

## Magic

Magic is a term used for a wide range of phenomena, from the elaborate ritual beliefs and practices that are at the core of many religious systems, to acts of conjuring and sleight of hand for entertainment. Used in the former sense magic is a social and cultural phenomenon found in all places and at all periods, with varying degrees of importance.

### NATURE AND SIGNIFICANCE

Magic essentially refers to a ritual performance or activity that is thought to lead to the influencing of human or natural events by an external and impersonal mystical force beyond the ordinary human sphere. The performance involves the use of objects or the recitation of spells or both by the magician. The nature of magic is frequently misunderstood because of uncertainty as to its definition, its relationship to other religious behaviour and institutions, and its social and psychological functions. This uncertainty is largely a consequence of 19th-century views on cultural and historical evolution that set magic apart from other religious phenomena as being especially prevalent in archaic and primitive societies and as merely a form of superstition without cultural or theological significance. This view has led to magic being considered as different and distinct from other religious rites and beliefs and the overlooking of its essential similarity and connection with them, since both magical and non-magical rites and beliefs are concerned with the effects on human existence of outside mystical forces. The frequently held view that magical acts lack the intrinsically spiritual nature of religious acts, comprising external manipulation rather than supplication or inner grace, and that they are therefore of a simpler and lower kind in theological terms, has compounded the misunderstanding. The definition given above recognizes a main point of distinction between magic and other religious phenomena, in that the latter are concerned with a direct relationship between men and spiritual forces, whereas magic is regarded as rather an impersonal or technical act in which the personal link is not so important or is absent, even though the ultimate force behind both religious and magical acts is believed to be the same. The distinction made by Émile Durkheim (1858-1917), a seminal French sociologist of religion (see below), that a religious practitioner has a congregation whereas a magician has a clientele, is also a meaningful one. The difficulty of definition of magic and its differentiation from religion is due largely to Western ethnocentric views. In Judeo-Christian belief it has been distinguished from other religious acts, but this distinction is not always found in other religious systems and in fact would appear to be unusual. Many writers have referred to "magico-religious" phenomena, a convenient blanket term.

Magic is often confused with witchcraft, especially in the history of European religions. Modern anthropologists, however, make the useful distinction between magic as the manipulation of an external power by mechanical or behavioral means to affect others, and witchcraft as an inherent personal quality to the same ends. In this classification, the word sorcery is used for magic that aims to harm other people; that is, sorcery is "black" magic, whereas magic used for beneficent ends is "white" magic. This distinction does not always hold for specific societies but is a useful one in analysis. Divination, the skill of understanding mystical agents that affect people and events, should be distinguished from magic in that its purpose is not to influence events but rather to understand them. The ultimate mystical power of diviners, however, may be thought to be the same as that behind the forces of magic. In some societies, magicians act as diviners, but the two skills should be distinguished. Magicians are often confused with priests, shamans, and prophets, mainly because many activities of the other personages include acts that are traditionally defined as "magical"; i.e., while essentially they are regarded as intermediaries between men and gods or spirits, in the sense of acting in

a direct personal relationship, some of their acts are also impersonal or "magical." It is often, perhaps usually, impossible clearly to distinguish between priests and magicians; as stated above, the distinction is largely a Western ethnocentric one and lies in the kind of actions they perform in particular situations rather than in any true distinction between the kinds of practitioners themselves.

### HISTORY AND DISTRIBUTION

Magic in one form or other appears to be a part of all known religious systems, at all levels of historical development, although the degree of importance given to it varies considerably. The term has been used loosely by many writers, especially when discussing European magic. Also the ethnographic accounts of small-scale preliterate societies vary in the degree to which they contain detailed descriptions even when magic is important in a particular culture. Thus the analyses of magic in its total cultural setting are remarkably few.

