

SCIENCE

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SCIENCE AND THE SUPERNATURAL¹

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I INTEND to make this discourse more modest than the title, and I trust you will find it so. Science is one, at least in its essential element, the method of reaching approximate truths. But scientists are many. On the topic before us it is preposterous for any man to speak for science as a whole and, by inference, for all scientists. We have scientists who still pray to the gods, scientists who laugh at the gods, and some who neither pray nor laugh, because they think they understand. I am sure all you expect of me this evening, and certainly all I intend to do, is to discuss the supernatural in the light that years of service in the science of physiology have given me. The topic of this discussion is not of my own selection. The views are my own. But they are neither unique nor original, except in the sense of

¹William Vaughan Moody Lecture, University of Chicago.

being derived from cogitation on the common life, cogitations disciplined by years of research. I am not foolish enough to pretend that I am about to present to you anything that is both new and true. There are able tomes on the nature of science; and literature, *ad infinitum*, on the supernatural, especially in religions. There are able works on the conflicts between science and the supernatural. There are attempts at reconciliation of the supernatural with science. We have, in print, confessions of faith in traditional religions by otherwise competent scientists. We have, also in print, rejections of the supernatural by preachers and teachers of religion. I assume you are familiar with some, if not all, of this literature. Everything I am going to say has already been said, perhaps better, by other people. Nevertheless, here is the confession of a physiologist of lack of faith in the supernatural, and his reasons.

SCIENCE

It is scarcely necessary, before this audience, to go into detail as to what we understand by science, although the term is frequently used loosely and with very different connotations. Probably the most common meaning of science is a body of established, verifiable and organized data secured by controlled observation, experience or experiment. Such data frequently lead to an approximate understanding of the causal relations between events, and these relations give us the so-called laws of science. To my way of thinking, the element in science of even greater importance than the verifying of facts, the approximation laws, the prediction of processes is the method by means of which these data and laws are obtained and the attitude of the people whose labor has secured them. In other words, the most important element in science appears to be the scientific method. What is the method of science? In essence it is this—the rejection *in toto* of all non-observational and non-experimental authority in the field of experience. No matter how high in state, church, society or science the individual may be who makes pronouncement on any subject, the scientist always asks for the evidence. When no evidence is produced other than personal dicta, past or present, “revelations” in dreams, or the “voice of God,” the scientist can pay no attention whatsoever, except to ask: How do they get that way? If evidence is produced, he proceeds to examine the evidence. Does the evidence justify the conclusions or statements made? There is nothing recondite or abstruse in the method of science. To be sure, in many fields of scientific research methods of approach, methods of experimentation and data leading to certain or probable conclusions are becoming increasingly so recondite and specific that laymen in general and, in fact, scientists in other fields, are unable to follow, but the principle of the method is simple enough, and that this method of approach will give us the closest approximation to understanding and truth that we are able to reach to-day I think will be agreed to by all informed people.

The principle of the scientific method, in fact, is only a refinement, by analysis and controls, of the universal process of learning by experience. This is usually called common sense. The scientific addition to common sense is merely a more penetrating analysis of the complex factors involved, even in seemingly simple events, and the necessity of numerous repetitions and controls before conclusions are established. Where laymen, as a rule, do not understand or apply the scientific method is in the matter of controls. Thousands of honest errors have been committed and ludicrous conclusions promulgated by failure to understand the necessity of controls. Illustrative instances

of this may be cited from the field where I have most experience, namely, physiology and disease. Fortunately, man recovers, as a rule, spontaneously from many diseases, such as colds, pneumonia, typhoid fever, headaches, diarrhea, etc. To be sure, some of these diseases may also lead to death, but if the person having these ailments does not die in the process of the malady, there is more or less complete recovery. Now, if the person not aware of this has the notion handed to him by his father, his priest or his mythology that holy water, holy oil, an amulet, a prayer, the killing of a goat or the laying on of hands will cure these diseases, experience will teach him that after applying any one or all of these measures to the sick persons many of them do get well. Indeed, applying all these to the sick might be a kind of control because a thinking person might be led to wonder which of these measures was the most potent in re-establishing health, and such questioning might lead him to try whether the person might recover without any of them. But usually this is not done. Those who believe that ill health can be cured by prayer will pray. Those who believe that an amulet is a cure will apply the amulet, and those who have faith in holy oil or laying on of hands will try these methods, and most of the people get well. A true statement of the facts is that sick persons so treated do get well after the treatment. The common error made is that the person recovers because of the treatment. The experience is correct. The conclusion is wrong. There is no control. The obvious control, of course, is a sufficient number of people of the same age with the same malady and none of the above measures applied, and the duration of their illness and percentage of recovery contrasted with the treated group. Until consciousness of the necessity of controls in all endeavors to ascertain new truths or in evaluating current theories, dogmas or practices, until this consciousness has become a compelling factor in society, man remains essentially unscientific no matter how much detailed scientific facts he may remember and how much scientific patter he may have absorbed. He is like the rooster who crows every morning before daybreak, notices that a little later the sun rises, and then concludes that it is his crowing which brings the sun above the horizon.

