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## PSEUDOSCIENCE AND ANTISCIENCE IN AN AGE OF SCIENCE\*

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This paper is about an unpleasant subject, pseudoscience and antiscience. In this age of enlightenment and of a far-reaching public press, it seems incredible that these are so widespread. Possibly it is as we might expect from the perversity of human prejudice and the lag of the mind of the multitude behind the conceptions of the scientists.

Pseudoscience and antiscience are not so distinct as they might seem. The old pseudoscience astrology and the strong antiscientific, antievolution movement which culminated in the antievolution law of Tennessee in 1925 and two other states shortly thereafter, will be cited.

Astrology is still rampant. Daily astrological horoscopes are found in our newspapers and in the large magazine stores there are many astrological magazines. They do not appear antiastronomical and may seem to be a harmless absurdity. But try to show this absurdity to a confirmed believer and you will recognize the antiscience which animates him.

In the antievolution movement there developed a strong pseudoscience. I refer not to the view of a large number of people, who, unaware of the nature and evolution of man and the universe, more or less feel they do not care about evolution or feel that evolution is irreligious. Instead, I refer to a relatively small number who write plausible tracts and books to be read by the aforementioned large group. For the most part these writers understand only a few of the facts. They are confused by some statements about data and unwittingly misuse them. The result is often considerable misrepresentation of the scientific evidence and concepts.

Among the best known of the pseudoscientific developments in this field was the so-called upside down geology of George McCready Price, geological authority of the Seventh Day Adventists. In his books (e.g., Price, 1926) he made much ado about the small areas of the west where thrust faulting had reversed certain strata, making them upside down so to speak. Despite the fact that geologists know the true time sequence of these strata over the continent, the reversed local position was all that Price needed to convince his readers that the fossils showed the evolutionary sequence wrong and that hence evolution was disproved.

The last antievolution book I read and closely analyzed (in the summer of 1947) bears the title "*After Its Kind, The First and Last Word about Evolution*" by Byron Nelson, Th.M. (1927).

You may be able to visualize the nature of the book by an example; I use the

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first example, the frontispiece with explanation. Since it is concise, I shall quote it in full.

FIG. I. Fossil cockroach from the so-called Carboniferous, supposed to have been deposited half a billion years ago. Cockroaches identical with this fossil form are living today. Concerning other insects it has been said "Certain Fossil insects well preserved in amber from geological periods which are reckoned by millions of years, differ in no perceptible way from individuals of the same species today." Professor D. F. Jones, Yale University (Genetics, p. 26.) "The only difference between a fossil and a recent animal is that one has been dead longer than the other" . . . Huxley (Biology and its Makers, by Locy, p. 335.) Fossil from Smithsonian Institute.

This is the quotation in connection with a picture of a fossil cockroach. The included quotations from Jones (1925) and from Locy (1908), which latter includes part of a statement of Huxley, are much out of context.

My answer will not be so concise. The half billion years is an exaggeration, to make his readers feel that the figure is most outlandish. From beginning of the Carboniferous or Mississippian period is about half that long, 250 million years. The first winged insects, Paleodictyoptera, occurred a little later, in early Pennsylvanian period. In the same period appeared Protoblattoidea or first primitive cockroaches, as well as others. Cockroaches comprise the family showing least evolution in morphological characters. It would not have served his purpose to refer to any of the larger and higher orders of insects with their relatively rapid evolution in many branches. There was much diverging evolution in insects in the Permian period and also in the 135 million years of the Mesozoic Era. By the beginning of the Cenozoic Era of 60 million years, all modern orders and most of their families were existing. Only newer genera and species continued appearing (Zittel, 1927).

Amber insects date from Oligocene epoch, about 40 million years ago, about one-third way up from beginning of the Cenozoic, and is at least five-sixths of the way along in time from the primitive first-winged insects. They are much like the insects of today, and to the layman they would look alike. For a concise statement on amber ants I quote from *Prehistoric Life* by Raymond (1939) who says, "Only 44% of the genera of amber ants seem to be extinct: eight of the species are practically indistinguishable from forms now living." Nelson would not like to know about the extinct genera. He stresses the few indistinguishable from living ones.