Knowledge of magic in prehistory is limited by lack of reliable data. Many cave paintings and engravings, from all parts of the world, have been claimed to represent figures practicing hunting magic and sorcery, but this can at present be no more than conjecture or interpretive reconstruction (see PREHISTORIC RELIGION). More certain information about magical phenomena is available for the ancient Near Eastern and Greco-Roman cultures, Christian Europe; and contemporary preliterate societies.

**Magic in the ancient world.** There are many recorded texts of what appear to be magic spells and formulae from ancient Mesopotamia and Egypt. Most accounts of these cultures class almost all records of ritual as forms of magic and as examples of magical or mythopoetic ways of thought. This is usually because the writers themselves assumed that these cultures were examples of "prelogical" modes of thought (as compared with the thought of civilized man), and so took any religious record as evidence of this. The pharaohs of Egypt, for example, were what are usually called "divine kings," and as such had powers believed to control nature and fertility. Many writers refer to their powers as magical, but the evidence is rather that they were representations of royal omnipotence, expressing the power and the permanence of the kingship, their believed magical powers being contingent on their divine status. Examples of true magical spells and formulae are recorded from both Mesopotamia and Egypt; e.g., spells to ward off witches and sorcerers. Spells addressed to gods, to fire, to salt, and to grain are recorded from Mesopotamia and Egypt, as are spells said by sorcerers and including necromancy or invocation of the spirits of the dead, who were referred to as a last resort against evil magic. Excellent examples of spells are recorded from the earliest times, and especially in Greco-Egyptian papyruses of the 1st to the 4th centuries AD. They include both magical recipes involving animals and animal substances, and also instructions for the ritual preparations and purification necessary to ensure the efficacy of the spells.

In ancient Roman culture much importance was given to sorcery and counter-sorcery, both forms of magic. These seem to have been associated with the development of new urban classes whose members had to rely on their own efforts both in material and magical terms to defeat their rivals and to rise in the new regimes, where individual merits and talents were rewarded. Spells are recorded to ensure victory in love as well as in business, games, and academic pursuits such as oratory. With these are counter-spells to defeat rival sorcerers.

**Magic in Christian Europe.** For the European Middle Ages and later periods there is a vast corpus of written records. As is known from recent anthropological and historical work on witchcraft, magic, and religious syncretism, magic is specially prevalent during periods of rapid social change and mobility, when new personal relations and conflicts assume greater importance than the more traditional kin and family relations more typical of times of social stability. This appears to have been true in Europe also, and particularly at the times when

Magic and religion

Magic in Egypt and Mesopotamia

accusations of magic against its rivals were part of the struggle of the church to assert its spiritual and temporal hegemony. There are three main aspects to the history of European magic, much of which is ill-described and almost always without adequate accounts of the full cultural setting. One is that of magic and sorcery in petty everyday relationships at the village and community level from the end of the Classical world until recent years when beliefs in magic have in general become weakened. In most cases these beliefs were part of the culture of lowly rural people and records are scant. An exception was sorcery used by wealthier and urban people, especially in Italy and Spain from the 14th century onward, a concomitant of increased social mobility and growth of class hierarchies. A second aspect is the better known but frequently misunderstood belief in magic defined by the church as the heretical practice of making pacts with the devil and evil spirits. Saint Augustine and other early Christian writers had considered magic to be a relic of paganism and removable by conversion and education. After a papal bull in 1320, magic came to be defined as heresy, and the Inquisition's records begin to mention the Witches' Sabbath (midnight assembly in fealty to the devil) and the Black Mass (a travesty of the Christian mass) as forms of magic and witchcraft, the two being regarded as synonymous. They were defined as magic because of the supposed use of material objects, philtres, spells, and poisons. The spells included the perverted use of prayers and the use of sacred writings and objects for diabolical ends. This aspect of European magic has persisted into recent times in the activities of self-styled satanists.