It seems that the supernatural in the sense of religions or a religious attitude toward nature and life is nearly universal among men at some stage of development. Science in the sense of elements of the scientific method, the learning by experience, is even more universal. It antedates man. The amoeba appears to work in part by the principle of trial and error; so do some of the higher animals, including the ape. This type of reaction or behavior in the

simpler forms of animal life does not necessarily connote conscious associative memories, but there is no good reason for denying the latter factor in the higher animals. The trial and error method is direct experience. Experience is experimentation in embryo. The very fact that every known race or tribe of humans has changed (some say progressed or improved) in the practical arts of living, in mores, in social organization and in religion is evidence of some learning by experience, despite all the retarding force of tradition and myths, and despite the absence of conscious control and analysis. Learning by experience, however, can not be dignified as science until a critical analysis of the factors and rigid controls of experience are introduced.

The *attitude* of the scientist is also an important factor in application of scientific method and therefore in the science itself, or at least in the growth of science.

This attitude is, of course, partly characterized by challenge of authority, be it man or God. It is further characterized by a serious attempt on the part of the scientist to control his own emotions and his own wishes in the matter. The scientist is, after all, an ordinary human being and the control of his desires, emotions or wishes in a problem is seldom, if ever, one hundred per cent. The scientist tries to rid himself of all faiths and beliefs. He either knows or he does not know. If he knows there is no room for faith or belief. If he does not know he has no right to faith or belief. He may have grounds for hypotheses, but the moment he begins to have faith in his hypotheses the hypotheses tend to become myths. One of my teachers in zoology used to say to us: "Friends, it is necessary, at present, to entertain theories in zoology, but we must be on our guard against being entertained by these theories." These elements of the scientific attitude I have indicated are scientific ideals which few, if any, scientists are able to attain all the time, particularly when they are dealing with matters of tradition or matters to which they are emotionally conditioned in early youth.

The term science is sometimes limited to the fields of mathematics, astronomy, chemistry, physics, geology, biology, and their practical applications. This may be due partly to the fact that in these fields we have to-day the greatest body of verifiable data and so-called laws of science. However, one of the elements in the scientific attitude is the application of the scientific method to the entire universe, including all human experience and all human relations. The man of science seeks for evidence in the case of all traditional beliefs and practices, and he must abstain from positive views when evidence is lacking in these fields just as he does when evidence is lacking in his

own particular field of endeavor. Of course, it is much more difficult to apply the method of science to such fields as religion, social customs, political and economic institutions. Scientific controls are not readily devised or secured, but the application of the method of science in these fields has justified itself by results. It has afforded us a better understanding of the origin of our social heritage, even if it has not to date yielded any considerable body of verified data or laws similar to that of physics, chemistry, geology or biology. To the oft-repeated question—Are psychology, sociology, economics, etc., real sciences?—I would answer: They are, to the extent that the rigid application of the scientific method and scientific attitude is pursued by the people who cultivate these fields. The biologist is confronted in his own field by some of the difficulties that other scientists experience when they enter the fields of sociology, political science, psychology or religion. The past seems to be behind us despite the idea recently advanced that time may actually run backwards. Time may run backwards or in circles in the mind of the philosopher, but it does not seem to run backwards in biology. At any rate the history of the early ancestors of living plants and animals, and possibly the very origin of life itself, is only dimly written in the strata of the earth of bygone geological epochs. We may discover and describe a link here and there, but many of the links are as yet missing. We can not experiment with the past, we can not establish controls. Not only that, but many of the processes in the life of the individual man, animal or plant of to-day appear to be as complex, as difficult to analyze and separate and therefore control as the complex forces in society.

