are yet undiscovered; the use and reduction of iron are unknown. The employment of the latter led to an important advance in naval architecture; to the accumulation of wealth in the products of the soil, in woven fabrics, in iron and copper and silver and gold; and these together to the establishment of a system of exchanges through fleets and caravans; and thus commerce was developed.

In barbarism the people lived largely in towns, each town being an independent body politic. But when commerce was developed, towns grew into cities, and with increasing wealth there was increasing temptation to predatory forays; and at the same time the discovery of bronze and copper had given the barbaric warriors superior arms. Then it became necessary to defend the cities with their wealth and teeming population, and they were walled. At this stage the people have learned to burn brick and to cut stone, and a vast improvement in architecture is the result. They have also become skilful in the manufacture and decoration of pottery; there are forges in the cities, and glass-manufactories flourish. Water-mills are set up, great irrigating ditches are built, and mines are opened.

It is not proposed to set forth the great industrial achievements of modern civilization by which the powers of nature have been discovered and utilized by mankind: it is simply intended to explain the first form of civilization, that it may be distinguished from anterior barbarism.

[Major Powell next treated of the change in institutions which marked the transition from barbarism to civilization.]

In setting forth the evolution of barbarism into civilization it becomes necessary to confine the exposition to eastern Europe, western Asia, and northern Africa, and to a large extent to one great stock of people, — the Aryan race, — together with those other stocks — as the Egyptian, the Semitic, and the Turanian races — whose history is involved in that of the Aryan, and with whom they were inextricably mixed, and whose ultimate destiny was controlled by the progress of Aryan culture. On the other hand, some Aryan people are not included, from the fact that they severed themselves from the body of the people and entered upon an independent history. The centre of this world was the Mediterranean Sea; and from its shores, far away in every direction, the peoples were scattered whose history was involved in one vast interdependent system, for the culture of every one re-acted upon the culture of every other one. Throughout all the region above indicated, tribal towns and nomadic villages existed. Gradually the most prosperous towns became centres of power and population. Less powerful tribes became subject to and dependent upon more powerful tribes, and gradually many tribal towns became city States, and these city States were transitional bodies politic between barbarism and civilization.

[The organization of a city State was then described, and the origin of ranks shown. The organization of city States into nations was then traced out, the nations being essentially tax-gathering bodies, with no attempt to re-organize the society of such nations so as to secure general homogeneity and interdependence of parts, and that unification which gives solidarity. This came later. The evolution of kingship, the contest between the throne and the Council or Parliament, the origin of courts, the development of civilized law, and the establishment of the authority of the superior in rank, were next explained. Thus it was shown that the institutional change from barbarism to civilization was a change first in the constitution of the State itself, a change in the form of government, a change in the principles of law. In like manner the change in language, the change in opinion, and the change in mentations was traced. Under the last head Major Powell spoke as follows.]

The most important acquisition to intellectual activity gained by man is the power of inductive reasoning beyond the penetration of the senses, and beyond sensuous conceptions, and into a realm in which conclusions are reached which are apparently contradicted by the senses and by experience.

[The following are the closing paragraphs of the lecture.]

I have thus endeavored to indicate the course of culture and characterize its three great stages by following a few lines of its evolution, and I will recapitulate in part, and add other particulars: but that the statement may be laconic, all qualifications and provisos must be neglected.

The age of savagery is the age of stone; the age of barbarism, the age of clay; the age of civilization, the age of iron. The savage propels his canoe with a paddle; the barbarian propels his boat with oars; the civilized man navigates the sea with ships propelled by sails. In savagery, music is only rhythm; in barbarism it is rhythm and melody; in civilization it is rhythm, melody, and harmony. The age of savagery is the age of kinship clan, when maternal kinship is held most sacred; the age of barbarism is the age of kinship tribes, when paternal kinship is held most sacred; the age of civilization is the age of nations, when territorial boundaries are held most sacred. In savagery, law is designed to secure peace; in barbarism, to secure peace and authority; in civilization, to secure peace, authority, and justice. In savagery, law extends only to kindred; in barbarism, to kindred and retainers; in civilization, to all people of the nation. The age of savagery is the age of sentence-words; the age of barbarism, the age of phrase-words; the age of civilization, the age of idea-words. In savagery, picture-writings are used; in barbarism, hieroglyphics; in civilization, alphabets. In savagery there is no verb 'to be;' in barbarism there is no verb 'to read;' in civilization, verbs are resolved into parts of speech. In savagery, beast-polytheism prevails; in barbarism, nature-polytheism; in civilization, monotheism. In savagery a wolf is an oracular god; in barbarism it is a howling beast; in civilization it is a connecting link in systematic zoölogy. In savagery the powers of nature are feared as evil demons; in barbarism the powers of nature are worshipped as gods; in civilization the powers of nature are apprenticed servants. In savagery, men can only count; in barbarism they have arithmetic; in civilization they understand geometry. In savagery, vision is limited by opinion; in barbarism, vision is limited by horizon; in civilization, vision is limited by the powers of the telescope and microscope. In savagery, reason is based on zoömorphic analogies; in barbarism, on anthropomorphic analogies; in civilization, on intrinsic homologies. The great intellectual achievement of savagery was the discovery of the difference between the animate and the inanimate, between the organic and inorganic, between the living world and the dead world, but, the discovery having been made, the animals were deified and believed to be the authors and movers of the world of phenomena; the greatest intellectual achievement of barbarism was the discovery of the limited powers of animals, but, the discovery having been made, the powers and wonders of nature were deified and given the forms of man; the greatest intellectual achievement of civilization was the discovery of the physical explanation of the powers and wonders of the universe, and the intellectual superiority of man, by which he becomes the master of those powers, and the worker of wonders. In savagery the beasts are gods; in barbarism the gods are men; in civilization, men are as gods, knowing good from evil.

