the air in the lungs with a certain proportion of the vapor of these substances, to allow it a short time to act, and then to let it escape by permitting the patient to breathe fresh air. The escape of the vapor under these circumstances is immediately followed by a violent reaction in the circulation, attended with a dangerous liability to syncope; this reaction, in fact, does lead to syncope in numerous instances, and the syncope so induced may prove fatal." He further refers to this reaction as a "reverse movement of the reflex mechanism," and states that "here is to be found the solution of the enigma of chloroform syncope and of all supposed anomalies in the action of chloroform."

The investigations referred to, and many others of which the limitations of this article will not permit mention, seem to prove that anæsthetics are capable of dangerously affecting the heart by reason of their direct action upon it.

The local action of anæsthetics upon the lungs has received considerable attention. The Glasgow Committee noted the fact that "chloroform, when administered by the lungs, produces, as a direct local action, such a change in the walls of the vessels as to cause . . . a retardation and stoppage of the circulation in the lungs, first in the capillaries, then in the arterioles, and subsequently in the larger vessels"; in this way acting as an obstruction to both respiration and circulation.

Holscher has arrived at the following conclusions regarding the action of ether upon the lungs: "Aside from a slight increase of mucous secretion, ether vapor has no other irritative action on the tracheo-bronchial mucous membrane. The glistening appearance of the bronchial and tracheal epithelium is not altered during narcosis."

The action of anæsthetics on the kidneys has been extensively studied both clinically and experimentally. Clinically it has been shown that in the deeper degrees of anæsthesia the urine is more or less suppressed and contains albumin in a considerable percentage of cases. Weir has reported observations on the urine in 34 carefully selected cases, excluding operations upon the abdomen and the genito-urinary organs. All were free from albuminuria before etherization, afterward 9 presented a trace of albumin, the remaining 25 being unchanged. In 5 cases presenting evidence of diseased kidneys before operation, there was no increase of albuminuria in 3, slight increase in 2 after etherization.

Legrain found albuminuria in 10 out of 54 persons after chloroform and in 12 out of 41 after ether. From experiments on dogs this writer considered that the effects of chloroform upon the kidneys were more lasting than those of ether. Popoff found occasional transient albuminuria after ether, but in 140 carefully observed cases he saw no permanent damage even in those with evidence of kidney disease before the administration.

Patein noted transient albuminuria after chloroform in one-third of the cases observed.

Thompson and Kemp, in some elaborate experiments on the "effects of different anæsthetics on the kidneys," arrived at the following conclusions: "As regards ether, it would appear that this agent produces a *special contraction of the renal arterioles*, with a consequent damaging effect upon the renal secretory cells, similar to those which follow clamping the renal artery. The kidney shrinks in bulk, with consequent fall of the oncometric tracing, and accompanied by diminution of secretion, marked albuminuria, and, finally, suppression. . . . This condition of the kidney is not due to any change in the general arterial circulation, since it occurs not only when pure ether is administered, but also in the mixtures in which it is a constituent, if the semi-closed or closed method is employed. . . . The effect of chloroform upon the kidneys seems to be *nil*. The oncometric curves are nearly normal, and are affected only through sharing in general circulatory changes. The secretion of urine continues up to the last moment of life, and the albuminuria is so slight that its presence at all is apparently due only to respiratory interference."

Chloroform mixtures containing ether were found to affect the kidneys in the same manner as chloroform, if administered by the open method, as ether if by the closed method. Popoff, Schiff, Knoll, and Wunderlich believe that the renal disturbances accompanying etherization are due "to general vaso-motor disturbance, and not to local kidney changes."

In healthy kidneys chloroform is said to cause albuminuria more frequently than ether, while in diseased kidneys the use of ether is said to be more dangerous than chloroform.

These renal disturbances after anæsthesia are in direct proportion to the amount of the anæsthetic the patient receives. The researches of Parasporo, Thiem, Fischer, Schenk, and others show that both ether and chloroform, particularly in their prolonged administration, are capable of causing degenerative, inflammatory, or necrotic changes in the internal organs.