So much for science. If we have rightly understood and correctly outlined the method, attitude and scope of science, we might stop right here, and let you draw your own conclusions as to the supernatural, the "holy," the "divine." It might be better thus, for those of you who have already done so will be bored by the rest of this discussion; and others might take the conclusions on my mere say so, or reject them because contrary to their faith. In either case further discussion is largely futile.

THE SUPERNATURAL AS A WAY TO KNOWLEDGE

By supernatural we understand information, theories, beliefs and practices claiming origins other than verifiable experience and thinking, or events contrary to known processes in nature, such as the production of wine from water alone; the resurrection from the dead of persons in advanced stages of decomposition; accounts of creation of the world and of man by people who were not present at these events, and not in a position to infer from cosmic data; specific

codes of behavior enunciated directly to some man by some anthropomorphic god; arrest of the course of the sun through space so that the Jewish army could see to kill a few more natives; casting devils out of men, and sending demons into hogs; human pregnancies solely through non-material, that is, divine agencies; perpetual recurrence of a species of "immaculate conception" in that a divinity sends embryonic "souls" into every human fetus either at the moment of union of sperm and ova, or later in intra-uterine life, etc., *ad infinitum*, *ad absurdum*, *ad nauseam*. This supernatural has been presented to man with varying degrees of clarity in a great variety of books and sermons by prophets, priests, and other holy men, in addition to the information in so-called sacred books, such as the Bible, the Koran, the Vedas and the book of Mormons. We all know that there are great variations among modern adherents of the sundry religions both in the amount that they individually accept and in interpretations put on what they do accept of this supernatural. But the supernatural in this sense is found at present in the theories, beliefs and practices of most, if not all, religious groups. We find a sprinkling of it here and there in social habits, customs and ethics. At one time it was prominent in political institutions and theory, but in most parts of the world "rule by divine rights" has been abolished, at least in theory. The gradual elimination of the supernatural and the divine in governments can not be primarily credited to science or scientists. It was forced by the travails of the common life. The supernatural sanction in social customs, habits or ethics frequently touches matters of relatively little importance, such as the interdiction of eating pork for the Jew, and the eating of meats on Friday for the Catholic, the ritual of baptism in the Christian religion, the circumcision in the Jewish religion, shaving or not shaving the face or the head, etc. The dogma that each individual marriage, when solemnized by a priest, is a "sacrament" made in Heaven by Almighty God and holds "till death do them part" has a more practical significance.

I am no authority in this field, but according to the best information now available it would appear that early mores had little or no connection with the supernatural. The grafting of the supernatural on ethics appears to come relatively late in human history. At any rate, so far as the essential mores of practical living is concerned, similar principles have been developed in various social groups independent of, parallel with, or under the influences of a variety of religious beliefs. These, therefore, have the sanctions of social necessity, convenience, or safety quite apart from the supernatural.

The supernatural is particularly abundant in the field of religions. I shall not attempt the impossible, *viz.*, a definition of religion. We have, however, people who entertain religious theories and follow religious rituals. When I speak of the Jewish, the Christian or the Mohammedan religions I refer to the theories, practices and attitudes peculiar to the people in these religious groups. I think we may get somewhere in the discussion if we treat religion in this way rather than by abstract definition. Most religions have in common the view and belief that some time somewhere God or gods, supernatural beings, communicated to man information on the origin and nature of the universe, on the origin and nature of man, on the nature and control of the forces of nature about us, on the nature of evil, etc. In most cases these so-called revelations occurred so long ago that the person or persons receiving them are buried in obscurity and myths. We can not analyze the alleged facts and circumstances. Fortunately, we have in this country two recent divine revelations of this type, namely, Mormonism on the basis of the Book of Mormons, and Christian Science on the basis of the divine teaching of Mary Baker Eddy. These are so recent that the personalities and the circumstances involved are not yet entirely obscured by myths and lore.