He read of the Huxley statement in Locy who, in a 19 line paragraph, makes very clear what Huxley meant. To offset the idea that fossils were merely dead, hard things of use as time markers, he stressed that paleontology was the study of organisms merely dead longer than the kinds with which people are familiar. Locy's last sentence reads, "The Statement of Huxley, that the only difference between a fossil and a recent animal is that one has been dead longer than the other, represents the spirit in which the study is being carried forward."

By cutting off the last line Nelson makes his readers feel that fossils are not very old and are of about the same age. In many places in the book he belabors this trying to convince his readers that the one Noachian deluge explains all.

Every page of the book contains errors. I must, before leaving it, point out that the first word about evolution in his intriguing title is Genesis, and the last word about evolution is Mendelian heredity, which he misunderstands as being contradictory to evolution and which he therefore makes much of in the last parts of his book.

Evolution is, of course, a fundamental principle in biological science, attested to by a tremendous, almost illimitable amount of evidence in nature. It is interesting and pertinent to see how, even long before as much was known of it as is known today, evolution had made a convincing impact upon the thought of man. There was relatively fast acceptance of the ideas of Darwin in his own time.

After his return from the Beagle voyage in 1836, Darwin dedicated himself to his work until his death. In 1859 appeared *The Origin of Species*. Quite a few leading scientists fully accepted it, but mainly there was strong criticism and protest. We recall the crowded meeting at which Bishop Wilberforce attacked it and Huxley defended it. But the attitude changed quickly. Even in 1871, when *The Descent of Man* appeared, applying the conception to man himself, the storm of protest was shorter-lived.

Before his death, honors came to Darwin. Cambridge University gave him a doctorate. The chancellor proclaimed, "You who have so learnedly illustrated the laws of nature are hereby declared our doctor of laws" (Moore, 1955). Darwin died in 1882 and was buried in Westminster Abbey. Scientists and statesmen of wide renown were there to honor him. Canon Farrar was among the pall bearers. The Church of England had accepted him and honored him. But it is ironical that even today so many people do not know this.

Most of the opposition to evolution has been due to the idea in the minds of people that evolution is irreligious. Science and religion are two different fields in many ways, and partly in the same ways as science and the humanities are two different fields. The methods of science study; the investigations in evolutionary biology, such as paleontology, embryology, and genetics, obviously differ from religious studies.

We have often read about the war between religion and science. If viewed in an objective way, it has been rather the intolerance of man of new ideas, the opposition of a fixed medieval theology to a growing and changing science, the contention of dogmatists that strict literal interpretation of early biblical writings be accepted just as the prescientific age people envisioned them, regardless of how childish a cosmogony that implied. And pathetically the fundamentalists still try to preserve this intolerance and medievalism. They do religion a disservice.

We know that at one time theologians and others regarded the idea of the rotundity of the earth and its movement around the sun as major heresies. Gradually more modern ideas of the universe became acceptable. Now the inconceivably enormous extent of the universe is accepted and even the idea of its evolution is accepted, or at least tolerated. Organic evolution is accepted not only by the modernistic groups but by numbers of people of education—the thinkers, scientists and leaders of many religious denominations. But we should not overlook the fact that the fundamentalists who still oppose evolution comprise groups of very large membership.

Dean Shailer Mathews (1922) aptly and concisely stated, "It is only those who are ignorant both of the origin and nature of the Bible and the facts of our universe who are terrified lest science should make them lose their faith."

In his review of John Burrough's book *Accepting the Universe*, Fisher (1920) selected a significant statement from the chapter, "The Faith of a Naturalist"; I quote, "Were not Darwin, Huxley, Tyndall and Lyell, and all other seekers and verifiers of natural truth among the most truly religious men? Any of these men would have gone to hell for the truth—not the truth of creeds and rituals, but the truth as it exists in the councils of the Eternal, and as it is written in the laws of matter and of life."

We are reminded by Reverend John O'Brien (1930) of the strong support for evolution of that distinguished geologist and paleontologist and likewise distinguished scholar of the Catholic Church, Canon de Dorlodot. As the official representative of the University of Louvain to the Darwin centenary at Cambridge in 1909, Dr. Dorlodot gave a remarkable tribute, attributing to Newton, and to Darwin for the organic realm, the correct interpretation of the universe.