Whereas these forms of magic were regarded as evil and symptomatic of heresy, the third aspect has usually been considered as good, or "white," in intent. This is the use of magic as part of the alchemical tradition. It is true that many reputed alchemists were considered as evil magicians, acquiring their knowledge by a pact with the devil (as in the Faust legends), probably because much of their knowledge came from Kabbalistic sources (esoteric Jewish mysticism). But most of them were considered to be essentially in the main and culturally acceptable Judaic and Christian traditions, their antisocial pretensions and activities not being central to the alchemical studies and being as much simple trickery as anything else (as in the activities of the 18th-century charlatan Alessandro Cagliostro and others).

**Magic in preliterate societies.** Most knowledge of magic in its social setting is derived from anthropological accounts of people of the non-Western world who today believe in magic. The importance of first-hand anthropological accounts, even though many anthropologists tend to make use of the ethnocentric distinction between religion and magic, is that they show how the people themselves actually regard magic and what they actually do with it and against it, rather than relying on the records of inquisitors and missionaries whose duty it was to stamp out magic. Detailed descriptions of magic come mostly from accounts of societies in Oceania and Africa; information from other parts of the world is less adequate although it is clear that magic is equally widespread elsewhere. It is reported particularly from many Muslim societies where pre-Islamic beliefs still exist, as in Malaya and Indonesia. A difficulty in this respect is that accounts only rarely distinguish magic from witchcraft and divination, both of which are found in virtually every known Oriental society.

**STRUCTURE AND FUNCTIONS**

**Structure.** A general point to be made is that the frequent tales of peoples living in fear of evil magicians and black magic are merely fanciful travellers' stories. Magic is normally regarded as an everyday aspect of religion used to explain certain kinds of events and to help bring about desired eventualities. Like most religious phenomena, magic may be regarded with some sense of awe and mystery, but this is more often a sign of the importance given to it than of fear or terror. Typically people perform magical acts themselves or they go to a magi-

cian, a person unusually knowledgeable in the art, who knows how to observe the necessary ritual precautions and taboos, and who may be a professional consulted for a fee. Depending upon the beliefs of the particular culture, the skill may be transmitted by inheritance or bought from other magicians, or may be invented by the magician for himself. Magicians may be consulted for nefarious purposes, to protect a client from the evil magic of others, or for purely benevolent reasons. It seems universal that magic is morally neutral, although the emphasis in any particular society may be on either good or evil magic.

In some religions, especially those of small-scale preliterate societies, magic may be considered as important and even central to religious belief; whereas in others, especially in the main world religions, it may be unimportant, and often regarded as a mere superstition that is not acceptable to official dogma. It has often been maintained that magic is important in societies that possess a particular world view or cosmology, in which a scientifically or empirically correct cause-effect relationship between human and natural phenomena is seen as a symbolic one. This view, which is associated particularly with the British anthropologist Sir James Frazer (1854-1941), is based on a misunderstanding of patterns of thought in pre-scientific cultures. It is true that they may lack the scientifically accurate knowledge of Western industrial societies, but the importance of this may be exaggerated. To some extent it is true: members of pre-industrial societies may use magical techniques (for example, rain-making) whereas in an industrial society it is known that such techniques are instrumentally ineffective. But magic is also performed for expressive purposes, i.e., stating and maintaining the formal culture and organization of the society, so that rainmaking magic has also the function of stressing the importance of rain and the farming activities associated with it.

It has been stated that magic includes the use of material objects, or the recitation of spells; i.e., the use of words that are attributed an innate essence or power of their own. There are usually considered to be three main elements in magic: the spell, the rite itself, and the ritual condition of the performer. This was first stated by the anthropologist Bronislaw Malinowski (1884-1942) in his study of the Trobriand Islanders of Melanesia. With the spell may be included the material objects or "medicines" used in many other societies.

