SCIENCE, MEDICINE, NATURAL HISTORY pdf

1: Natural history - Wikipedia

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Earth science also known as geoscience , is an all-embracing term for the sciences related to the planet Earth , including geology , geophysics , hydrology , meteorology , physical geography , oceanography , and soil science. Although mining and precious stones have been human interests throughout the history of civilization, the development of the related sciences of economic geology and mineralogy did not occur until the 18th century. The study of the earth, particularly palaeontology , blossomed in the 19th century. The growth of other disciplines, such as geophysics , in the 20th century led to the development of the theory of plate tectonics in the s, which has had a similar effect on the Earth sciences as the theory of evolution had on biology. Earth sciences today are closely linked to petroleum and mineral resources , climate research and to environmental assessment and remediation. Atmospheric sciences Though sometimes considered in conjunction with the earth sciences, due to the independent development of its concepts, techniques and practices and also the fact of it having a wide range of sub disciplines under its wing, the atmospheric sciences is also considered a separate branch of natural science. This field studies the characteristics of different layers of the atmosphere from ground level to the edge of the time. The timescale of study also varies from days to centuries. Sometimes the field also includes the study of climatic patterns on planets other than earth. Oceanography The serious study of oceans began in the early to midth century. As a field of natural science, it is relatively young but stand-alone programs offer specializations in the subject. Though some controversies remain as to the categorization of the field under earth sciences, interdisciplinary sciences or as a separate field in its own right, most modern workers in the field agree that it has matured to a state that it has its own paradigms and practices. As such a big family of related studies spanning every aspect of the oceans is now classified under this field. Interdisciplinary studies[edit] The distinctions between the natural science disciplines are not always sharp, and they share a number of cross-discipline fields. Physics plays a significant role in the other natural sciences, as represented by astrophysics , geophysics , chemical physics and biophysics. Likewise chemistry is represented by such fields as biochemistry , chemical biology , geochemistry and astrochemistry. A particular example of a scientific discipline that draws upon multiple natural sciences is environmental science. This field studies the interactions of physical, chemical, geological, and biological components of the environment , with a particular regard to the effect of human activities and the impact on biodiversity and sustainability. This science also draws upon expertise from other fields such as economics, law and social sciences. A comparable discipline is oceanography , as it draws upon a similar breadth of scientific disciplines. Oceanography is sub-categorized into more specialized cross-disciplines, such as physical oceanography and marine biology. As the marine ecosystem is very large and diverse, marine biology is further divided into many subfields, including specializations in particular species. There are also a subset of cross-disciplinary fields which, by the nature of the problems that they address, have strong currents that run counter to specialization. In some fields of integrative application, specialists in more than one field are a key part of most dialog. Such integrative fields, for example, include nanoscience , astrobiology , and complex system informatics. Materials science The materials paradigm represented as a tetrahedron Materials science is a relatively new, interdisciplinary field which deals with the study of matter and its properties; as well as the discovery and design of new materials. Originally developed through the field of metallurgy , the study of the properties of materials and solids has now expanded into all materials. The field covers the chemistry, physics and engineering applications of materials including metals, ceramics, artificial polymers, and many others. The core of the field deals with relating structure of material with it properties. It is at the forefront of research in science and engineering. It is an important part of forensic engineering the investigation of materials, products, structures or components that fail or do not operate or function as intended, causing personal injury or damage to property and failure analysis , the latter being the key to understanding, for example, the cause of various aviation accidents. Many of the most pressing scientific problems that are faced today are due to the limitations of the materials that are available and, as a result, breakthroughs in this field are likely to have a significant impact on the future of technology. The basis of materials science involves studying the structure of materials, and relating them to their properties. Once a materials scientist knows about this structure-property correlation, they can then go on to study the relative performance of a material in a certain application. The major determinants of the structure of a material and thus of its properties are its constituent chemical elements and the way in which it has been processed into its final form. Natural philosophy and History of science Some scholars trace the origins of natural science as far back as pre-literate human societies, where understanding the natural world was necessary for survival. Water turned into wood, which turned into fire when it burned. The ashes left by fire were earth. Plato rejected inquiry into natural philosophy as against religion, while his student, Aristotle, created a body of work on the natural world that influenced generations of scholars. While Aristotle considered natural philosophy more seriously than his predecessors, he approached it as a theoretical branch of science. Unlike Aristotle who based his physics on verbal argument, Philoponus instead relied on observation, and argued for observation rather than resorting into verbal argument. Robert Kilwardby wrote On the Order of the Sciences in the 13th century that classed medicine as a mechanical science, along with agriculture, hunting and theater while defining natural science as the science that deals with bodies in motion. The scientific revolution, which began to take hold in the 17th century, represented a sharp break from Aristotelian modes of inquiry. Data was collected and repeatable measurements made in experiments. Antoine Lavoisier , a French chemist, refuted the phlogiston theory , which posited that things burned by releasing "phlogiston" into the air. This growth in natural history was led by Carl Linnaeus , whose taxonomy of the natural world is still in use. Linnaeus in the s introduced scientific names for all his species. By the 19th century, the study of science had come into the purview of professionals and institutions. In so doing, it gradually acquired the more modern name of natural science. Modern natural science â€"present [edit] According to a famous textbook Thermodynamics and the Free Energy of Chemical Substances by the American chemist Gilbert N. Lewis and the American physical chemist Merle Randall , [75] the natural sciences contain three great branches: Aside from the logical and mathematical sciences, there are three great branches of natural science which stand apart by reason of the variety of far reaching deductions drawn from a small number of primary postulates â€" they are mechanics , electrodynamics , and thermodynamics.