The history of man's fight against diseases that plague his body is replete with instances of brilliant ideas and effective experimentation. But it is also replete with persistence of primitive conceptions and of obstruction to medical advances.

There is the unfortunate opposition of befuddled people who both fear the new medical advances and cling with credulity to outmoded practices. There is the cupidity of quacks.

Animal experimentation has yielded infinitely much to medical progress. Obviously experiments with rats and mice, guinea pigs, cats, dogs, monkeys and others, have allowed much exploratory work, which when perfected could be done on human beings. But it could not have been initiated on humans. There can be no reasonable objection to animal experimentation. Religion does not oppose it. It has in fact been stated that man is in duty bound to so experiment, as justifiably as he uses animals for other purposes.

But there developed opposition on the part of people who are proud of the label antivivisectionists, people who bear more humaneness to the dog than they do to humanity. They make two broad, amazing claims that the work is cruel and that it has no value. To be objectively fair is not within the makeup of these opponents. When presented with a long list of cases of medical progress due to animal experimentation, they ignore it. Vivisection has a foreboding sound. Meaning "live cutting," it is pictured as cutting up live animals, so that it can be claimed that surgeons are sadistic torturers. If they called it animal surgery, they would lose their chief incentive for attack. They could not admit that the experimental surgeon carries out the operation with anaesthesia and the same care as on humans, so that the dog may live and the operation be proved a success, a necessary preliminary to its use on humans.

Animal experimentation is of much greater scope than just surgery, and many more animals are used in testing drugs, inoculations, physiological experiments, and others.

The awakening of medical scientists to the need of counter-acting the antivivisectionists (dating from about 1920), by explanation of the truth of the nature of the work, has gradually improved the situation. Chief in this educational campaign is the National Society for Medical Research, Chicago. Publications and reprints of this society, and publications of the A.M.A. and others, have helped disseminate information to the public.

The antivivisectionists lost their chief purveyor of lurid propaganda at the death of newspaper publisher William Randolph Hearst. Gradually they have had to retreat but it is sure they always retrench.

Scarcely a year ago a bill was passed by the Ohio Legislature giving medical scientists the use of animals from dog pounds, animals which would otherwise be destroyed in the pounds. At the consideration of this bill, antivivisectionists joined forces with many who claimed they were not against animal experimentation, but merely opposed to the bill for various reasons. Devious reasoning went with some of this opposition, for example that the passage of the bill was a dire threat to humane societies. None of the opposition would admit the important point that thousands of animals collected by the animal pounds are destroyed and have hence no usefulness, whereas the use of these or some in medical experiments would yield results and also lessen the cost of the necessary animals to the medical institutions.

I know about the emotionalism of the antivivisectionists. I wrote an article entitled, "Anti-vivisection versus your Health" (Kraatz, 1949). Following that, I received many letters emotionally upbraiding me.

Another incident might be recalled. Someone found a spider spinning under the glass of a clock dial. He took it to a newspaper where someone on the staff foisted it upon me. A big story was made of it, and I was supposed to be doing something scientific with it. I hastily returned it to the newspaper. In the U. S. and abroad newspapers carried the tale of the spider's spinning against the relentless movement of the hands of the clock. I was the recipient of a sheaf of letters all deploring my cruelty to the poor spider. It was an experience with the most misguided, emotional, sentimental fringe of *Homo sapiens*.

For enlightenment, whenever medical progress due to medical experimentation is announced in newspapers, it should be made clear just how the animal work was necessary to yield the results. That is occasionally done nowadays. Had it been done invariably and from early times, much good might have been accomplished.

Very effective was the account used in the magazine *Life* (Anon., 1949). It included a full page picture of a boy with his arm around a dog, a dog used in the original experiments at Johns Hopkins Hospital by Dr. Blalock, who first perfected the so-called blue-baby operation. The boy's life had been saved by such operation. The dog was in good health and enjoying the finest old age a dog can enjoy. Another telling event was the ceremony of the bestowal of the first annual Whipple prize for "outstanding service to humanity" upon two dogs which had been used for blood plasma experimentation so valuable in saving lives of World War II soldiers.

