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STUDIES IN LAW AND MEDICINE

The Beginning of Human Life

by
Jerome Lejeune, M.D.
Micheline M. Mathews-Roth, M.D.
Hymie Gordon, M.D., F.R.C.P.
Herbert Ratner, M.D.

Testimony prepared for the Subcommittee on Separation of
Powers of the United States Senate Committee on the Judiciary.

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Law and Medicine Series

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JEROME LEJEUNE M.D.
Professor of Fundamental Genetics
University of Rene Descartes, Paris, France

My Chairman and members,

My name is Jerome Lejeune, Doctor in Medicine and in Science. I am in charge of the mentally defective out-patients at the Hospital des Enfants Malades (Sick Children's Hospital of Paris). After spending ten years in full time research, I am professor of fundamental genetics at the University Rene Descartes.

Some twenty-three years ago I described the first chromosomal disease in our species, the extra chromosome 21, typical of mongolism. For this work I had the privilege of receiving the Kennedy award from the late President, and the William Allen memorial medal from the American Society of Human Genetics. I am a member of the American Academy of Arts and Sciences.

With my colleagues at the Institut de Progenese of Paris, I am involved in the description of basic facts in human heredity. By a comparative study of many mammalian species, including the great apes, we are studying the chromosomal variations which occurred during evolution. In our species, we analyze more precisely the deleterious effects of some chromosomal aberrations.

This very year we have demonstrated for the first time that a chromosomal disease could be amenable to therapy. In this fragile-X syndrome, associating a fragility of the X chromosome and severe mental retardation we have shown that a chemical treatment can cure the chromosomal lesion in tissue culture. Moreover, appropriate supply of these chemicals (monocarbons and their carriers' molecules) also improve the behavior and the mental abilities of the affected children. Thus, the most fundamental research on mechanisms of life can lead to direct protection of endangered human lives.

When does a person begin? I will try to give the most precise answer to that question actually available to science. Modern biology teaches us that ancestors are united to their progeny by

The following testimonies were submitted to the Subcommittee on Separation of Powers of the United States Senate Committee on the Judiciary. Doctors Matthews-Roth, Gordon and Lejeune presented their papers orally on April 23, 1981. The paper of Dr. Ratner was submitted in written form only.

a continuous material link, for it is from the fertilization of the female cell (the ovum) by the male cell (the spermatozoa) that a new member of the species will emerge. Life has a very, very long history but each individual has a very neat beginning, the moment of its conception.

The material link is the molecular thread of DNA. In each reproductive cell, this ribbon, roughly one meter long, is cut into pieces (23 in our species). Each segment is carefully coiled and packaged (like a magnetic tape in a minicassette) so that under the microscope it appears like a little rod, a chromosome.

As soon as the 23 paternally derived chromosomes are united, through fertilization, to the 23 maternal ones, the full genetic information necessary and sufficient to express all the inborn qualities of the new individual, is gathered. Exactly as the introduction of a minicassette inside a tape recorder will allow the restitution of the symphony, the new being begins to express himself as soon as he has been conceived.

Natural sciences and the science of law speak the same language. Of an individual enjoying robust health a biologist would say he has a good constitution; of a society developing itself harmoniously to the benefit of all its members, a legislator would state it has an equitable constitution.

A legislator could not conceive what a given law is before all its terms have been clearly and fully spelled out. But when this full information has been given, and when the law has been voted for, then it can help defining the terms of the constitution.

Nature works the same way. The chromosomes are the tables of the law of life, and when they have been gathered in the new being (the voting process is the fertilization) they fully spell out his personal constitution.

What is bewildering is the minuteness of the scripture. It is hard to believe, although true beyond any possible doubt, that the whole genetic information necessary and sufficient to build our body and even our brain, the most powerful problem-solving device, even able to analyze the laws of the universe, could be epitomized so that its material substratum could fit neatly on the point of a needle!