2: Natural History Museum of Los Angeles

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Science as natural philosophy Precritical science Science, as it has been defined above, made its appearance before writing. It is necessary, therefore, to infer from archaeological remains what was the content of that science. From cave paintings and from apparently regular scratches on bone and reindeer horn, it is known that prehistoric humans were close observers of nature who carefully tracked the seasons and times of the year. About bce there was a sudden burst of activity that seems to have had clear scientific importance. Great Britain and northwestern Europe contain large stone structures from that era, the most famous of which is Stonehenge on the Salisbury Plain in England, that are remarkable from a scientific point of view. Not only do they reveal technical and social skills of a high orderâ€"it was no mean feat to move such enormous blocks of stone considerable distances and place them in positionâ€"but the basic conception of Stonehenge and the other megalithic structures also seems to combine religious and astronomical purposes. Their layouts suggest a degree of mathematical sophistication that was first suspected only in the midth century. Stonehenge is a circle, but some of the other megalithic structures are egg-shaped and, apparently, constructed on mathematical principles that require at least practical knowledge of the Pythagorean theorem that the square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides. This theorem, or at least the Pythagorean numbers that can be generated by it, seems to have been known throughout Asia, the Middle East , and Neolithic Europe two millennia before the birth of Pythagoras. This combination of religion and astronomy was fundamental to the early history of science. It is found in Mesopotamia, Egypt, China although to a much lesser extent than elsewhere , Central America , and India. The spectacle of the heavens, with the clearly discernible order and regularity of most heavenly bodies highlighted by extraordinary events such as comets and novae and the peculiar motions of the planets, obviously was an irresistible intellectual puzzle to early humankind. In its search for order and regularity, the human mind could do no better than to seize upon the heavens as the paradigm of certain knowledge. Astronomy was to remain the queen of the sciences welded solidly to theology for the next 4, years. Science, in its mature form, developed only in the West. But it is instructive to survey the protoscience that appeared in other areas, especially in light of the fact that until quite recently this knowledge was often, as in China, far superior to Western science. China As has already been noted, astronomy seems everywhere to have been the first science to emerge. Its intimate relation to religion gave it a ritual dimension that then stimulated the growth of mathematics. Chinese savants , for example, early devised a calendar and methods of plotting the positions of stellar constellations. Since changes in the heavens presaged important changes on the Earth for the Chinese considered the universe to be a vast organism in which all elements were connected , astronomy and astrology were incorporated into the system of government from the very dawn of the Chinese state in the 2nd millennium bce. As the Chinese bureaucracy developed, an accurate calendar became absolutely necessary to the maintenance of legitimacy and order. The result was a system of astronomical observations and records unparalleled elsewhere, thanks to which there are, today, star catalogs and observations of eclipses and novae that go back for millennia. In other sciences too the overriding emphasis was on practicality, for the Chinese, almost alone among ancient peoples, did not fill the cosmos with gods and demons whose arbitrary wills determined events. Order was inherent and, therefore, expected. It was for humans to detect and describe this order and to profit from it. Chemistry or, rather, alchemy , medicine, geology , geography , and technology were all encouraged by the state and flourished. Practical knowledge of a high order permitted the Chinese to deal with practical problems for centuries on a level not attained in the West until the Renaissance. India Astronomy was studied in India for calendrical purposes to set the times for both practical and religious tasks. Primary emphasis was placed on solar and lunar motions, the fixed stars serving as a background against which these luminaries moved. Indian mathematics seems to have been quite advanced, with particular sophistication