We also can use emotional appeal, but this is appeal not based on sentimentalism, but on behalf of freedom for medical research on animals.

People opposed to vaccination are a declining group. The long proven efficacy of smallpox vaccination and diphtheria inoculation is recognized by the public. I remember well years ago outbursts in public print about "shooting dirty pus and poison into innocent children's blood."

When we speak of Christian Science, it is to be emphasized that we have no quarrel with it as a religion. We have no thought of forcing medication upon people who believe their religious views are against it. It is traditionally American to respect views regardless how unfortunate their results. But we look with pity upon the unfortunate child whose life is sacrificed because his misguided parents will not permit a blood transfusion.

My reason for reference to Christian Science was the New York State case where, with respect to compulsory health and hygiene teaching in the public schools, Christian Scientists in 1950 secured passage of a bill or amendment exempting their children from attendance at health teaching periods.

One of the Christian Scientists in a letter in *Science* (Metcalf, 1951) waxed rhetorical about health teaching as a form of statism; he said that scientific theories were not necessarily true, and that it was bigotry to make children take health teaching. The answer (Kraatz, 1951) maintained that health teaching is valuable to the children, it is not indoctrinating a theory, and that bigotry resided rather in the elders who wanted to prevent their children learning about health, hygiene and some simple medical facts.

The chiropractic art or profession may be examined. Some chiropractors advertise such features as x-ray therapy, drugless therapy, electrotherapy, "massotherapy," "ultrasonic therapy," and "plasmatic therapy." We are told that chiropractic deals with subluxated vertebrae which must be correctly adjusted by hand, giving relief to impinged nerves, thereby curing everything that can ail you in the area supplied by the nerves.

There were published diagrams of longitudinal section of head and trunk, showing vertebrae and emergence of spinal nerves, with names of body parts and arms and legs, in plausible sequence up and down the back. In the head was the brain outline, but no cranial nerves. Sense organs and other cranial nerve innervated parts were taken care by names such as eye, ear, nose, etc., placed in the cervical vertebrae region! I have put this in the past tense because such diagrams which for years occurred in chiropractors' advertisements no longer appear in our newspapers. I hope this signifies real anatomical enlightenment.

Medical quackery has cut a wide swath in this country. One of its main forms has been the manufacture of patent medicines, in which the chief motive was profit to the manufacturer. Concoctions of colorful liquids, with low-priced ingredients, but nice medical taste, were sold for high prices. Labels on the bottles

enticingly told that they were a cure for this and that. Unquestionably the worst feature of this business was the credulity of the users, who were lulled into belief that they were curing themselves and who refrained from seeing a physician for diagnosis. Some of the medicine imbibers gave testimonials, often solicited, which the manufacturers used effectively.

The pure food and drug laws did much to eliminate one fault of the labeling. No longer do the bottle labels claim cure for so-and-so. They merely say in fine print that they are a remedy or advised for the same so-and-so.

Other forms of quackery are the devices used, some scarcely above the level of charms or amulets, but some more elaborate looking machines. These machines supposedly effect remarkable cures. Much improvement in this deplorable situation has been accomplished by the American Medical Association in its campaign to eradicate this sort of humbug. It is, however, a continuing battle.

In the A.M.A. popular journal *Today's Health*, one important case is explained by George P. Larrick, U. S. Commissioner of Foods and Drugs in two signed articles (Larrick, July 1956 and Feb. 1957). "Public Warning" is given about a cancer medicine dispenser who it is related was twice convicted in courts of using what they unequivocally term "worthless treatment."

Most amazing is that (and not referring to thousands of people who swallowed this medicine) a group designating themselves as a "Better Health Bureau," in Cleveland, approve of this cancer medicine dispenser. A representative gave a talk in Akron lauding this "treatment."

Also amazing is that under the same sponsorship of this Akron talk there was another talk by an antifluoridationist. This seems like the supreme contradiction, approving "cancer medicine," and at the same time condemning fluoridation as medication of water.