**The spell.** The importance of the spell or incantation has been somewhat exaggerated by the influence of Malinowski's work. Among the Trobriand Islanders this aspect is extremely important: the immaculateness of the words is regarded as essential to the efficacy of the rite. Among the Maori of New Zealand this element is thought so important that a mistake in the recitation of a spell would lead to the magician's own death. Frequently spells have an archaic or esoteric vocabulary that adds to the respect in which the rite is held. But in many societies the spell is of minimal importance, the magician using his own words and regarding the content as being more significant.

**Material objects or "medicines."** Equally widespread—perhaps more so than the use of spells—is the use of material objects, often known in the literature as "medicines" (hence the popular use of the term medicine man for magician). The nature of the medicines varies greatly. Among many peoples the medicines are in fact poisons that may actually cause the desired effect (as among some African peoples who place magical poisons in rivers to stun and catch fish, but regard them as they do any other "medicines"—that are not in fact efficacious). More usually they do not empirically bring about the effect but in some way present it; for example, it is common practice for a magician to try to harm another person by destroying something from his body (e.g., hair or nail-parings), or something that has been in contact with him (e.g., a piece of clothing or other personal possession). From the beneficial aspect, this is similar to the old European belief that to touch the king's garment would cure scrofula (swelling or tuberculosis of the lymphatic

The magical view

Magic in Egypt and Mesopotamia

glands). Another kind of symbolism is exemplified by the Trobriand use of light vegetable leaves in rites to ensure a canoe's speed, symbolizing the ease by which it will glide over the water; the Azande of the Sudan place a stone in a tree fork to postpone the setting of the sun; many Balkan peoples used to swallow gold to cure jaundice.

*The rite.* The significance of the magical rite itself is often overlooked by those who hold the view that magic is something apart from religion. But it seems universal that magic is practiced only in formal and carefully defined ritual situations. The rite itself may be symbolic, as with the sprinkling of water on the ground to make rain or the destruction of a waxen image to harm a victim.

*Condition of the performer.* The ritual nature of magical performances may also be seen in a third element, that of the condition of the performer. Even though regarded as an everyday and "natural" phenomenon, magic is none the less considered as potentially dangerous and polluting, as is any sacred or religious object or activity. Both the magician and the rite itself are typically surrounded by the observance of taboos, by the purification of the participants, and so on. The magician may observe restrictions on certain foods or on sexual activity, and he may be regarded as polluting to other people at these times. There are two obvious reasons: failure to observe such precautions nullify the magic, and they indicate to the participants and others the importance of the rite itself and the ends desired. They mark off the rite from ordinary and profane situations and invest it with sanctity and more than usual importance.

*Functions.* The functions of magic are several; but there are two main aspects, the instrumental and the expressive. A basic feature of magical rites and beliefs is that the practitioners believe that these are instrumental; i.e., they are designed to achieve certain ends in nature or in the behaviour of other people. This is the aspect that is usually the most important for the people concerned and regarded as most important by past writers on the subject. The symbolic or expressive aspect is always present, however; it is precisely because of its symbolic content that magic may best be understood as a part of any system of religion.

*Instrumental functions.* Malinowski and his followers have distinguished three main instrumental functions: the productive, the protective, and the destructive. Productive magic is concerned to bring about a good harvest, to increase the food supply, to ensure a successful outcome to some creative or productive activity both in terms of human labour and of natural bounty. Malinowski showed clearly how it may foster confidence in situations in which technology is weak or uncertain; his famed example of the Trobriand Islanders making magic when fishing in the open sea but not doing so when fishing in the calm and protected lagoon makes the point clearly. In addition, productive magic may also assist the efficient organization of labour and give greater incentive to those who feel confident of success. Protective magic aims to prevent or remove danger, to cure sickness, and to protect an individual or community from the vagaries of nature and the evil acts of others. Again, it may give confidence for people to continue their normal ways of life and activities. Destructive magic is sorcery, directed specifically against other people to harm them or their activities. It has been pointed out that the fear of this form of magic may reduce individual initiative since a successful or wealthy person in an egalitarian society may fear the sorcery of those jealous of him. On the other hand, the use of counter-magic against it rids a community of its internal fears and tensions.

