

thought-provoking qualities; enigmatic, because no one has yet been able to say just what Maxwell's views were. The pursuit of his treatise is like a journey through a dreamland, wherein the travelers seem never to reach their destinations. But the leading idea is plain. It is that the medium is the important factor, and on the medium the attention must be riveted if we would seek a satisfactory explanation of electricity and magnetism.

Faraday died twenty years before, and Maxwell nine years before, anything like crucial experiments decided in favor of their theory. The old theories of action at a distance, without the aid of an intervening medium, but with their fluids and positive and negative subtilties, died hard, if indeed they can be said to be quite dead yet. The recent investigations of Hertz and others, however, seem to render it practically certain that the Faraday-Maxwell conception is the correct one; and that the medium in question can be no other than the medium of light and heat.

Thus the multifarious phenomena of the four sciences of heat, light, electricity, and magnetism appear destined to become unified as the mechanical properties of a universal plenum. The present concentration of activity along this line of inquiry seems fraught with results of the greatest interest. We seem to be, in fact, on the eve of discoveries no less brilliant and important than those whose record has already adorned the history of mechanics. Nevertheless, it may not be our good fortune to witness such advances. The ether may prove intractable for a century or more. It is conceivable, at any rate, that the full comprehension of this medium lies beyond the present range even of that extra sense which the late Charles Darwin attributed to mathematicians. It may be essential, in fact, to first give attention to visible and tangible substances, like shoemaker's wax, before the mind will be

prepared to visualize the hidden reality.

But however this may be, mechanical science will remain worthy of the arduous labors of its devotees. The phenomena of matter and motion, though subject to few and simple laws, are infinitely varied and infinitely instructive. The knowledge of those phenomena already acquired gives assurance, as Helmholtz said in these halls a year ago, that we possess the *right method* of investigation. We may therefore expect that a diligent application of this method will yield in the future a not less inspiring body of truth than that which has come down to us from Archimedes and his successors.

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THE FIVE BOOKS OF HISTORY.

IN the study of the phenomena of history scientific men resort to five great classes of records. The science of geology seeks to discover the history of the earth—of the rocks of which it is composed and of the plants and animals which have lived from time to time. In this research the geologist discovers that nature's last chapter contains a story of mankind, for it is found that the bones of man and some of the works of his arts have been buried by natural agencies in the geologic formations. Sometimes these materials of history are buried in cave drift and in deposits derived from mineral waters which drop from the ceilings or ooze from the crevices of the caves. In flowing away and evaporating, such waters leave behind certain mineral constituents, especially carbonate of lime, which, consolidating and crystallizing, accumulate over the floors and walls of the caves and form pavements of calcite and aragonite. From the waters dropping down from the ceilings stalactites are formed above and stalagmites below, in marble columns of great natural beauty. Under and within such formations the bones of men and vestiges of their arts

are sometimes discovered associated with the bones of animals, some of which are found to be of extinct species; but the relics of man are found in other formations. Altogether, the finds are not many. The geologic record of man we may call the Stone Book. It records but a meager tale; the rock-leaved bible of geology has but a postscript devoted to mankind, but in it are facts which prove to be of profound interest.

Man was scattered widely over all the habitable earth in the early period of his development. The 'Garden of Eden' was walled with ice, so that man was not dispersed to the poles, for the outer or polar lands were uninhabitable. Within these walls men were scattered far and wide, on the coasts of every sea, on the shores of every lake, and on the banks of every stream, for everywhere between the frigid zones the vestiges of primeval man are discovered. The ruins of his habitations are thus widely spread—in palefits erected over lakes, in habitations constructed in every valley, in villages where men gathered by tribes, and in cities where they were gathered by nations. The ruins of his ancient dwelling places and the vestiges of his arts scattered over the lands are now esteemed of priceless value by the scientific historian. The ruins furnish much more material than the rocks for the ancient history of mankind. Stone implements are found in great abundance over all the earth; implements of bone, horn, shell and wood are in like manner widely dispersed. In ruins of habitations and vestiges of arts a story is told of developing activities in all of the five great departments of art, for by them we learn much of the industries, pleasures, speech as recorded in glyphs, institutions as illustrated by the paraphernalia of social organizations, and even of opinions as they are expressed in picture writings and ideographs. Let us call this the Ruin Book. It is a strange

book, studied by aid of the pickaxe and the shovel. Sometimes habitations are found in ruins piled one over another, giving evidence of the occupancy of sites for many centuries during successive culture periods extending from ruder to higher life.