The story of human culture is a story of transformations: arts have transformed, institutions have transformed, language has been transformed, opinions have been transformed, and reason has been transformed. There are many strange transfigurations in nature. It is a wonder that the blows of the hammer are transmuted into heat; it is a wonder that the motions of the ether can be transmuted into the rainbow; it is a wonder that the egg can be transmuted into the eagle; it is a wonder that the babe can be transmuted into the sage; it is a wonder that an objective blow may be transmuted into subjective pain; it is a wonder that the printed page may be transmuted into visions of the beautiful: but the wonder of wonders is the transfiguration of selfishness into love. Amatory passion transfigured appears as love; parental care, as parental love; infantile dependence, as filial love; fraternal sympathy, as fraternal love. Thus love of kindred was born; and the love of kindred, by the expansion of the kinship body into the tribe and nation, grew to love of country and love of mankind. The last transfiguration in the process of evolution appears as the ethics of mankind.

Man, so far as he is superior to the beast, is the master of his own destiny, and not the creature of the environment. He adapts

the natural environment to his wants, and thus creates an environment for himself. Thus it is that we do not discover an aquatic variety of man; yet he dwells upon the sea, and derives sustentation from the animals thereof by means of his arts. An arboreal variety of man is not discovered, but the forests are used in his arts, and the fruits of the forests for his sustentation. An aerial variety of man is not discovered, but he uses the winds to propel his machinery and to drive his sails; and, indeed, he can ride upon the air with wings of his own invention. A boreal variety of man is not discovered, but he can dwell among the everlasting snows by providing architectural shelter, artificial warmth, and bodily protection.

Under the influences of the desert, a few plants secure a constitution by which the moisture imbibed during brief and intermittent rains is not evaporated: they become incrusted with a non-porous glaze, or contract themselves into the smallest space, and exist without life, until the rain comes again. Man lives in the desert by guiding a river thereon and fertilizing the sands with its waters, and the desert is covered with fields and gardens and homes. Everywhere he rises superior to physical nature. The angry sea may not lash him with its waves; for on the billows he builds a palace, and journeys from land to land. When the storm rises, it is signalled from afar, and he gathers his loved ones under the shelter of his home, and they listen to the melody of the rain on the roof. When the winds of winter blow, he kindles fossil sunshine on his hearth and sings the song of the Ingleside. When night covers the earth with darkness, he illumines his path with lightning light. For disease he discovers antidote; for pain, nepenthe; and he gains health and long life by sanitation; and ever is he utilizing the materials of nature, and ever controlling its powers. By his arts, institutions, languages, and philosophies he has organized a new kingdom of matter over which he rules. The beasts of the field, the birds of the air, the denizens of the waters, the winds, the waves, the rivers, the seas, the mountains, the valleys, are his subjects. The powers of nature are his servants, and the granite earth his throne.

INFLUENCE OF FORESTS UPON THE CLIMATE OF AUSTRALIA.

IN connection with the discussion that is going on at the present time in reference to the influence of forests upon rainfall in the western parts of the United States, the following remarks of Dr. R. von Lendenfeld on the influence of deforestation upon the climate of Australia, which were published in the February number of *Petermann's Mitteilungen*, will be of interest. The influence of the forest upon the climate in the damp regions of the temperate zone, for instance in central Europe, is undoubtedly such as to increase the humidity of a place. The roots of the trees, forming a network, retain the earth on steep slopes, and thus prevent the water from running off rapidly. On slopes without forest or vegetation the water rushes downward: it is collected in streamlets and rivers, and carried into the ocean before much, if any, evaporation has taken place.