A destructive action of anæsthetics upon the blood corpuscles has been disproved, at least in the case of ether, by the investigation of von Lerber. "In 101 cases the blood was examined and the hæmoglobin was, in the majority of instances, unaltered; the corpuscles were found to be but little changed either in number or in appearance, although some leucocytosis was present. Spectroscopic examination of the urine showed no increase of urobilin." He concludes, therefore, that ether does not exert any deleterious effect upon the blood, as claimed by Hermann, Da Costa, and others. The body temperature under anæsthetics has been studied by Kappeler, Bert, Hare, and others. Kappeler found that with ether and chloroform a slight rise of temperature was often observed during the stage of excitement. Later, the temperature fell from 0.2° C. to 1.1° C. under chloroform, and from 0.3° C. to 1.5° C. under ether.

According to the researches of Angelesco the temperature falls "during the whole time anæsthesia lasts. The variation in temperature is most marked during the first and second fifteen minutes. The temperature fall continues, though slight, during the deep sleep following anæsthesia. Temperature begins to rise at the moment of waking."

The anæsthetics are eliminated almost entirely by the breath. Small quantities of chloroform have been found in the urine and milk after anæsthesia.

The Phenomena of Anæsthesia.—These depend, for the most part, upon the successive involvement and final paralysis of the different parts of the nervous system. Narcotics which act rapidly, as nitrous oxide, allow few phenomena, while slow-acting agents, as alcohol or opium, furnish a great many. Ether and chloroform occupy an intermediate position in this respect. While these phenomena are modified greatly by the rapidity with which the anæsthetic is administered, their sequence, in usual cases, is marked by several prominent physiological changes, according to which the narcosis has been divided into degrees or stages. Of these terms, "degrees" is the better, for, as Snow has pointed out, "the slighter degrees of narcosis occur in the later stages of the process, during the recovery of the patient, as well as in the beginning."

Although different authorities variously divide narcosis into from two to five stages, the four as described by Hewitt present the most distinct limitations. Briefly outlined they are as follows: 1. The period of conscious inhalation. 2. The period of unconsciousness with imperfect anæsthesia. 3. The period of perfect anæsthesia. 4. The period of excessive and dangerous narcosis. The phenomena of these periods, briefly stated, are as follows:

1. *The Period of Conscious Inhalation.*—The odor of the agent is first appreciated, and if it be pungent and strong, the regularity of the respiration will be interrupted by delayed, hesitating, and imperfect inspirations, closure of the glottis, swallowing movements, choking, cough, smothering and suffocative sensations with consequent fear, struggling, and resistance. After a few respirations the following may be experienced: general exhilaration and warmth, fulness in the head, buzzing or ringing in

the ears, dizziness, exaggeration of hearing (rendering normal sounds excessive), flashes of light, numbness, tingling, and a feeling of weight and stiffness in the extremities, emotional feelings, sinking sensations, and a feeling of impending unconsciousness. Increased flow of tears and saliva is common in this stage, due most likely to the pungency of the vapor.

The pulse at this time depends more upon the mental state of the patient than upon any action of the anæsthetic. The rapid heart's action commonly noted is due to nervousness or fright, and if the latter is excessive, more or less shock may be present, with rapid, small pulse, pallor, and prostration.

The respiration is usually normal except as above noted. The pupil is variable, being affected by other things than the anæsthetic. Dilatation of the pupil is not uncommon at this time, particularly in nervous, apprehensive patients.

2. *The Period of Unconsciousness with Imperfect Anæsthesia.*—Consciousness is lost suddenly, as a rule, and at about the same time disordered cerebration becomes manifest through delirious expression and action, including laughing, crying, irrational talking, shouting, singing, hallucinations of sight and hearing, struggling, fighting, etc. These manifestations may increase to a certain point and then subside gradually or suddenly: speech becoming more and more incoherent and inarticulate, and finally ceasing after a period of mere phonation. Muscular action becomes more and more incoordinate, and a period of general muscular rigidity of a tonic character frequently precedes the final relaxation. Occasionally, clonic movements and tremors occur during this period.

There is usually an increased flow from the lachrymal and salivary glands. The pulse becomes full, bounding, and rapid, often reaching the rate of 140 or 160, and, under chloroform, often presents considerable irregularity. The blood pressure is increased and the body temperature elevated. The color is heightened, especially about the face, neck, and chest, and a bright red spotted rash (similar to the eruption of measles) not infrequently appears on these parts from ether, and has been called the "ether rash." Profuse perspiration is common. The respiration, sharing in the general excitation, becomes exaggerated, often excessively, and is liable to some degree of obstruction from one or more of the following causes: (1) Stertor; (2) stridor; (3) rigidity of the respiratory muscles; (4) valve-like action of the pharynx, cheeks, lips, and nostrils; (5) foreign matter in the air passages.