This speaker, an authority of the antifluoridationists, wrote a book he entitled *The Drama of Fluorine, Arch Enemy of Mankind*. I have so far not read this magnum opus. But its author, Leo Spira, wrote a series of papers which are declared scientifically invalid by Dr. Gerald Cox in his chapter in the A.A.A.S. symposium, *Fluoridation as a Public Health Measure* (Cox, 1954). Also a "Fluoridation Reading Room" was arranged, presenting exclusively antifluoridation reading matter.

The underlying deeper common denominator may be an obsession of opposition to all scientific medicine as if it were an antipersonal, oppressive enemy.

Who are the antifluoridationists? They include antimedical groups, Christian Scientists, chiropractors, and some others. They include a very few older physicians and dentists, whose knowledge of biochemistry terminated with their textbook written circa 1920, which could mention fluorides only in connection with mottled enamel. Their idea is about as outmoded as the old dictionary definition of uranium, described as an element "having no important uses." They include persons who insist that adding fluorides to water is compulsory medication, interference with individual rights, and a step to statism, and even that it is a subtle effort of the Soviets to poison and weaken people! They carry on their campaign cleverly enough to influence many people who are not getting scientific facts. They halt at nothing; for example, they have made vicious criticism of the United States Public Health Service.

This phenomenon was investigated in Northampton, Massachusetts and presented in the *Scientific American* under the title "A Study of the Anti-scientific Attitude" (Mausner, 1955). As a subtitle there was this summary: "It has been clearly demonstrated that fluoridation tends to prevent tooth decay and does no harm. Then why are many people violently against it? How the question was investigated in Northampton, Massachusetts." The authors cited the main opposition argument as having three themes: "(1) fluoridation is an experiment which has not proved its value and may hold unknown dangers; (2) fluorides are

poisons; (3) treatment by public agencies of the water that everyone must drink is a step in the direction of socialized medicine and an invasion of individual rights."

The ten-year Kingston-Newburgh study in New York and studies in other places proved the value of fluoridation. People have lived all their lives in areas where water contains even several times as much fluorides as the advised optimum of 1 ppm without suffering more diseases or shortened lives as compared with people living elsewhere. This is sufficient proof of the absurdity of the claim by frightened people who, after fluorides were introduced into their water, said they suffered some serious illnesses. In fact in some places these antifluoridationists suffered these alleged dire illnesses at once when fluoridation supposedly had started, but when unknown to them there was a delay in actually starting the machinery. There is a much greater range of tolerance to fluorides in water in such concentrations used, than in the use of many other things, including many medicines and freely-used sleeping remedies.

Some antifluoridationists formed the so-called Ohio Pure Water Association. Do they mean H<sub>2</sub>O alone? There is no such thing as pure water in nature. All natural waters include traces of many substances in solution. There are varying tiny amounts of fluorides in nearly all natural waters. The Ohio Department of Public Health publishes a list (Anon., 1954), giving fluoride content of natural waters used by 140 cities and 473 villages. Akron happens to have 0.2 ppm in its water. And at the time of the report, five Ohio cities were adding fluorides to their municipal water. Since then Cleveland has added them. Also 4 cities and 97 villages have in their water naturally about 1 ppm or over. I wonder what the opponents of bringing our Akron water from 0.2 ppm up to 1ppm of fluorides would do if they lived in Delphos which has 1.4 ppm, or in Deshler, which has 1.6. If they did not know about it they would be perfectly healthy and happy in Delphos, or Deshler.

These antis are clever. If confronted with instances of larger natural concentrations, they have a ready argument; they try to imagine a difference between natural and artificial fluorides and claim the artificial are much more poisonous, hundreds of times as much as natural fluorides. Their claim is wrong, as every competent chemist knows. The fluorides introduced are, of course, natural fluorides, i.e. coming ultimately from nature. One of the compounds may be used rather than another for practical reasons.

As reported recently in Science (Anon., 1957) the World Health Organization made a strong endorsement of fluoridation of water after a study in seventeen countries. In this study it was shown that in the U. S. alone 32 million people in 1500 communities use fluoridated water.