*Expressive functions.* The expressive functions of magic are symbolic, and usually latent in the sense that the performers may not themselves be immediately aware of them. They have largely to do with the effects of individual acts upon society at large. It is in regard to this point that the part played by magic in a total system of religion may be seen (see below *Magic, religion, and science*).

Taboos, purifications, and precautions

MAGIC, RELIGION, AND SCIENCE

**Magic and religion.** The relationship of magic to other religious phenomena depends on three main considerations. The first is the nature of the power toward which the rites are directed. The eminent British anthropologist Edward B. Tylor (1832-1917) and his successors distinguished a personal, conscious, and omnipotent spiritual being as the object of religious ritual; magical performances have no power in themselves but are usually thought by the people to be an expression of an external, impersonal force in nature, for which the Melanesian term *mana* has typically been used. A second consideration is that of the personnel involved: the magician and those who go to him. As noted above, Durkheim pointed out that a priest has a church or congregation whereas the magician has a clientele. A religious ritual has as its principal function (in sociological terms) the maintenance of a sense of cohesion among the members of the church, whereas the magical rite lacks this function, and is, indeed, often anti-religious in quality. This view has been influential in the past and has by now become part of general anthropological thinking, although some of its details have been ignored by recent researchers, as it is based mainly on Australian aboriginal data that are today more accurately known and are not directly relevant elsewhere.

The third consideration is that of the function of magic and of other religious phenomena. The magician may see the overt function of his action as instrumental, as geared to a specific end; the external observer may accept this but also see a latent function. Malinowski, for example, maintained that much of Trobriand magic was performed as an extension of human ability, as a power beyond the normal or understood. It had as its most important function the instillation of confidence in situations where human knowledge and competence cease. In addition, the rite helps to throw the importance of the activity and the cooperation needed for it into relief and thus to help maintain the high social value of cooperation in a small community beset by disruptive jealousies and competition over scarce and difficult resources. A.R. Radcliffe-Brown (1881-1955) pointed out in his work on the Andaman Islanders that their magical rites and precautions at childbirth and death may comfort those concerned, although they are also irksome, but that their main function is to highlight the social importance of birth and death and to bring to public notice the changes in patterns of local and kinship organization that follow them. Some of the hypotheses of Malinowski and Radcliffe-Brown are today regarded as questionable and are difficult of definitive proof, but they have been influential in later studies in that they were concerned not only with the individual's belief in magic but also with its function in the total social system.

In brief, it may be said that religious rites are ways of acting out beliefs about the relationships of man to God, man to man, and man to nature. Magic is rather a way of achieving certain ends beyond the knowledge and competence of everyday people, especially in technologically limited societies, and of expressing these desires in symbolic terms. There are certain functions that are common to both: the provision of explanation for the otherwise inexplicable; a means of coping with the unusual and mysterious; and the enhancing of the social values of certain activities and situations and of coordinating socially valuable activities.

**Magic, technology, and science.** The problem of the relationship of magic to technical and scientific knowledge has concerned most writers on the subject. Magical rites contain at least superficial similarities to nonmagical technical activities. In each the actor performs an action that he expects will have a certain consequence. The distinction between the two processes made by Tylor and Frazer (see below) was that the magician assumes a direct cause-effect relationship between the action and the later event, whereas in empirical fact the relationship is one of the association of ideas only. Many writers have pointed out that magic is used when technical knowledge is missing or uncertain. This view does not really state that

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Frazer's theory

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magic is a substitute for technical knowledge but that its performance gives confidence to people aware of their technical limitations (as in the example of Trobriand fishing magic mentioned above). The magician does not regard his magic as being the same kind of activity as weeding a field or sharpening a knife; the magical rite is of a different order, dealing with external and mystical forces.