(1) The stertor present at this time is usually of a reflex character and is frequently associated with deprivation of oxygen from too rapid administration.

(2) Stridor is also reflex and is due to spasmodic closure of the glottis. It may be caused by the pungency of the vapor or other irritation.

(3) The respiratory muscles may take part in the general tonic muscular rigidity, to the extent of preventing the respiratory movements more or less completely, and alarming asphyxial states may be brought about in this way. This phenomenon is usually associated with too rapid administration of the anæsthetic and consequent limitation of air.

(4) Mechanical obstruction to respiration may result from valve-like action of the pharynx, cheeks, lips, and nostrils, favored by the vigorous respiration present. If the oral airway is obstructed by reason of closure of the jaws, the presence of perfect teeth and rigidity of the lips and cheeks, the nasal apertures will often be inadequate to the rush of air on inspiration and the normal action of the dilator muscles of these orifices will be overcome by the resulting suction force. The alæ nasi will be drawn together, and there is then a tendency to the production of a vacuum in the cavities of the nares, the mouth, and the pharynx on inspiration. In consequence of this the tongue, the epiglottis, and the walls of the pharynx are drawn together over the laryngeal opening, and complete mechanical obstruction may thus be brought about, favored by the hyperæmia and swelling of all of these parts which take place at this time, as pointed out by Hewitt. Obstruction to expiration is often observed at this stage. It is the result of closure of the mouth and forward movement of the tongue against the teeth, coupled with a valve-like action of the soft palate resulting in closure of the naso-pharyngeal airway. This produces a puffing form of expiration accompanied by blowing up of the cheeks and not infrequently by expiratory stertor. Muscular rigidity of the parts in question plays a prominent part in these forms of respiratory obstruction. The jaws are often set by spasm of the masseters, the cheeks rigid, and the lips firmly closed or pursed up by muscular action.

(5) Mucus and saliva—which are formed freely in this period—often produce some degree of obstruction to respiration by being drawn into the larynx and trachea. The same is true of products of vomiting which may occur at this time. Duskiness or cyanosis appears in proportion to the amount of obstruction produced in these various ways. During this period the reflexes are active, although in its later stages they become sluggish. The pupil is variable. There is a tendency toward dilatation in the early, and toward contraction in the later stages of this period.

As the narcosis deepens, these phenomena of excitation subside. The muscles relax, the pulse and respiration assume more normal characteristics, anæsthesia becomes complete, and the patient passes into the third period of narcosis.

3. *The period of perfect anæsthesia* is characterized by complete muscular relaxation; by absence or marked sluggishness of the lid and of conjunctival or corneal reflex; by a state of the pupil which under ether is somewhat dilated, under chloroform somewhat contracted, and the reaction of which to light is sluggish or absent; and by a state of the respiration and circulation not markedly different from normal, the respiration being inclined to stertor of a palatine or snoring character. In the early stages of this degree the sensibility of ordinary parts is abolished, but certain special localities, as the anus, perineum, bladder, matrix of great toe nail, etc., are not incapable of causing reflex response to irritation and are only overcome in the more advanced stages.

The body temperature is lowered, the heightened color lessens, and the spotted rash of ether becomes confluent.

4. *The period of excessive and dangerous narcosis* is characterized by dilated and fixed pupils, entire absence of conjunctival or corneal reflex, a half-open condition of the eyelids, and gradual failure of the respiration and circulation. As this period approaches, the respiration frequently takes on a gasping character, with very quick, short inspirations, each of which is accompanied by a downward movement of the lower jaw causing the mouth to open. This is the form of breathing usually seen in nearly all dying persons and is distinctly characteristic of impending death. The breathing may, however, simply become more and more feeble, shallow, and irregular; it may be rapid or slow, and it may cease gradually or suddenly. The pulse is usually slowed in this period, although it may remain rapid. It gradually loses volume and strength, and before ceasing becomes irregular and intermittent. If this degree of narcosis has been brought about slowly, the pulse persists till after respiratory failure has become complete. It is then rapidly affected by the resulting asphyxia.