What has science to say to all this? The most serious aspect of the supernatural is, not the revelations, *per se*, the miracles, the myths and the guesses, but the injunction that all this must be taken on faith, that inquiry and doubt is tabu—that is, sin. A good deal of "revealed" information about the nature of the world and the nature of man has proved entirely erroneous. So far as the nature of the world and of man is concerned the revelations appear to be nothing but what could have been projected as guesses by any human contemporary of the revelations, on the basis of the knowledge and the ignorance of those times. The "revelations" have been of no aid in the advance of real knowledge of cosmogony, physiology, physics, chemistry or disease. On the contrary, they have, through human stupidity and obscenity, frequently aided in retardation. The revelations to Joseph Smith (the Book of the Mormons), the repeated revelations by Jehovah to Brigham Young, and the rise of Christian Science are recent. The character, education, intelligence and environment of the people concerned are fairly well known. In the light of all the known facts in these instances, is there any intelligent man or woman to-day, not steeped in childhood in the lore of Mormonism or Christian Science, who can have any respect for such revelations as a source of knowledge? When the Mormon leaders received a tip from God that po-

lygamy was ordered by him for his chosen people on earth (by the way, a revelation that is easy to take by the average human male), the United States Government did not hesitate to challenge God, or Brigham Young's sanity and veracity. The Federal Government was powerful and adamant and God yielded through a second revelation to the effect that he had changed his mind and polygamy was no longer according to the plan of God! In some cases the "revelations" are reported as coming through dreams; in other cases through brush fires; by direct writing of the finger of God on stones, or indirectly through oracles, popes, the flight of birds and the liver of slaughtered bulls.

The physiologist can not accept revelations from dreams any more than he can detect wisdom in hallucinations. The brush fire may reveal something of the nature of the world, but it can tell us nothing of the origin of man or the ways of the good life. The supernatural as a way to knowledge is in direct conflict with science.

That many intelligent people of to-day both inside and outside the religious groups reject much of the anthropomorphism of the gods and the more palpably absurd phases of the supernatural as a way to understanding is no news to you. They usually retain a distillate of the supernatural in form of beliefs in a "moral purpose" in the universe. And having injected human ethics into an obviously a-moral universe,² they endow man with personal immortality. This refined supernaturalism is still essentially anthropomorphic and homocentric. Even this form of the supernatural has no sanction in science or analyzed human needs, as I understand them.

THE CONTENT OF THE SUPERNATURAL REVELATIONS

So far we have considered the supernatural mainly from the aspect of the way of learning, the way of extending knowledge, the way of greater approximation to truth. A word or two on the content of the supernatural seems in place here. Most of the weird stories of creation of the universe, animals, man, of divine or demoniacal control of natural forces, of disease, etc., that have come to us *via* the supernatural route run contrary to facts now known, or rendered untenable, as possibilities, by known facts. Between the stories in the book of Genesis, as an article of faith, and the planetesimal hypothesis of Chamberlin and Moulton (probably the greatest intellectual

achievement so far in the University of Chicago) as a working theory, science *must* choose the latter. Divine benevolence and wrath, devils and demons are not factors in health and disease, according to the data of modern medicine. Science and miracles are incompatible. Much happens in nature and in man for which science has yet no complete analysis of the causal chain. We recognize the unknown but not the unknowable. When we know that we don't know, that is itself an achievement, for then the field is cleared of the confusing and obstructing rubbish of tradition, and we are free to use all our ingenuity and imagination in contriving methods to find out. Miracles of sufficiently recent occurrence so that fair information is available of the alleged facts and circumstances are resolved into misrepresentation or misinterpretation of the facts. In regard to the recurring miracle of changing bread and wine into human flesh and blood by Christian rituals, biological and biochemical tests of the bread and wine after being subjected to such rituals reveal nothing but the original bread and wine. To persons fairly familiar with biology and physiology the theory of animal and human evolution and genetic relations is a closer approximation to what happened in the past than any guess or story in "sacred books" or mythology. I have a fair acquaintance with most of them.

The theory of dual nature of man (body and "soul") and its equal: The theory of *personal immortality* appears to be partly of mythological and supernatural origin, partly philosophical. The alleged objective evidence of these views is entirely mythological and supernatural, unless we are to dignify as evidence the ancient and modern communications with the dead by clairvoyance, "psychic mediums" and "ectoplasm." When examined, the "ectoplasm" appears to go the way of all errors and frauds. I know these attempts, and I am still skeptical.

Has science anything to say on the theory of personal immortality? The idea of persistence of the individual after physical death came down to us from the ancients in most if not all races. What credibility are we going to give to the idea solely because of its venerable age? So far as I can see, we can give no greater credibility to the ancients, views on immortality than to their views on other things about which they knew nothing. Conscious phenomena and intelligence in man, that is, personality, appear to be just as much an evolution of the material world as is the rest of the body processes. We seem to be forced to this conclusion from the evidence of the intimate dependence of all phases of consciousness, memory, and personality on the quantity and quality of the nervous system, and these, in turn, depend on all the rest of the body mechanisms.