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A problem that is relevant here is that of the scientific proof of the efficacy of magic. Why do people continue to believe in magic when it is clear (at least to outside observers) that there is empirically no cause-effect relationship between a magical rite and the desired and supposed consequence? The main purpose of magic is not so much to achieve a certain technical end as to perform an act that has symbolic or psychological value. It is thus pointless to test it, in the sense that a Christian does not test the efficacy of prayer as he might that of an internal combustion engine. The problem was discussed by Tylor (see below), who produced reasons why failure of magic was not easily apparent. The idiom of magic pervades all in contact with it and cannot be tested scientifically in its own terms, so that tests as to the magic's efficacy are not in fact tests at all but rational statements about common-sense experience.

THE MAIN THEORIES OF MAGIC

There is a voluminous literature on magic. The earliest studies were those of Judaic and Christian scholars concerned with the relationship of magic to their faiths, both as relics of paganism and as heresy. During the latter part of the 19th century, anthropologists entered the field, with the aim of analyzing magic by looking at cases as reported from peoples throughout the world and to see the place of magic in the evolution of all religions of mankind from prehistory to the contemporary world.

**Anthropological.** The first important figure was E.B. Tylor, who, in his *Primitive Culture* (1871), regarded magic as a "pseudo-science" in which the "savage" postulated a direct cause-effect relationship between the magical act and the desired event, whereas in reality the link is one of the association of ideas only. Although Tylor regarded magic as "one of the most pernicious delusions that ever vexed mankind," he studied it not as a superstition or heresy but as a phenomenon based on the "symbolic principle of magic," a logical scheme of thought founded on a quite rational process of analogy. He also faced the question of why the believer in magic did not realize its inefficacy. His reasons included the frequent association of magic with empirical behaviour, nature often performing what the magician tries to do; the attribution of failure to the breaking of taboos or to hostile magic forces; the plasticity of the notions of success and failure; and the weight of cultural belief and authority behind the magician. He also realized that magic and religion are parts of a total system of thought; they are not alternatives but complementary, and thus not stages in the evolutionary development of mankind—although he considered that magic and animistic beliefs decreased in the later stages of history.

Frazer's theory

In *The Golden Bough* (1890 and later editions) James G. Frazer refined Tylor's views on magical thought, discussed the relationship of magic to religion and science, and placed them all in a grandiose evolutionary scheme. He analyzed the principles of thought that lay behind the false cause-effect relationship between magical and natural events. They were that "like produces like, or that an effect resembles its cause" (the Law of Similarity) and that things once in physical contact with each other later continue to act on each other at a distance (the Law of Contact or Contagion). Magic based on the former he called homeopathic magic, that based on the latter he called contagious magic. He added the notion of taboo as negative magic, acting on the same principles of association. He accepted Tylor's linking of magical and scientific thought as both being based on the belief that a particular act necessarily or invariably results in a particular effect, magic thus being a "spurious system of natural law." Frazer also developed an evolutionary scheme for mag-

ic and religion. He saw magic and religion as belonging to different stages in the development of human thought. Magic was prior because it seemed to him to be logically more simple, because he assumed (erroneously, as was shown later) that the Australian aborigines, examples of an archaic people, believed in magic but not in religion, and because magic forms a substratum of superstition even in advanced societies. Individuals in the earliest cultures must have come to realize the inefficacy of magic and the powerlessness of men to control nature; from this they postulated the existence of omnipotent spiritual beings who required supplication to direct nature as men wanted. Thus there came into existence religion. The final stage in this schema is when men begin to recognize the existence of empirical natural laws, aided by the discoveries of alchemy and then of science proper. With this final development religion joins magic as superstition.