In all ages birth and death have been abroad in the land. From the infant's wail at birth to the mourner's cry at death men are engaged in the five great activities. Primeval man learned to bury his dead, and as the swarming generations have come down from antiquity through fields of life whose sheaves were garnered by the sickles of death, the tombs have become the granaries of arts, to which the scientific historian resorts that he may discover the vestiges of the earlier humanities. Over all the earth these granaries are scattered in graves, mounds, catacombs, sepulchers and mausoleums, and the whole habitable earth is a necropolis. Sometimes more than bones are found in the ancient tombs, for often they contain works of art. Primeval men were organized into tribes by bonds of affinity and consanguinity. The ownership of property was mainly in the tribe and in the clans and gentes, which were organized tribal units; hence property was chiefly communal in the clan or gens and in the tribe. But some articles of property belonged to individuals, chiefly clothing and ornaments, though a few implements and utensils were owned by individual men and women. In order that controversy should not arise about the ownership of property of this character, it was a fundamental doctrine of this early life that personal property should be inherited by the grave. With the dead person, therefore, were buried the clothing, ornaments, instruments and utensils which he possessed at his death. Gradually this institution became a sacred rite, as about it were thrown the sanctions of religion; and in this more highly developed stage property belonging to the mourning

friends was sometimes added to the sacrifice. This was especially the case when personages of great importance were buried. In connection with the rite a mythologic lore sprang up in many tribes by which special virtues were attributed to the sacrifices as necessary to the happiness and prosperity of the dead on their journey to the spirit abode and for their welfare on their arrival in the land of the ghosts.

In the burial of these works of art, records of the stage of culture to which they and their contemporaries had arrived were placed with the dead. It is thus that the tombs become priceless relics of antiquity. In later times, when tribes had been organized into nations and higher arts developed, catacombs, sepulchers and mausoleums were constructed, sometimes hewn in the rock. In the sarcophagi and in the chambers of death many vestiges of culture are found, and often inscriptions are discovered, all of which are now of priceless value. It is thus that the tombs of the ancients constitute a book of history. Let us call it the Book of the Tombs.

Tribes and nations are still scattered over the whole habitable earth, and the people who dwell on the continents and islands labor in many arts, sport in many pleasures, speak in many tongues, are governed by many institutions, and entertain many and widely divergent opinions. In all of these forms of culture some peoples have passed beyond others on the five highways of life, so we are able to study peoples in various stages of culture. No people have invented a culture at one great effort, but whatever arts they practice have been gradually acquired by effort extending from primeval to present time. The humanities discovered as existing in any tribe or nation constitute an epitome of the history of welfare, which has been developed by minute increments of progress through untold generations of effort. Their arts, then, have been inherited

from generation to generation, while every generation has made its contribution to their development. The primeval arts of industry, therefore, have not been lost, but have grown to something higher.

In like manner, the pleasures in which a people primarily engaged far back in antiquity, when the habitable earth was first peopled by lowly tribes, still remain, transformed into a higher life of childish sports, athletic exercise, more beautiful decorations, more intellectual games, and more elaborate fine arts. There is thus an immortality of the arts of pleasure by inheritance from generation to generation.

Speech is produced by generations of peoples. Words are lost in the air, but the meanings of words and the knowledge of their formation remain and are taught from generation to generation, so that even evanescent oral language has perennial life.

Institutions, which are devised to regulate conduct, live on, and gradually develop as new conditions arise which demand new solutions. Old forms are inherited, but by minute increments they are transformed, as new concepts of justice are developed.

So opinions have a personal existence by inheritance and a constant change by development as knowledge increases.

I see the germ bursting from the acorn, with its stem and plumule of leaves; I see the plantlet bourgeoning from the earth; I see the scion stretching its green arms into the air; I see the old oak with its great branches in a benediction of shade. Discovering oaklets in acorns, and mighty oaks with dead branches and dying trunks and multitudes of intermediate forms in every oak grove, I learn the history of the growth of oaks without watching the germs until they become dead trees. In like manner, all of the humanities may be studied in various stages of growth by studying the forest of tribes and nations scattered over the face of the earth. A host of men are en-

gaged in scientific research for the purpose of discovering the characteristics of the five great systems of humanities as they are represented in the daily life of peoples. This is found to be a book of many books, gathered into libraries of tribes and nations. Let us call this the Folk Book.

Gradually man has developed written speech. He has learned to write his thoughts in glyphs of meaning on rocks, on bark, on the skins of animals, on tablets of stone and clay and on parchments made of many fibers. It is thus that we have tomes in written language which are gathered in libraries scattered over all the world of enlightenment.

In these books the opinions of mankind are gradually collected, and the process has been going on since the dawn of civilization. The erroneous and the correct, the true and the false, have both been recorded, so that the books contain a strange mixture of truth and error. Yet when rightly read in the spirit of modern scientific criticism, they tell interesting stories and contain valuable instruction. Scientific men do not appeal to history for the truths of science about the objective world. From the beginning of culture to the present time man has interpreted the external world sometimes truthfully, sometimes erroneously. That which is true remains, that which is error dies. Yet ever in recording error something of value has been preserved, for these errors reveal the development of mind and exhibit the methods by which the facts of nature have been interpreted from time to time.