This general account of the phenomena of anæsthesia is based upon a gradual and uncomplicated administration. It has been elsewhere shown that if this is too rapidly conducted, an overwhelming effect upon the respiration or circulation may be produced suddenly and without reference to the usual succession of signs. While the phenomena above noted are those of narcosis in general, the different anæsthetic agents possess individual peculiarities of action which serve to make their narcosis characteristic. The narcosis of nitrous oxide is characterized by the great rapidity with which complete anæsthesia is established, the apparent absence of stages, the

scarcity of phenomena, the lack of muscular relaxation, and the great tendency to the production of asphyxial states. The narcosis of ether is characterized by phenomena of irritation and stimulation, by a moderate tendency to the production of asphyxial states, and by the marked absence of phenomena of depression as compared with chloroform. The narcosis of chloroform, as compared with that of ether, is characterized by the absence of irritation and stimulation, by a tendency to the production of mechanical asphyxia, and by the occurrence of phenomena of depression.

(For details of the administration of the general anæsthetics for surgical purposes, the reader is referred to the author's article on *Chloroform, Ether, and Other Anæsthetic Agents, Administration of.*)

Thomas L. Bennett.

ANÆSTHOL.—This is an anæsthetic recently introduced by Willy Meyer, of New York, to replace the A.C.E. mixture. He mixes chloroform and ether in molecular proportions, *i.e.*, 43.25 per cent. of chloroform and 56.75 per cent. of ether by volume, and calls the mixture "M. S." Of this he takes 83 volumes, and adds to it 17 volumes of ethyl chloride. The mixture has a boiling point of 40° C. (104° F.), and would seem to be open to the objection urged against the A. C. E. mixture, that constituents of different volatilities do not volatilize equally. We might expect the ethyl chloride to vaporize more rapidly than the ether, and this more rapidly than the chloroform. *W. A. Bastedo.*

ANAKHRE. See *Goundou.*

ANAPHRODISIACS.—This is a term applied to agents which are used to lessen an immoderate or morbid sexual desire, but the treatment must be of wide scope and include the moral, dietetic, and hygienic management of the case, while not infrequently surgery must be called upon. The causes of aphrodisia are many, and not the least important is reflex irritation of the genitalia, caused by physical peculiarities or deformities, phimoses, strictures of the urethra, diseases of the prostate, chronic constipation, fissures or hemorrhoids of the anus, eczema, highly concentrated urine, etc. In other cases the reflex irritation may be caused by the presence of worms in the rectum or in the vagina, in the case of female children, and by excessive exercise causing friction of the thighs in young children (horseback riding, bicycle riding). These conditions will each call for its own special treatment in addition to the general measures which should be adopted; for the detection and relief of the exciting cause are difficult problems and far more important than the exhibition of drugs. For another class of patients, those suffering from diseases of the nervous system or those with psychical perversion, the essential of treatment is confidence in the physician, on the part of the patient, and suggestion, hypnotic or otherwise. Many authenticated cases have been recorded of permanent cures based upon the treatment by suggestion, and it is invaluable in cases of neurasthenia.

In general, for the treatment of aphrodisia nothing will be found better than physical and particularly mental work to the point of fatigue. The latter accomplishes its results in two ways: first, by exhausting the brain where the sexual impulse (if not reflex) has its origin; and secondly, by so absorbing the patient's interest as to preclude the occupation of his mind by lascivious thoughts, pictures, and mental impressions. The anaphrodisiac effect of mental activity is easily explained when we consider the large amount of nervous energy which accompanies each conjugal act.

In the general management of a case the physician should advise a non-sedentary life, as much as possible in the open air, light diet, with an absence of meats, coffee, highly seasoned foods, and alcoholic stimulants; the kidneys should be kept well flushed, the bowels well open, and the patient should sleep on a hair mattress, with light covering, in a cool, well-ventilated room. As a full bladder is frequently a cause of irritation, it should be emptied upon going to bed and the first thing in the morning. The patient should arise early and take a cold douche or sponge bath. The only mechanical contrivance which seems to be of much benefit is one that will prevent the patient from sleeping on his back, and for this purpose a towel knotted at the back may be used. The insertion of rings in the prepuce or labia and the local application of caustics are to be condemned. Drugs which may be used are the bromides, gr. x. to xx. three times a day, and antimony, chloral, salicin, conium, and other depressants; nauseants may be used with care, and are effective sometimes. *Charles Adams Holder.*

ANAPLASIA.—This word is used by some writers synonymously with anaplasty, having the meaning of a repair of injured parts by means of plastic operation. In 1893 its use in an entirely different sense was introduced by Hansemann, who wished to designate by some specific term the morphological and physiological differences which exist between the cells of malignant tumors and those of the normal parent tissue.