These writers, and their followers such as Robert Ranulph Marett (1866-1943), regarded magic as essentially an individual and intellectual matter, one of the ways in which individuals think about the world. Another line of writers has widened the discussion by regarding the problem as essentially one of the social function of magic. The first such writers of note were the French sociologists Marcel Mauss (1872-1950) and Emile Durkheim. Durkheim, in *The Elementary Forms of the Religious Life* (Eng. trans., 1915), considered that magical rites comprised the manipulation of sacred objects by the magician on behalf of individual clients; the socially cohesive significance of religious rites proper, by the priests, was therefore largely lacking. His views were followed by A.R. Radcliffe-Brown (*The Andaman Islanders*, 1922) and to a lesser extent by Bronislaw Malinowski (*Argonauts of the Western Pacific*, 1922, and various papers brought together as *Magic, Science and Religion*, 1925), the latter influenced more by Frazer and the early psychoanalysts. Radcliffe-Brown's main hypothesis has been mentioned above: the social function of magic was to express the social importance of the desired or protected event. Malinowski, on the other hand, regarded magic as being opposed to religion, and as directly and essentially concerned with the psychological needs of the individual. It acted to extend his normal knowledge and competence; to provide confidence in situations of technical uncertainty by "ritualizing optimism"; to express desires that are otherwise unrealizable in a small and technically limited community; and, as counter-magic, to explain failure. Malinowski's influence has been marked, due largely to the fact that his was the first detailed and first-hand account of the actual working of an ongoing system of magic. Other writers, notably R.R. Marret in England and Robert Lowie and Alexander Goldenweiser in the United States, differed from Tylor and Frazer in pointing out that the distinction between magic and religion is largely untenable, reflecting an ethnocentric distinction between the "natural" and the "supernatural" that is not made by most other religions.

In recent years there have been many reports of the working of systems of magic, especially from Africa and Oceania. On the whole they have followed Malinowski and Radcliffe-Brown and have been based on the single most important work on the topic that has appeared since them, E.E. Evans-Pritchard's (1902- ) *Witchcraft, Oracles and Magic Among the Azande* (1937). He shows concisely how magic is an integral part of religion and culture, being used to explain events the normal understanding and control of which are beyond the technical competence of this southern Sudan people. The Azande accept magic as a normal part of nature and society, together with witchcraft and oracles. These various phenomena form a closed logical system, each part of which buttresses the other and provides a rational system of causation of both natural order and the social order—as well as disorder or coincidence.

**Psychological.** These various anthropological approaches to magic have had the advantage of regarding it as a social phenomenon rather than one of individual psychology. The views of Tylor and Frazer, however,

Theories of Malinowski, Radcliffe-Brown, and E.E. Evans-Pritchard

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are eventually psychological in nature, since they are based on their notions of individual ways of thought. Their work was considerably based on that of Herbert Spencer and Wilhelm Wundt, thinkers of pronounced psychological interest, and was followed by anthropologists with psychological views on origins of magic and religion, such as Lowie, Paul Radin, and Goldenweiser, all of whom were concerned with the problem of the individual psychological status of believers. Much of Malinowski's work depends on providing psychological reasons for belief in magic. Sigmund Freud (*Totem and Taboo*, 1918) had at one time considerable influence in his view that magic, the earliest phase in the development of religious thought (following Frazer), was similar in its essential processes to the thought of children and neurotics. This view was based on his theory of the "Omnipotence of Thought," by which savages, children, and neurotics all assumed that wish or intention led automatically to the fulfillment of the desired end. This view has long been abandoned as a tenable hypothesis, due not so much to its inherent misunderstanding of the expressive nature of magical ritual as to the general recognition that the assumption of the similarity between primitive, infantile, and neurotic modes of thought is false; it arose largely from the ignorance of the nature of primitive culture before the development of modern anthropological field researches.

**Conclusion.** The study of magic as a distinct cultural phenomenon has a long history in anthropological and historical studies. Although the distinction between it and other religious phenomena may often heuristically be useful, it cannot be studied in isolation as was once the fashion. It is essentially an aspect or reflection of the worldview held by a particular people at a particular stage of development in scientific and technical knowledge. It is thus a part, although to the people concerned often a very important part, of their total system of religion and cosmology.

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(J.F.M.)