² The concept of moral and immoral behavior has developed in connection with normal human adults or any hypothetical personality, to whom we ascribe consciousness of "right" and "wrong," and a feeling of freedom of choice in behavior. "*A-moral*" signifies the absence of these elements of personality, as in the behavior of young children, animals, the insane, and the physico-chemical forces of the universe.

It is perfectly true that we can cut off an arm or leg, remove certain peripheral ganglia and even a certain limited part of the central brain without seriously interfering with consciousness or personality. We can leave the brain structure anatomically intact, and through poisons eliminate consciousness temporarily or alter the individual personality permanently. The data from brain tumors, brain injuries, drugs, such as sedatives, hypnotics and anesthetics, experimental physiology, defective heredity, show that there is a close correspondence or dependence of consciousness, intelligence, memory or individuality on the nervous system.

What is personality? I think biologists would agree, to-day, that one element in personality is heredity, the kind of germplasm with which we are endowed at conception.

In the case of man and other mammals the original germplasm is subjected to months of intra-uterine environment. The latter is complex, not simple. Such material factors as the constitution, health and food of the mother appear to have a very real influence on the constitution of the fetus, and after birth such material factors as disease, accidental injuries, food, etc., may further materially modify the final product: man or woman.

The hereditary personality is further modified and built up gradually by experience and memory, so that to-day I am a somewhat different person from what I was twenty years ago. It seems at least highly probable, on the basis of biology, physiology and medicine, that this experience or the cumulative effect of the environment depends on changes built up mainly in the nervous system. The modifications of the nervous system called memory are less stable than the hereditary elements of the nervous organization. All the present evidence points to the fact that at death the nervous system goes to pieces with the rest of the body. Indeed, the disintegration of the nervous system, and with it the personality, may start before the death of the individual. The tragedies of "second childhood," of the aphasias, of senile dementia are known to all informed people. It doesn't make any difference whether the disintegration is fast or slow. We may preserve for a time some externals by desiccation, embalming or petrification. But fossils and mummies are as dead as the ashes of the funeral pyre. I can not conceive of events and environments in the future that would exactly reproduce my heredity and personal experience. Our basis of the known and the probable, immortality of the person is, at present, untenable. Leaving, for a moment, the realms of knowledge and reason and speaking of personal wishes, of likes and dislikes, the wish for personal immortality may be an extension of the pleasure in

living, sometimes called "the will to live." The quantity of these emotions appears to vary in different people. Many seem to find comfort in the theory of "Nirvana," the state of everlasting unconsciousness. "Nirvana" may, without trickery or undue violence to reason, be translated into what modern biology indicates as the end of the individual, but the ways of attaining "Nirvana" appear to me incompatible with the good life here. As for other conditions of existence of the individual after death, other abodes of the "souls," the sundry infernos arouse in me, not fear, but pity and wonder how man can choose to torture his mind with such cruel absurdities; and I have not seen any heaven described where I care to go. My forebears had their Valhalla with its mead, its roast pork, its combats; the American Indian his happy hunting grounds; the followers of Mohammed their haven of houris; the Christian has his golden city of many apartments, his golden harp and his oriental worship of adulation. But hunting means destroying fellows not so very different from ourselves. A heaven of mead and pork and fights and females forever leaves me cold. Flowers, though they like ourselves last but for the moment, are finer than gold, and justice seems a better goal than worship. When the shadow lengthens I am content to call it a day and leave the work to others. The passing of personal immortality seems to have added interest to my work to-day, greater interest in my students, in my fellow men, in other things that seem worth-while human efforts. For when I die, I will be a long time dead.

I am perfectly well aware that many able and fine people inside and outside this hall will arise with impatience, if not in anger, and say: "Your analysis of the supernatural refers to an extinct species. It does not apply to religions or religious people of to-day. You are belaboring a man of straw." What are the facts? Is supernaturalism a thing of yesterday? Have the peoples of the earth ceased to chant every variant of the tune, "The old time religion is good enough for me"? If the orthodox Jew (and that embraces most of the Jews) has dethroned Jehovah, and rejected the Bible, I have not heard of it. According to the latest news the Pope is still God's viceroy among men and the faithful Roman Catholics still believe that the voice of the Vatican is the voice of God. The acceptance of the whole Bible as divine truth is not a rarity among Protestant Christians. The God of the Jews, the Christians and the Mohammedans in 1930 is not a fossil. Enter almost any religious service and you get an earfull of ancient and modern supernaturalism anent the soul, the devil, hell and heaven, sin, redemption, almighty Gods, angels, divine purposes, prayer. Is the supernatural