Even more impressive, during the maturation of the reproductive cells, the genetic information is reshuffled in so many ways that each conceptus receives an entirely original combination which has never occurred before and will never again. Each conceptus is unique, and thus irreplaceable. Identical twins and true hermaphrodites are exceptions to the rule: one man, one genetic make-up; but interestingly enough, these exceptions have to take place at the time of conception. Later accidents could not lead to harmonious development.

All these facts were known long ago and everybody was agreeing that test-tube babies, if produced, would demonstrate the autonomy of the conceptus, over which the test tube has no title of property. Test-tube babies now do exist.

If the ovum of a cow is fertilized by a bull's sperm, the tiny conceptus, floating freely in the liquid, starts immediately its cattle career. Normally it would travel for a week, through the fallopian tube, and reach the uterus. But thanks to modern technology it can travel much farther, even across the ocean! The best shipping equipment for such a two milligram cattle being, is to introduce it inside the fallopian tube of a female rabbit. (Air freight is much less than for a pregnant cow.) At destination, the miniscule animal is carefully removed and delicately settled inside the uterus of a recipient cow. Months later the calf exhibits all the genetic endowment he received from its true parents (the donors of the ovum and of the sperm) and none of the qualities of its temporary container (the rabbit) nor of its uterine foster mother.

How many cells are needed to build an individual? Recent experiments spell out the answer. If very early conceptuses of mice are artificially disassembled (by a peculiar enzymatic treatment) their cells come apart. By mixing such suspensions of cells, coming from different embryos, one sees them reassembling again. If the tiny mass is then implanted in a recipient female, some little mice (very few indeed) manage to develop to term, completely normal. As theoretically expected by B. Mintz and demonstrated by Market and Peter, a chimeric mouse can derive from two or even three embryos, but no more. The maximum number of cells cooperating to the elaboration of an individual, is three.

In full accordance with this empirical demonstration, the fertilized egg normally cleaves itself in two cells, one of them dividing again, thus forming the surprising odd number of three, encapsulated inside their protective bag, the zona pellucida.

To the best of our actual knowledge, the prerequisite for individuation (a stage containing three fundamental cells) is the next step following conception, minutes after it.

All this explains why Drs. Edwards and Steptoe could witness *in vitro* the fertilization of a ripe ovum from Mrs. Brown by a spermatozoa from Mr. Brown. The tiny conceptus they were implanting days later in the womb of Mrs. Brown, could not be a tumor or an animal. It was in fact the incredibly young Louise Brown, now three years old.

The viability of a conceptus is extraordinary. Experimentally a mouse conceptus can be deep frozen (even to -269c) and, after careful thawing, implanted successfully. For further growth, only a recipient uterine mucosa can supply the embryonic placenta with appropriate nutriments. In his life-capsule, the amniotic bag, the early being is just as viable as an astronaut on the moon in his space-suit: Refueling with vital fluids is required from the mother-ship. This nurturing is indispensable for survival, but it does not "make" the baby; no more than the most sophisticated space shuttle can produce an astronaut. (Such a comparison becomes even more cogent when the fetus moves. Thanks to a refined sonar-like imagery, Dr. Ian Donald from England a year ago succeeded in producing a movie featuring the youngest star of the world, an eleven week old baby dancing in utero. The baby plays, so to speak, on a trampoline! He bends his knees, pushes on the wall, soars up, and falls down again. Because his body has the same buoyancy as the amniotic fluid, he does not feel gravity and performs his dance in a very slow, graceful, and elegant way, impossible in any other place on the earth. Only astronauts in their gravity-free state can achieve such gentleness of motion. By the way, for the first walk in space, technologists had to decide where to adapt the tubes carrying the fluids. They finally chose the belt-buckle of the suit, reinventing the umbilical cord.

Mr. Chairman and members, when I had the honor of testifying previously before the Senate, I took the liberty of referring to the universal fairy-tale of the man, smaller than a thumb.