But more; that which the writers of the books of the ages sought to teach is one thing; that which they unconsciously taught is another. In the telling of an event of history something more becomes a matter of record, for a statement may contain many facts, though the author purposely or unconsciously sought to propagate a lie. If we

read of an army sailing in a fleet of vessels to pursue a predatory war, the item of history may be true or false, but unconsciously the writer in making his statement records many facts of value about the time in which he writes. He may truthfully explain arts, habits, customs or institutions. In all of these ancient writings something of value is stored. Many of the earlier writings are in poetic form, and in these and others the ostensible subject-matter may be mythical. Everywhere we find exclamatory and emotional passages informed with the mysticism and ignorance of the age, but these myths and mystical hymns and devout prayers reveal to scientific criticism a world of meaning relating to the history of opinions. So the writings of antiquity are held to be of profound interest and importance when used in the proper manner. Science does not appeal to Aristotle as an authority on the constitution of the mind, for he supposed the brain to be a refrigerator for the blood, but it appeals to Aristotle's ideas of the constitution of the mind for the purpose of exhibiting the state of thought to which he had arrived and of illustrating the evolution of philosophy. Science does not appeal to Homer as authority on the nature of the gods and the constitution of the earth as ruled by these gods, for he thought that the winds were kept in caves and transported in sacks, but from Homer it learns how the powers of nature were personified and how these personages as gods were supposed to take part in the affairs of mankind at the time Homer wrote. Science does not appeal to the novels of Plato for the purpose of discovering the best forms of institutions, though he elaborated his opinions with literary charm in 'The Republic,' but it does appeal to Plato to discover how the best minds of his age theoretically solved the problems of government in his time. Science does not appeal to the writings of Confucius or the Buddhistic scriptures for the purpose

of discovering the true religion, but for the purpose of discovering the history of religious opinions. If we use the writings of antiquity in this spirit the records of the past are of priceless value for the lessons of history which they teach. Let us call this the Scripture Book.

Modern history resorts to the Stone Book, the Ruin Book, the Tomb Book, the Folk Book and the Scripture Book for the materials to be used in discovering and formulating the development of the industries, pleasures, languages, institutions and opinions of mankind.

The present generation has inherited all the labors of the past. The culture of the day is but a slight modification of the culture of the last generation, and that was derived from the antecedent generation; so all the generations have wrought for us, and our culture is the product of their labor and invention. Every generation has added its minute increment, and hence there has been progress. We cannot dis sever our life from that of the past. We inherit its arts and improve them a little; we inherit its pleasures and make but a slight change; we inherit its speech and improve our expression only to a slight degree; we inherit its institutions and modify the forms of justice only in small particulars, and we inherit its opinions and entertain new ideas only as we have discovered a few new facts. So we are indebted to the dead for that which we are, and are governed by the dead in all our activities. Yet the past is not a pall on the present, hiding the truth, but a search-light that may be turned on the future. The past is not a tyranny on the present, but an informing energy which evolves through us that the future may be improved. Science endeavors to guide the way by a study of the past and to conserve and direct our energies in a legitimate course of development. The past is the

chart of the future; if misread it is a false guide, if correctly read the way is clear. It is thus that the five volumes of the pilot book of life are of profound importance.

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UNITY OF NOMENCLATURE IN ZOÖLOGY AND BOTANY.

SYSTEMATIC biologists have reason to rejoice at the appearance of the completed list of ferns and flowering plants of north-eastern North America,* on which a committee of leading botanists has been engaged for the past two or three years. Following the example set by American ornithologists in 1883, a number of prominent botanists determined to sink individual preferences for the sake of that much sought goal—uniformity and stability in the names of genera and species. In 1892, therefore, a committee was appointed by the Botanical Club of the American Association for the Advancement of Science, comprising N. L. Britton, J. M. Coulter, H. M. Rusby, W. A. Kellerman, F. V. Coville, Lucien M. Underwood and Lester F. Ward; and was afterward increased by the addition of Edward L. Greene and William Trelease.† Although the De Candolle or Paris Code of 1867 is the alleged basis of departure, it is evident at a glance that nearly every important rule is borrowed direct from the American Ornithologists' Union Code of Nomenclature.

* List of Pteridophyta and Spermatophyta growing without cultivation in Northeastern North America. Prepared by a Committee of the Botanical Club, American Association for the Advancement of Science. (From Memoirs Torrey Botanical Club.) New York, 1893-1894. [Also issued in dated signatures, as published, during 1883 and 1884.]

† In addition to the members of the committee the following botanists have contributed special parts to the 'List': L. H. Bailey, T. H. Kearney, Jr., Thomas Morong, F. Lamson-Scribner, John K. Small, J. G. Smith and Wm. E. Wheelock.