extinct? Take a look on and about this campus, and you will find a very prolific and very recent growth of chapels and churches: edifices, I am delighted to note, only in part dedicated to the rituals of the "God of old." To be sure the supernatural is not in our federal constitution. But it is not absent from state and municipal codes. "Acts of God" are embalmed in legal lore. Physiology and biology can not be taught at public expense in the states of Tennessee, Arkansas and Mississippi because it conflicts with "revelation." Is supernaturalism dead? What I have said here to-night would subject me to arrest and imprisonment in the state of Massachusetts, and disqualify me as a witness in court in at least six other states in the Union. Yes, my friends, supernaturalism is dead, indeed! Let a Jew, a Roman Catholic, a Mohammedan, or a man of no belief, like myself, run for governor in any state south of the Mason and Dixon line (and possibly in some states nearer home), or for President of the United States and he will discover something! The world has, indeed, moved since the days of Galileo, but in some places it has not moved very far. Why, the handful of liberal and informed people who have worked their way out of the cocoon of supernaturalism does not even make a respectable leaven in the college graduate group!

President Hoover, an engineer, and therefore at home in science, stated in his recent Thanksgiving proclamation: "We have been blessed with distinctive evidence of Divine favor. As a nation, we have suffered far less than other peoples from present world difficulties." This statement appears to imply that a divinity controls economic contingencies and rainfall, and either that we as a nation are morally more worthy than other peoples harder hit by economic and natural events of the past year, or else that this divinity is unfair in decreeing punishments and favors.

According to several Italian churchmen, the recent disastrous earthquakes in Italy were caused, not by unbalanced stresses in the crust of the earth, but by the Christian God, as punishment for the sins of men, women and little children in the devastated areas! Granted, for the sake of the argument, that the bishops are right and modern geology is wrong about earthquakes, we may still ask for evidence that men, women and little children living in earthquake areas are greater sinners than people living elsewhere; and again, if questioning was not tabu, how can a *just* and *loving* god institute such indiscriminate punishment? How can a *just* and *almighty* God permit such catastrophes to occur?

Within the present year five Protestant pastors in our neighboring state, Kentucky, are reported to have published the following statement: "God will and can answer prayer for rain. God has never withheld rain

from the earth except in a gracious effort to bring his own people back to the ways of righteousness and holiness." If there is a God both almighty and just, prayer for rain and all kinds of favorable weather anywhere is unassailable. But if rain is sent to earth in proportion to holiness and prayer to Jehovah, the sundry heathens and all worshipers of "false gods" would have a dry time, not to speak of plants and animals who, according to the Bible, have no souls to pray with. Unfortunately for that kind of faith, the rainfall in heathen Philippines (that is, before the introduction of Christianity) was greater than in our Christian state of Tennessee. But this question need not be left in the realm of faith and controversy. It can be settled by controlled observation. What is the ratio of rainfall to Christian, Jewish, Mohammedan or Mormon prayers in various lands? The states of Washington and Oregon (west of the Cascades) have more rain than has the state of California (west of the Sierras). Is this difference due to the wickedness of Hollywood, and the past generation of gold diggers, and the holiness of the lumberjack? The adherents of the supernatural pray and irrigate the arid lands; others merely irrigate. The crops seem to parallel the irrigation rather than the prayers. Were it not for supernatural tabus, many other supernatural claims could be put to the experimental test. It should not be much more difficult to determine the efficacy of prayer against such diseases as syphilis, malaria, diabetes and goiter, than to establish the merits of arsenic, quinine, insulin and iodine. Not very long ago I read a signed public statement by a lady in the state of Kansas to the effect that she had seen a goiter melt away from the neck of another lady during the praying of the Reverend Aimee Semple McPherson directed toward this end. This appears like direct evidence. But metabolism tests, neck measurements and motion pictures of the "melting" process would go further to convince the skeptics. What people under intense emotions and desire to believe think they see has frequently no relation to the light that actually impinges on the retina. Intense faith as well as intense fear seem to predispose to hallucinations in many people.