At two months of age, the human being is less than one thumb's length from the head to the rump. He would fit at ease in a nutshell, but everything is there: hands, feet, head, organs, brain, all are in place. His heart has been beating for a month already. Looking closely, you would see the palm creases and a fortune teller would read the good adventure of that tiny person. With a good magnifier the finger prints could be detected. Every document is available for a national identity card.

With the extreme sophistication of our technology, we have invaded his privacy. Special hydrophones reveal the most primitive music: A deep, profound, reassuring hammering at some 60-70 per minutes, (the maternal heart) and a rapid, high pitched, cadence at some 150-170 (the heart of the foetus); these mixed mimic those of the counterbass and of the maracas, which are the basic rhythms of pop music.

We now know what he feels, we have listened to what he hears, smelled what he tastes and we have really seen him dancing full of grace and youth. Science has turned the fairy-tale of Tom Thumb into a true-story, the one each of us has lived in the womb of his mother.

And to let you measure how precise the detection can be: if at the very beginning, just after conception, days before implantation, a single cell was removed from the little berry-looking individual, we could cultivate that cell and examine its chromosomes. If a student, looking at it under the microscope, could not recognize the number, the shape, and the banding pattern of those chromosomes, if he was not able to tell safely whether it comes from a chimpanzee being or from a human being, he would fail in his examination.

To accept the fact that, after fertilization has taken place, a new human has come into being is no longer a matter of taste or of opinion. The human nature of the human being from conception to old age is not a metaphysical contention, it is plain experimental evidence.

MICHELINE M. MATHEWS – ROTH, M. D.

My name is Micheline Mathews-Roth, I am a physician, a graduate of the New York University School of Medicine. My academic position is Principal Research Associate in the Department of Medicine at the Harvard Medical School, in Boston. I am not testifying here as a representative of either Harvard University or the Harvard Medical School, but as an individual.

In biology and in medicine, it is an accepted fact that the life of any individual organism reproducing by sexual reproduction begins at conception (fertilization), the time when the egg cell from the female and the sperm cell from the male join to form a single new cell, the zygote; this zygote is the starting cell of the new organism.

Most textbooks of embryology have chapters describing the history of embryology, and the experiments done to show that multicellular organisms develop from a single cell, the zygote. Because these kinds of experiments on embryological development have been repeated so many different times on so many different species, and have always led to the same result, that organisms reproducing by sexual reproduction always arise from a single cell - and that they are always of the same biological species as their parents; this fact is universally accepted, and taught at all levels of biological education. It is the continuous repetition, duplication and confirmation of experimental results that proves that the fact is indeed true.

For example, in the textbook on embryology by Bradley Patten (3rd. Ed, 1968) we find on page 43:

“It is the penetration of the ovum by a spermatozoon and the resultant mingling of the nuclear material each brings to the union that constitutes the culmination of the process of fertilization and marks the initiation of the life of a new individual.”

And on page 8 there is written:

“In the process of fertilization, a male and a female gamete unite to form a single cell, the zygote, from which a new individual develops.”

In another embryology text, “Developmental Anatomy” by Leslie Arey, (7th Ed., 1974), there is found on page 55:

“The formation, maturation and meeting of a male and female sex cell are all preliminary to their actual union into a combined cell, or zygote, which definitely marks the beginning of a new individual.”

And again, in “Human Embryology” by Hamilton, Boyd and Mossman (4th Ed., 1972) it is stated on page 1:

“The zygote, which has been formed by the fusion of a male and female gamete is a single-celled organism. After a longer or shorter period this unicellular organism will become progressively transformed by the processes of cell division, cell migration, growth and differentiation into a multicellular mature member of its species.”

And also on page 14:

“Bisexual reproduction is characteristic of all vertebrates, and gametogenesis (the production of germ cells) is its first phase. The next phase, the beginning of the development of a new individual, is the fusion of two germ cells (gametes) of different nature; one, the spermatozoon from the male parent; the other, the ovum from the female parent. The result of this fusion is the formation of the first cell of the new individual, the zygote.”