## Magnesium Products and Production

Magnesium is a silvery-white metallic element similar in appearance to aluminum but weighing approximately one-third less. It has a density of 0.0628 pound per cubic inch (1.738 grams per cubic centimetre). Like many other metals, magnesium in its pure form has few appli-

cations, but magnesium alloys are widely used, particularly where light weight and high strength are important, as in aerospace and automotive applications. The chemical compounds of magnesium have wide application in industry, medicine, and agriculture.

**History.** The English chemist Sir Humphry Davy is said to have produced an amalgam of magnesium (an alloy with mercury) in 1808 by reduction of the oxide, using a mercury cathode. But the first free metallic magnesium was produced in 1828 by the French scientist A.-A.-B. Bussy. His work involved the reduction of fused magnesium chloride by metallic potassium.

In 1833 the English scientist Michael Faraday was the first to produce magnesium by the electrolytic reduction (breaking down by an electric current) of magnesium chloride. Magnesium remained a laboratory curiosity until 1886, when I.G. Farbenindustrie of Germany undertook the manufacture of metallic magnesium on a production basis, using Faraday's electrolytic process.

Until 1915 Germany was the sole producer of magnesium, but during World War I this source was shut off from most of the world. Operations to produce magnesium were initiated in the United States by several organizations, most successfully by the Dow Chemical Company of Midland, Michigan. The Dow process, involving the electrolytic reduction of magnesium chloride, originally utilized deep brine wells at Midland as the raw material source, but these have been superseded by the use of seawater.

**Raw material sources of magnesium.** A number of extractive methods are used in the recovery of metallic magnesium from its raw sources. These methods vary considerably depending upon the type of primary raw mineral, which may be found either in mineral deposits or in aqueous solutions.

Among the raw ore deposits, the most common minerals are the carbonates dolomite (a compound of magnesium and calcium carbonates,  $MgCO_3 \cdot CaCO_3$ ) and magnesite, or magnesium carbonate ( $MgCO_3$ ). The oxide mineral brucite, magnesium oxide associated with water ( $MgO \cdot H_2O$ ), is less common, while the chloride mineral carnallite, a compound of magnesium and potassium chlorides and water ( $MgCl_2 \cdot KCl \cdot 6H_2O$ ), is rarer still.

Magnesium is recoverable from aqueous solutions of brine wells, but by far the largest source of magnesium is the oceans of the world, where it appears in its chloride form. While seawater is only approximately 0.13 percent magnesium, this proportion remains quite constant and represents an almost inexhaustible source of supply—approximately 12,000,000,000 pounds (5,500,000,000 kilograms) of magnesium per cubic mile of seawater.

The uniformity of magnesium content in seawater facilitates standardization in process recovery and offers certain economic advantages, which can vary with geographic location of the producer.

**Refining and recovery.** Magnesium is produced by two distinctly different methods. One is the direct reduction of the magnesium ores by strong reducing agents such as carbon, silicon, etc. The other is by electrolytic reduction of magnesium chloride. In the past, magnesium produced by direct reduction was of higher purity than that derived by electrolytic reduction, but because of process refinements, this is no longer the case. Where power costs are low, electrolytic reduction is the cheaper method; and, indeed, it accounts for much the greater part of world production.

**Electrolytic reduction processes.** Both the early German process and the Dow process use magnesium chloride as the basic source, differing primarily in the characteristics of the electrolytic cell employed.

The flow chart of the Dow process is shown in Figure 1 and represents the method used by the Dow plant near Freeport, Texas, where abundant natural gas is available for cheap power; nearby Galveston Bay provides an inexhaustible supply of lime in the form of oyster shells. In this process, seawater is mixed with calcium hydroxide in a processing unit called a flocculator. The calcium hydroxide is obtained by processing oyster shells. In the flocculator the calcium from the calcium hydroxide is

First  
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magnesium

Magnesium  
in  
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Magnesium  
chloride  
as raw  
material