In closing this section of my paper I use a statement attributed to William Osler; "In all matters relating to disease credulity remains a permanent fact uninfluenced by civilization or education." To this I add, antiscientists of fixed obsessions and determination exploit this credulity.

I turn to a different and possibly trivial instance of antiscientific attitude.

Two people showed me a specimen of *Pectinatella magnifica*, of class Bryozoa, a rounded, gelatinous, massive animal colony attached to submerged branches found in lakes. They had somehow heard of ambergris, a morbid intestinal secretion of sperm whales valuable in the perfume industry. By a process of wishful thinking they had arrived at the hope and expectation that they had something like ambergris or something just as valuable. Despite my lengthy explanation, they left dissatisfied.

This is unscientific thinking, coupled with distrust of scientists. There are many people who, in submitting for testing something which can be checked with an instrument showing results, especially if expressed by a color, or light, or click or a buzz, will be impressed, even though they understand nothing, but who will

not be impressed by the explanation of a scientist sitting across the table from them, regardless of how clear or valid the explanation is.

In the parade of antiscientific manifestation none seems to have had so much sudden attention as the battery additive case. A battery additive was tested by the Bureau of Standards and declared worthless. But the Senate Small Business Committee took up the cudgels for the manufacturer. The Secretary of Commerce put his foot into it, issuing a notorious statement: "I think that the National Bureau of Standards has not been sufficiently objective because they discount entirely the play of the market place." As the editor of *Science* said (DuShane, 1956), "A curious view of objectivity!" The Secretary's dismissal of the director of the Bureau of Standards met with such repercussion that the director was reinstated. A committee of the National Academy of Science, appointed to check the tests, confirmed the Bureau's findings. This might have been a victory for science and the scientific method.

But charges of false advertisement of the battery additive were dropped by the Federal Trade Commission. Consumer testimony was valued as much as scientific testing. Now defense lawyers for a worthless product will be more bold to plead their case. Testimonials by untrained laymen can be worthless.

From what I have shown of pseudoscience and antiscience, can we see some common pattern of fault? Usually credulity looms large, bias is common, prejudice is extensive. The result is intolerance, especially of things which seem to outmode cherished, ancient beliefs. And when emotionalism begets opposition to a scientific procedure, the results are often lamentable.

I quote from Chester H. Rowell's "The Cancer of Ignorance, the Spread of Anti-Science in an American Commonwealth" (Rowell, 1925).

Anti-Science is something more than mere unscientific thinking or lack of scientific information. It is an active emotional hostility to science, to its conclusions, and especially to its process of reaching them. It is repudiation of the authority of science, of the integrity of scientists, and of the validity of the scientific method, and an active, practical effort, moved by intense feeling to combat and suppress them.

Scientists, in defending their cause, commonly overlook this. They assume that if they prove a thing true, it will, therefore, be accepted as true. This does not begin far enough back. They must first persuade people to accept proof itself as a criterion of truth. People who have never in their lives known anything on conclusive evidence, and whose most cherished beliefs are based on no evidence whatever, are not going to surrender fixed convictions on mere demonstration that they are mistaken, or accept anything unfamiliar on mere proof that it is true. In fact they have never been trained to ask whether anything is true or false.

Is the condition as bad as it was in 1925? Fundamentally there may have been no improvement. Specifically there has been some improvement in such instances where a revealing, far-reaching campaign was waged. Some enlightenment results so that the oncoming generation through curiosity learns more about it. I believe that the aftermath of the Tennessee antievolution case was, within a period of years, a somewhat more tolerant view of evolution teaching.

Obviously more and more science education must be developed. This guarantees no miraculous results, but is the only thing we can do.

The development of science has been so staggering that it is much faster than the public can assimilate. Indeed we might as well admit that proverbially anyone in science is able to encompass less and less of the areas of scientific development. The public accepts eagerly all those machines and gadgets science and technology invent, especially if they make life more comfortable, easy and colorful. And the public pays lip service to science. That is recognized and taken advantage of by all the advertisers blaring forth their products daily. Possibly people are under the belief that they are more scientific, when in truth they are unscientific in their evaluations.