In Moore’s “The Developing Human” (2nd Ed., 1977), a text written for students in the health sciences, one finds on page 1;

“Zygote. This cell results from fertilization of an oocyte by a sperm and is the beginning of a human being.”

And on page 12:

“Development begins at fertilization, when a sperm unites

with an oocyte to form a zygote...Each of us started life as a cell called a zygote."

And again on page 24:

"Embryonic life commences from fertilization; hence the beginning of fertilization may be taken as start of Stage 1 of development."

The authors of textbooks of obstetrics presume that the reader has a prior knowledge of embryology, so it is really not necessary for them to emphasize the fact that the beginning of a human life is at fertilization. However, acknowledgement of this fact does occur. In the book, "Human Reproduction, Conception and Contraception" edited by Hafez, (2nd Ed., 1980) it is stated in the section on "Culmination of Fertilization" on page 461,

"The first cleavage, which follows immediately, is the initial step of human embryonic development."

Again, in the book, "Biological Principles and Modern Practice of Obstetrics" by Greenhill and Friedman (1974) it is stated on page 17:

"The term conception refers to the union of the male and female pronuclear elements of procreation from which a new living being develops. It is synonymous with the terms fecundation, impregnation and fertilization."

And again on page 23, in a section discussing the formation of the zygote,

"The zygote thus formed represents the beginning of a new life."

In the book, "Principles and Management of Human Reproduction," by Reed, Ryan and Benirschke (1972) it is stated on page 176, in the section on fertilization:

"With fusion of the two pronuclei (synkaryon) fertilization is completed and marked changes occur in the organelles preparatory to the ensuing rapid cleavage divisions (mitotic divisions of the early zygote)."

This statement points out that the zygote, which is the name given to the first cell of the new individual, begins its development immediately at the completion of fertilization.

The fact that life begins at conception is not just taught to specialized students of embryology or medicine - it is also taught to biology students at the high school and college levels. For example, James Watson, in his book, "Molecular Biology of the Gene" (3rd Ed., 1976), states on page 7:

"The cell theory thus tells us that all cells come from pre-existing cells. All the cells in adult plants and animals are derived from the division and growth of a fertilized egg, itself formed by the union of two other cells, the sperm and the egg."

And on page 8:

"Thus, although a complicated organism like man contains a large number of cells (up to 5×10^{12}), all these cells arise initially from a single cell. The fertilized egg contains all the information necessary for the growth and development of an adult plant or animal."

Salvador Luria, in his book, "36 Lectures in Biology" (1975) says on page 146:

"The zygote is the starting cell of the new individual."

And again, on page 215:

"A fertilized egg generates a baby in 9 months, an adult in 15 years."

"A fertilized human egg containing a diploid number of chromosomes divides repeatedly to produce 10^{13} cells."

The high school text, "Modern Biology" by Otto and Towle (1969) states on page 19:

"The mountain lion [shown in figure 2-1] began its life as a fertilized egg. From this tiny mass of living substance no larger than a pinhead, it grew into a completely new, complex organism."

And on page 30:

“A human being develops from a mass of living material no larger than a pinhead, material contributed by both parents and capable of living and growing for a lifetime.”

And again on page 144:

“This genetic makeup was established at the beginning of your life, when a haploid egg and a haploid sperm combined to produce a diploid zygote, your first somatic cell.”

Even publications written for lay people state this fact. The TIME Magazine - Rand McNally Atlas of the Body (1980) states on page 139:

“In fusing together, the male and female gametes produce a fertilized single cell, the zygote, which is the start of a new individual.”

And on page 144, the section entitled “Fertilization, the beginning of life,” it is stated:

“Through the fusion of genetic material from the father and the mother a new individual is formed who is genetically different from either of them.”

And even the new Encyclopedia Britannica (15 Ed., Macropedia, Vol. 14) states on page 968, in the article on pregnancy:

“A new individual is created when the elements of a potent sperm merge with those of a fertile ovum, or egg.”

Thus, we can see that it is widely accepted and widely taught that human beings as well as other organisms reproducing by sexual reproduction start their existence at the time of conception or fertilization, as a single cell, the zygote.