The moral efficacy of infant and adult baptism could also be tested experimentally, although with less accuracy, until better quantitative measures of human character are worked out. A prominent physiologist told me he had done this experiment in his own family, having two of his children baptized, and keeping the other two children as controls. I will not even mention the results, for we draw no conclusion from so few experiments, but it might be pointed out that identical twins would be the best material for this test. Is supernaturalism dead? Some Protes-

tant clergymen inform us that Jehovah is a prohibitionist, and the people who oppose our present prohibition of alcoholic beverages are fighting God. Some of the Roman Catholics tell us that raising grapes and drinking wine is God's plan for man. Such confusion on the celestial lines of communication ought to provoke thought. It seems to induce nothing but reciprocal anger.

Many people take the position that science is well and good in the "material" world. They would exclude the method and attitude of science from certain fields of human life. A prominent New York rabbi said only a few days ago: "Human feelings and emotions will remain outside the scope of science forever." As if the biological sciences, including medicine, have not already produced a very respectable body of verifiable data on the mechanisms of the emotions. The relation of the brain to the emotions is nearly as clear as the relations of the kidneys to the secretion of urine or the relation of the gullet to swallowing. That complete obstruction of the gullet will prevent swallowing I do not think would be denied even by a rabbi. It is a favorite saying that there is more than science in the universe and in human life. We grant that. At the present the unknown exceeds the known. There is more ignorance than science. But is that a cause for exultation? Instead of wasting time and energy in the futile effort of building fences around science, and in a meticulous labeling of the "unknowable," we had better join hands in tackling the unknown, not with worship, prayer or propitiation, but with the tool of science. Here is useful and joyful work for everybody.

THE ETHICS OF THE SUPERNATURAL

May I make a few concluding remarks on the ethics of the supernatural, speaking not as a scientist but as a common man? The ethics of science is simple: absolute honesty in recording and presenting data, and curbing wishes, personal prejudices and emotions by reason in interpreting the data.

There appears to be a great variety of ethics in the supernatural. Looking upon the supernatural simply as man's early stumbling attempts at learning, at adjustment, as flounderings toward greater happiness, as quests for explanations of the unknown, this variety is both inevitable and understandable. From this point of view, the modern man of science has no essential quarrels with Jesus, Confucius, Zoroaster, or Buddha. They did the best they could, considering the ignorance of their times. We can do no more. But now and then individual champions of the supernatural have been either unusually stupid or inordinately selfish and cruel. The judgment of posterity will be severe on the men who coerced Galileo and

their brethren of to-day who know or might know, yet rivet the shackles of supernaturalism on the human mind. For they sin against man. It is significant that neither Jesus nor his apostles appear to have claimed any supernatural authority or absolute wisdom for their sayings or writings. The ignoble doctrine of divine revelation of absolute truth for all times appears to be a later invention. But in Mormonism and Mohammedanism it is present with the founders. I said: ignoble doctrine. Intellectual tyranny is to me as immoral as physical tyranny. Stifling freedom of inquiry and of thinking by religious tabus or legal dicta appears to me highly immoral.

The view or belief that some one man or group of men (such as Brahmins, popes, priests, etc.), above all other humans, is specially endowed or enlightened to perpetuate and advance truth, and mediate between gods and man favors tyranny. It seems inimical to knowledge and human dignity, hence immoral.

The supernatural theories of "sin," personified evil, redemption, eternal damnation, etc., when actually believed, have created and are creating much disturbance in man's emotional life, in the way of fear, worry, melancholy, if not outright insanity. The theory or doctrine of the vicarious atonement in the Christian religion is not only a projection of views and practices of barbarism into modern life, but it connotes a principle of punishment and propitiation at variance with modern sense of justice. It goes without saying that many Christian people are not aware of this.

If we take a look at the gods, they can be understood and condoned as inventions of man, at varying stages of social development. The fossilization of nearly all so-called sacred books by edicts and tradition has brought about the anomalous condition that the best people in many religions to-day are ethically superior to their gods. In the recent invasion of Palestine the modern Israelites have shown themselves in treatment of the Arabs, by and large, superior to Jehovah of the Bible.