Evidently a great part of the rain falling in a wooded country is evaporated before it can flow off, as the roots of the trees retard its collection in brooks and rivers. Lendenfeld has made some preliminary computations which lead him to the conclusion that about twenty-five per cent of the rain falling in wooded regions of the temperate zone, such as central Europe, are due to the influence of the forest. A country grown with grass and herbs would also have more rain than one in which the bare rocks were exposed to the air.

In Australia the influence of the forest is entirely different from what it is in Europe. The views of those Australians who are principally interested in this matter are divided. The general opinion is that the climate is becoming dryer in consequence of deforestation. Others, however, maintain that the cutting-down of the woods has no influence whatever upon the climate, and that, if such an influence should exist, it is so small as to be of no account, compared to the advantages connected with the deforestation. The latter view is principally held by squatters and ranchmen, who, of course, have an immediate interest in the opening of forest-land for agricultural and stock-raising purposes, and who cannot be expected to be unbiassed.

Australia is a very dry country, its northern portion alone being exposed to tropical rains. Besides this, only the south-eastern part is mountainous, which has elevations exceeding six thousand feet in height. These elevations — the Australian Alps — materially increase the amount of rain, and thus cause the great productivity of the colonies of New South Wales and Victoria.

Setting aside the Alps and the east coast, the whole of Australia is very dry. The interior is almost rainless; and even near the coast, in the greater part of New South Wales and Victoria, the amount of rain is very small, and does not reach the height of eight inches, while the evaporation amounts to ten feet. In the interior, rain is very rare, occurring only once in a period of about three years. In countries where long-continued droughts prevail, such plants as grow in humid regions cannot live. All plants of the desert, and among them the trees, shrubs, and grasses of the steppes of Australia, have certain means for increasing the water-supply from the deeper layers of the soil (i.e., roots extending to great depths), and others for diminishing evaporation. The *stomata* of many *Eucalypti* are removed from the surface of the leaf, and those of the *Spinifex* of the deserts are protected by a peculiar arrangement. Leitgeb, who has studied the movability of the cells of the *stomata*, found that they close the aperture the more, the less the water at the disposal of the plant.

Besides these well-known facts, Lendenfeld observed that the *stomata* of the leaves of *Eucalyptus* are perfectly closed whenever a hot and dry wind is blowing, so that in such cases no evaporation to speak of takes place. Therefore the same wind which is so dangerous to grasses and herbs has almost no influence whatever upon the *Eucalyptus* trees. Furthermore, Lendenfeld concludes that probably most plants of the desert have their *stomata* closed during the day-time, while they are open during the night. It is only then that carbonic acid enters the plant, and is dissolved in the sap. In the morning they close the *stomata*, and assimilation begins under the influence of the light. The carbonic acid dissolved during the night is decomposed, and the oxygen escapes through the epidermis.

It has been shown by Volkens, that during the latter part of the night the atmosphere, even of the desert, is to a greater or less degree saturated with vapor: therefore the plants do not lose much water by opening their *stomata* at night.

Almost all trees and shrubs of the interior of Australia produce ethereal oils in great quantities. In evaporating, it lessens the temperature of the leaves, and forms a layer of vapor all over the forest. According to Tyndall, air saturated with ether is less permeable for radiant heat than ordinary atmospheric air: thus the tree protects itself by means of a cover of ether from excessive heat and evaporation. As the leaves of the *Eucalyptus* trees turn their edges towards the sun, the effect of insolation is very slight. Thus it is shown that the trees and shrubs of the arid parts of Australia are well equipped to resist the dryness of the climate.

But, besides these plants, numerous small grasses and herbs occur, which Lendenfeld, following Volkens's example, calls ephemeric. They are not at all protected against evaporation. Their roots do not penetrate the soil to any great depth, and their *stomata* are open in the day-time. As their seeds are spread all over the ground in great quantities, they grow up rapidly after every rainfall, and cover the bare ground with a fresh green. They are the principal food of the sheep.

As long as water remains in the upper layers of the soil, the ephemeric plants grow. As soon, however, as the stock of water is used up, they die, as their roots do not extend deep enough. The roots of the trees spread from ten to fifteen feet below the surface of the ground, and absorb all the humidity of these layers which otherwise would gradually reach the surface in consequence of capillary attraction. Thus they prevent the stock of deep water from supplying the needs of the grasses.

In all temperate and humid countries the struggle of the plants is for light. In the interior of Australia, and in other similar subtropical regions, they struggle for water. Thus the ephemeric plants are here killed by the trees, and in wooded countries they do not occur at all.