in geometrical and algebraic techniques. This latter branch was undoubtedly stimulated by the flexibility of the Indian system of numeration that later was to come into the West as the Hindu-Arabic numerals. America Quite independently of China, India, and the other civilizations of Europe and Asia, the Maya of Central America, building upon older cultures , created a complex society in which astronomy and astrology played important roles. Determination of the calendar, again, had both practical and religious significance. Solar and lunar eclipses were important, as was the position of the bright planet Venus. No sophisticated mathematics are known to have been associated with this astronomy, but the Mayan calendar was both ingenious and the result of careful observation. The Middle East In the cradles of Western civilization in Egypt and Mesopotamia , there were two rather different situations. In Egypt there was an assumption of cosmic order guaranteed by a host of benevolent gods. Unlike China, whose rugged geography often produced disastrous floods, earthquakes, and violent storms that destroyed crops, Egypt was surpassingly placid and delightful. Egyptians found it difficult to believe that all ended with death. Enormous intellectual and physical labour, therefore, was devoted to preserving life after death. Both Egyptian theology and the pyramids are testaments to this preoccupation. All of the important questions were answered by religion, so the Egyptians did not concern themselves overmuch with speculations about the universe. None of this required much mathematics, and there was, consequently, little of any importance. Mesopotamia was more like China. The land was harsh and made habitable only by extensive damming and irrigation works. Storms, insects, floods, and invaders made life insecure. To create a stable society required both great technological skill, for the creation of hydraulic works, and the ability to hold off the forces of disruption. These latter were early identified with powerful and arbitrary gods who dominated Mesopotamian theology. The cities of the plain were centred on temples run by a priestly caste whose functions included the planning of major public works , like canals, dams, and irrigation systems, the allocation of the resources of the city to its members, and the averting of a divine wrath that could wipe everything out. Mathematics and astronomy thrived under these conditions. The number system, probably drawn from the system of weights and coinage, was based on 60 it was in ancient Mesopotamia that the system of degrees, minutes, and seconds developed and was adapted to a practical arithmetic. The heavens were the abode of the gods, and because heavenly phenomena were thought to presage terrestrial disasters, they were carefully observed and recorded. Out of these practices grew, first, a highly developed mathematics that went far beyond the requirements of daily business, and then, some centuries later, a descriptive astronomy that was the most sophisticated of the ancient world until the Greeks took it over and perfected it. Nothing is known of the motives of these early mathematicians for carrying their studies beyond the calculations of volumes of dirt to be removed from canals and the provisions necessary for work parties. It may have been simply intellectual playâ€”the role of playfulness in the history of science should not be underestimatedâ€”that led them onward to abstract algebra. There are texts from about bce that are remarkable for their mathematical suppleness. Babylonian mathematicians knew the Pythagorean relationship well and used it constantly. They could solve simple quadratic equations and could even solve problems in compound interest involving exponents. From about a millennium later there are texts that utilize these skills to provide a very elaborate mathematical description of astronomical phenomena. Although China and Mesopotamia provide examples of exact observation and precise description of nature, what is missing is explanation in the scientific mode. The Chinese assumed a cosmic order that was vaguely founded on the balance of opposite forces yinâ€”yang and the harmony of the five elements water, wood, metal, fire, and earth. Why this harmony obtained was not discussed. Similarly, the Egyptians found the world harmonious because the gods willed it so. For Babylonians and other Mesopotamian cultures, order existed only so long as all-powerful and capricious gods supported it. In all these societies, humans could describe nature and use it, but to understand it was the function of religion and magic, not reason. It