If man as well as his social environment remained stationary, static mores might serve very well. But social, economic and political life appears to be more fluid than man. Hence the necessity of continuous amendment of the mores. For example, the travail of modern life is forcing the practice of birth control into the open for a more rational and humane settlement, despite the thunders from Mount Sinai and the echoes thereof from the Vatican Hill. If a physiologist, in 1930, may venture to reinterpret the aphorism of Paul, anent faith, hope and charity, it would read something like this: Faith is of the past, hope must be chastened by experience, charity in mod-

ern garb, is misdirected benevolence. But there remains the endeavor towards understanding, the hunger for beauty, the urge for justice—these three, and the greatest of the three is justice.

Science nurtures inquiry, the supernatural stifles it. The two are in their very essence incompatible, but they can apparently coexist in some scientists of the first rank. Man is, indeed, a perplexing animal. He is rarely consistently consistent or consistently inconsistent. The crook is not always crooked, the murderer not always cruel, the thief not always greedy. An honorable person may lie and a liar sometimes tells the truth. A shrewd business man may consult a soothsayer and be afraid of a black cat. Most men in early childhood are emotionally conditioned to the supernatural, just as they become emotionally conditioned to other elements of childhood environment: parents, places, playmates, nursery rhymes, the old swimming hole, and what not. Retaining and recalling these emotions please us. Adults may be conditioned, but usually with less emotional content than the child. We can be conditioned to science or justice just as to the supernatural, but the latter usually gets there first. The conditioned emotions usually outlive one's intellectual metamorphosis. Their disappearance seems to be a slow atrophy of disuse. Many factors appear to enter into the persistence of early conditioning to the supernatural, such as group loyalty, the desire to conform to social usage, the disinclination to disturb or distress parents and other intimate friends; social, political and financial ambitions, etc. Men also appear to differ in the emotional satisfaction obtained from the mystic. Additional factors, such as individual emotional capacity, may be operative in making some scientists think and work, while others think and work and pray. I admit it may be easier for men in the physical sciences than for biologists to cling to the supernatural, for much of the grotesque in the supernatural concerns man

and other living things rather than inanimate nature. But even so, it is a fact that Rev. Stephen Hale laid the foundation for the science of hemodynamics, and Friar Mendel discovered fundamental principles in heredity. So far as I know, the Reverend Hale and Friar Mendel were sincere adherents of their respective religious cults. Our social heritage, good, bad and indifferent, clings to us like the hand and the appendix of organic inheritance. Hence, like the proverbial Englishman, we "muddle" but, now and then, we "muddle through." Fear and faith have ruled much of man's past, but the millennium is still far, far away. Now let us try what may be accomplished by undertaking. Give science a chance.

I seem to sense a silent sigh from you, saying: "Thank God, he is through." I am—nearly. Knowing next to nothing about public speaking I consulted an experienced colleague, before preparing this talk. He referred me to a well-known canon, which reads: First, you tell your audience what you intend to tell, then you proceed to tell it, and lastly you tell what you have just told. You may have observed that I have followed this advice. I have now reached the lastly. Lest I be accused of hiding my real views in a plethora of verbiage, I will attempt to sum up, in threescore words, what I tried to say in seven thousand: As I see it, the supernatural has no support in science, it is incompatible with science, it is frequently an active foe of science. It is unnecessary for the good life. And yet, the supernatural, in varying dilutions, is likely to persist in society for a very long time. The unconditioning and reconditioning of mankind in fundamentals has been a slow process in the past. It may go a little faster in the future. It is a matter of forgetting the hypothetical universe created out of ignorance and motivated by our undisciplined emotions; and a reconditioning to the actual universe, as gradually understood through controlled experience and experiment.

COPE: MASTER NATURALIST¹

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AMERICA is slow to recognize her own great men. Along the entablatures of our scientific buildings as well as of our public libraries are enrolled all the

¹ Foreword of a volume soon to appear from the Princeton University Press entitled "Cope: Master Naturalist, the Life and Letters of Edward Drinker Cope," text 590 pages, classified bibliography of 150 pages and 1395 titles, by Henry Fairfield Osborn, assisted by Helen Ann Warren as editor and co-author. The volume is a sequel to the author's "Biographical Memoir of Edward Drinker Cope, 1840-1897," published by the National Academy of Sciences in 1930.

greater names in the long intellectual history of man beginning with the Greeks, but these tributes stop short when it comes to the enrolment of great Americans. We have shown so little appreciation of the life of the subject of this volume that his name is not even mentioned in the recent encyclopaedias which contain many lesser American names. In this case it is not difficult to find at least a partial explanation. Cope was never on the side of the great powers of the period either in science or in government, for both