The type and character of the parent cells are usually preserved to some extent in the tumor cells which arise from them; as, for example, the cells of a squamous-cell carcinoma of the skin may undergo a horny change; those of an adeno-carcinoma arising from cylindrical cells are more or less cylindrical in shape; the cells of an adeno-carcinoma of the thyroid may produce a colloid-like substance; metastases of an adeno-carcinoma of the liver may secrete a bile-like fluid; and the sarcomata arising from the chromatophores of the skin produce melanin. These resemblances of tumor cells to their parent cells are not so marked as the differences which exist between them, both in morphological and physiological characteristics. The latter are shown by striking variations in size and form; by changes in the finer structure of the nucleus and cell body as shown by staining reactions (hyperchromatosis, hypochromatosis, etc.); by abnormal cell-division forms; by the changed chemical character or total absence of cell function; and by the tendency to undergo degeneration. To all of these alterations in cell character which constitute malignancy Hansemann would apply the term anaplasia, as opposed to heteroplasia and metaplasia. According to his view, the significance of these changes must be that the cells of malignant tumors have lost in differentiation and so have acquired the power of individual existence. The manner in which the cells have undergone this change or the etiology of malignant tumors is not included in the meaning of the term. There can be no doubt that the use of the term anaplasia in this application is of great service; and though Hansemann's views have met with much opposition, it has gained a wide acceptance in modern pathology. *Aldred Scott Warthin.*

BIBLIOGRAPHY.

Hansemann: Studien über Specificität, Altruismus und Anaplasia der Zellen, Berlin, 1893. Die mikroscopische Diagnose der bösartigen Geschwülste, Berlin, 1897.

ANASARCA. See *Circulation, Disorders of.*

ANATOMY, HISTORY OF.—Considering the necessity of the anatomical sciences as a basis for the proper study of the healing art, and the high position assigned them in modern times, it may seem strange that their early development was slow, and the knowledge of the ancients concerning the structure of the human body crude and superficial. The principal cause of this was the prevalence of animistic ideas, it being thought that spirits inhabited or controlled the body in some mysterious way. Involuntary movements, such as the pulsation of the heart and arteries, the twitching of muscles, the phenomena of respiration and bodily heat, were all considered indubitable signs of the presence of such spirits, to which were ascribed most cases of disease and disordered action.

After leaving the body the spirit was thought to maintain some occult relation to it. Hence the corporeal remains were either preserved with pious care, or burned or entombed to prevent their suffering insult or injury that might affect the career of the spirit in the other world. Mingled with these superstitious ideas were others derived from horror of death and repulsion from corrupting flesh. Contact with a dead body was usually held to be a defilement requiring long purification, and to attempt to inspect its internal structure was a sacrilege meriting the severest punishment. Dissection was, under such circumstances, practically impossible. It is certain that but few writers of antiquity were able to avail themselves of this method of research.

The sources of information were therefore indirect. Animals killed either for food or sacrifice, the occasional examination of persons severely wounded or suffering from eroding diseases, the noting of the effects of putrefaction which displayed the deeper structures, especially the bones, were the usual means employed for the investigation of the human body. In Egypt, it is true, bodies were eviscerated for the purpose of preserving them as mummies; but this appears to have been done by a low class of servants under the direction of priests who regarded the interests of the spirit in the other world as the only essential, and who therefore gave no thought to exact anatomical knowledge.

Yet among the ancient Egyptians are found some of the earliest attempts at recording anatomical data. The Ebers papyrus, of about 1550 B.C., and said to be the oldest complete book extant, relates to the healing art and contains incidental allusion to the structure of the body. Vessels and nerves are together designated as "metu"; of which four are distributed to the nostrils, four to the temples, four to the head, two in each hand and foot, etc. The heart is regarded as the centre of the vascular system, and vessels containing blood, air, water and other fluids pass from it to all parts of the body. Vital spirits are said to enter one nostril and penetrate to the heart; an idea which was to have a great effect upon anatomy and physiology as far down as the seventeenth century. Similar determinations, of no greater value, are found in papyri of a somewhat later date.

Contemporary with the Egyptian culture, or possibly anterior to it, was that of Chaldæa and Assyria from which the Phœnicians and Hebrews derived much. One of the contributors to the Ebers papyrus is stated to be from Byblus, a town of Phœnicia. Certain cuneiform inscriptions indicate that the situation of the vessels of the neck was known, as they describe the compression of these structures to relieve the pains of circumcision.