was the Greeks who first sought to go beyond description and to arrive at reasonable explanations of natural phenomena that did not involve the arbitrary will of the gods. Gods might still play a role, as indeed they did for centuries to come, but even the gods were subject to rational laws. The birth of natural philosophy There seems to be no good reason why the Hellenes, clustered in isolated city-states in a relatively poor and backward land, should have struck out into intellectual regions that were only dimly perceived, if at all, by the splendid civilizations of the Yangtze, Tigris and Euphrates, and Nile valleys. There were many differences between ancient Greece and the other civilizations, but perhaps the most significant was religion. What is striking about Greek religion , in contrast to the religions of Mesopotamia and Egypt, is its puerility. Greek religion did not. It was, in fact, little more than a collection of folk tales, more appropriate to the campfire than to the temple. Perhaps this was the result of the collapse of an earlier Greek civilization, the Mycenaean , toward the end of the 2nd millennium bce, when the Dark Age descended upon Greece and lasted for three centuries. All that was preserved were stories of gods and men, passed along by poets, that dimly reflected Mycenaean values and events. Such were the great poems of Homer , the Iliad and the Odyssey, in which heroes and gods mingled freely with one another. Indeed, they mingled too freely, for the gods appear in these tales as little more than immortal adolescents whose tricks and feats, when compared with the concerns of a Marduk or Jehovah, are infantile. There really was no Greek theology in the sense that theology provides a coherent and profound explanation of the workings of both the cosmos and the human heart. Hence, there were no easy answers to inquiring Greek minds. The result was that ample room was left for a more penetrating and ultimately more satisfying mode of inquiry. Thus were philosophy and its oldest offspring, science, born. The first natural philosopher, according to Hellenic tradition, was Thales of Miletus , who flourished in the 6th century bce. We know of him only through later accounts, for nothing he wrote has survived. He is supposed to have predicted a solar eclipse in bce and to have invented the formal study of geometry in his demonstration of the bisecting of a circle by its diameter. Most importantly, he tried to explain all observed natural phenomena in terms of the changes of a single substance, water, which can be seen to exist in solid, liquid, and gaseous states. What for Thales guaranteed the regularity and rationality of the world was the innate divinity in all things that directed them to their divinely appointed ends. From these ideas there emerged two characteristics of classical Greek science. The second was the conviction that this order was not that of a mechanical contrivance but that of an organism: This motion toward ends is called teleology and, with but few exceptions, it permeated Greek as well as much later science. Thales inadvertently made one other fundamental contribution to the development of natural science. By naming a specific substance as the basic element of all matter , Thales opened himself to criticism , which was not long in coming. His own disciple , Anaximander , was quick to argue that water could not be the basic substance. His argument was simple: Hence, if Thales were correct, the opposite of wet could not exist in a substance, and that would preclude all of the dry things that are observed in the world. Therefore, Thales was wrong. Here was the birth of the critical tradition that is fundamental to the advance of science. Various single substances were proposed and then rejected, ultimately in favour of a multiplicity of elements that could account for such opposite qualities as wet and dry, hot and cold. Two centuries after Thales, most natural philosophers accepted a doctrine of four elements: All bodies were made from these four. The presence of the elements only guaranteed the presence of their qualities in various proportions.

3: American Museum of Natural History | New York City

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4: Natural science - Wikipedia

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If the history of science is to make any sense whatsoever, it is necessary to deal with the past on its own terms, and the fact is that for most of the history of science natural philosophers appealed to causes that would be summarily rejected by modern scientists.

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