This is a grave problem. Science teaching of the highest order is more and more mandatory in a democracy such as ours, in which people may have to vote

on matters entailing scientific questions. It is a serious matter when people are asked to vote as to whether the teaching of organic evolution be abrogated in schools, or whether they will or will not sanction health authorities in their communities to fluoridate their water supply. There needs to be clarifying in scientific matters which have impact upon the people. And the people must somehow learn to discriminate between the true science and the pseudoscience that is ever ready to claim them hostage.

As a practical aid in the dissemination of knowledge, I believe it is incumbent upon science teachers to spread their teaching further into the newspapers and magazines, the only way in which more people will be reached. There are scientific books and nature books galore. So few read them. There is no reason why newspapers cannot carry more scientific information. To be sure editors will have to cooperate more and the teacher-writers will have to do a superb job of clarifying without over-simplifying, and writing entertainingly without loss of scientific accuracy. It is no small task. Let us gird ourselves to the task.

## LITERATURE CITED

- Anon.** 1949. Blue-baby research. *Life* 26: 105-109.  
 ———. 1954. Fluoride Content of Ohio Municipal Waters, Ohio Department Public Health, Div. Dental Hygiene. 3 pp.  
 ———. 1957. *Science (News of Science)* 126: 553.  
**Cox, G.** 1954. Fluoridation as a Public Health Measure, A.A.A.S. Washington, D. C. 232 pp. (pp. 44-46).  
**Darwin, C.** 1859. *On the Origin of Species by Means of Natural Selection*. London. 6th and last Ed. 1872. D. Appleton and Co., N. Y. 1880; and others.  
 ———. 1871. *The Descent of Man, and Natural Selection in Relation to Sex*. London 2nd Ed. 1874. D. Appleton and Co., N. Y. 1880; and others.  
**DuShane, G.** 1956. Test by testimonial. *Science* 123: 1059.  
**Fisher, G. C.** 1920. The optimistic philosophy of a naturalist. *Natural History* 20: 572.  
**Jones, D. F.** 1925. *Genetics in Plant and Animal Improvement*. John Wiley and Sons, N. Y. 561 pp.  
**Kraatz, W. C.** 1949. Anti-vivisection versus your health. *Hygeia* 27: 120.  
 ———. 1951. The search for truth versus bigotry. *Science* 114: 447.  
**Larrick, G. P.** 1956. Public warning; U. S. Food and Drug Administration. *Today's Health* 34: 27.  
 ———. 1957. The Hoxsey cancer treatment. *Today's Health* 35: 21.  
**Locy, W. A.** 1908. *Biology and Its Makers*. Henry Holt & Co., N. Y. 477 pp.  
**Mausner, B. and Judith Mausner.** 1955. A study of the anti-scientific attitude. *Sci. Amer.* 192: 35-39.  
**Mathews, S.** 1922. *How Science Helps our Faith*. American Inst. Sacred Liter., Chicago. 15 pp.  
**Metcalf, C.** 1951. The search for truth. *Science* 113: 696.  
**Moore, Ruth.** 1955. Charles Darwin. A Great Life in Brief. Alfred A. Knopf. N. Y. 206 pp.  
**Nelson, B.** 1927. "After Its Kind," the First and Last Word about Evolution. Augsburg Pub. Co. Minneapolis. 227 pp.  
**O'Brien, J. A.** 1930. *Evolution and Religion. Facing the Facts*. Paulist Press, N. Y. 24 pp.  
**Price, G. M.** 1926. *Evolutionary Geology and the New Catastrophism*. Pacific Press Publ. Assoc. 352 pp.  
**Raymond, P. E.** 1939. *Prehistoric Life*. Harvard U. Press. 324 pp.  
**Rowell, C.** 1925. The Cancer of Ignorance; the Spread of Anti-Science in an American Commonwealth. *Survey* 55: 159-161.  
**Spira, L.** 1953. *Drama of Fluorine, Arch Enemy of Mankind*. Lee Foundation. 142 pp.  
**Zittel, K. A.** 1927. *Textbook of Paleontology*. Macmillan Co. Limited. Vol. I, 839 pp.