The anatomy of the Hebrews was probably derived mainly from Chaldean, Assyrian, and Egyptian sources. The principle of life was believed to reside in the blood (Gen. ix. 4; Lev. xvii. 11), which was accordingly forbidden as food and used as a propitiatory offering. The heart was supposed to be the seat of the understanding, courage, and love; to dilate with joy, contract with sadness, harden or soften with the passions. These expressions, which have become wholly figurative in modern times, were formerly believed to be literally true. The later Talmudists had some anatomical knowledge of the female genitalia, the œsophagus, the lungs, the kidneys, the spinal cord, and the cauda equina. One of the rabbis, at the close of the first century, is said to have boiled a body for the purpose of obtaining the skeleton. A fabulous bone, "luz," was thought to become the seed of the body from which it is to be renewed at the resurrection.

The early writings of India contain no anatomical knowledge except names of a few parts of the body. Somewhat later (900–200 B.C.) there are rude attempts at the enumeration of structures. To what extent these enumerations are based upon actual examination and misinterpretation of anatomical facts it is impossible to say. In them the primitive elements of the body are air, bile, and phlegm, air having its seat below the navel, the bile between the navel and the heart, the phlegm above the heart. Seven organic products were believed to be formed from these primitive elements: watery chyle which in the liver and spleen forms blood, from which arises flesh which forms cellular tissue, from whence comes bone which generates marrow, which gives origin to semen and menstrual blood. The ancient Hindoos are said to have practised dissection, it being held lawful to pursue such investigations for scientific purposes, though under many limitations and restrictions; but the sculptures of the rock-cut temples of Elephanta and Ellora show ignorance of the anatomy of muscles. Later authors appear to have had a vague idea of the circulation of the blood, as they state that the watery chyle circulates through the vessels and irrigates the system as water does a field.

The Chinese have not, even at the present day, any exact anatomical knowledge. The tracing of their crude notions back to the mists of the past is of purely archeologic interest, and it is difficult to say whether the allegations of great antiquity made for some of their medical writings are based upon authentic facts. They considered the elements of the body to be air, water, "metal," and "wood"; the liver to be the seat of the intelligence, the seat of life to be in the middle of the breast. Arteries and veins were not separately distinguished, but some notion of a circulation or translation of the blood appears to have been advanced, as it is stated that it completes a course throughout the body five times in twenty-four hours.

The Japanese in matters of anatomy copied from the Chinese. Their older writings are curious mixtures of fact and error. They teach that the heart contains blood, rules all the other viscera, and is connected with the liver, lungs, spleen, and kidneys; that blood is prepared in three "combustion organs" of rather mythical character, perhaps the thoracic duct, the pancreas, and the lacteals. They assert the structure of the lungs to be like that of a honeycomb, and state that they contain a nourishing gas which penetrates the whole body outside the vessels that carry the blood. The brain, the spinal cord, and the marrow are said to be of one nature, the brain having the highest rank. The seat of the soul is stated by most authors to be the heart, as it has been seen in some animals to beat after the severing of the head from the body. Others place it in the brain, the spleen, the lungs, the kidneys, or the liver. The nerves are often confounded with the tendons, often described as tubular canals. In the middle of the eighteenth century, a physician named Yamawaki obtained permission from his prince to dissect a body, an illegal act that could be done only under powerful protection. He published his observations and declared that the older teaching should no longer be thoughtlessly followed. Dissection was thereafter surreptitiously practised, and very accurate wooden models of the skeleton were made. After this anatomical works from the Dutch were translated into Japanese.

It is among the Greeks that we first meet with a knowledge of anatomy that can be called scientific. With keen and active intelligence they examined and speculated upon all things in the world around them. Prepossessed with the anthropocentric theory of the universe, they attained only a partial and distorted view of natural phenomena, but often showed astonishing powers of generalization in speculative theories. Among them arose the group of so-called "natural philosophers," at the head of whom we find Pythagoras (584–504 B.C.). He attempted to explain natural phenomena by means of harmonic numbers which he considered as actual entities having mysterious powers, the elements of the body being comprised in the number 10, each single number (1+2+3+4) having therein a counterpart. He was the first to deny the spontaneous generation of animals, holding that all life must spring from germs preexisting in the semen which, formed from the brain of the male, combines with moisture from the brain of the female, being the perfected foam of the blood. This idea is perhaps connected with that of the origin of the goddess of generation, Aphrodite (ἀφρός, foam), from the