It is important also to remember, as mentioned in the first quotation from the embryology book by Hamilton *et al.*, that like begets like - the zygote is always a member of the biological species of its parents from the time of fertilization throughout all of its life, before as well as after birth. No study or experiment

has ever refuted these scientific facts; and no competent scientist denies them. Thus, one is being scientifically accurate if one says that an individual human life begins at fertilization or conception.

You will notice that I have been using the words fertilization and conception interchangeably. It is very important that in drafting the statute the word “conception” be specifically defined as meaning the time of the fusion of the egg cell and the sperm cell. This is important because there seems to be a tendency in some medical circles to define conception as being the time of the implantation of the developing embryo in the wall of the uterus rather than the time of fertilization of the egg by the sperm. It is crucial to remember, since implantation occurs about 6 to 10 days after fertilization, that the zygote is already well on its way in the process of development by the time implantation occurs. Although with present technology we cannot demonstrate that a new individual is present until it has implanted, the indisputable fact is that if a zygote has been formed, the new individual is very much in existence by the time of its implantation. Thus, for your bill to be scientifically accurate, “conception” must be carefully defined.

In summary, then, it is incorrect to say that biological data cannot be decisive. In biology, as in any other branch of science, experiments repeated and confirmed by many different workers using many different species of organisms do indeed prove that a particular biological finding is true. And so it is with the biological finding that an organism reproducing by sexual reproduction starts its life as one cell, the zygote, and throughout its existence belongs to the species of its parents. No experiments have disproved this finding. So, therefore, it is scientifically correct to say that an individual human life begins at conception, when egg and sperm join to form the zygote, and that this developing human always is a member of our species in all stages of its life. Our laws, one function of which is to help preserve the lives of our people, should be based on accurate scientific data. The proposed statute, properly drafted, will be based on accurate scientific data; hopefully, it will help remind us all that we must always act responsibly toward all human life, at all stages of development.

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HYMIE GORDON, M.D., F.R.C.P., Professor of Medical Genetics*

I have been a medical practitioner for 30 years and I have specialized in Medical Genetics for the past 20 years. I am testifying on my own behalf - not as a representative of any group or institution.

The question of when life begins has been debated by theologians, philosophers, and scientists for almost 2,000 years. Rabbi Judah the Prince, who lived about the year 200 believed that life begins at the moment of conception - an opinion which he derived from a discussion with one of the Roman emperors, possibly Marcus Aurelius.¹ A similar opinion was expressed by Tertullian, one of the early Fathers of the Christian Church and an approximate contemporary of Rabbi Judah.² These early statements were based on philosophical reasoning rather than scientific observation. It was not until the early part of the 17th century that the English physician William Harvey applied the scientific method, as we now know it, to the study of biology. In the course of his investigation of the development of fertilized hens' eggs, he came to the conclusion that life begins when the heart can first be seen to be beating.³ In the developing human, this would be during the fourth week after conception.

By present-day standards, Harvey's capability of studying the early stages of life was very limited; at best he may have had a simple magnifying glass. Modern methods of investigation permit life's processes to be studied even beyond the limits of the most elaborate electron microscopes - not merely at the level of microscopically visible tissues and cells but at the level of the submicroscopic molecules of nucleic acids and proteins, the physical components of the living process.

Modern textbooks of biology and biochemistry often begin by describing the identifying characteristics of living matter. A representative example is given in the very highly-regarded textbook of biochemistry by Albert L. Lehninger of the Johns Hopkins University School of Medicine.⁴ I have abstracted the following from Lehninger's account of this subject:

*Chairman of the Department of Medical Genetics, Mayo Clinic, Rochester, Minnesota.

Perhaps the most conspicuous attribute of living organism is that they are complicated and highly organized. They possess intricate internal structures, containing many kinds of complex molecules....

[Living organisms] have the capacity to extract and transform energy from their environment, which they use to build and maintain their own intricate structures from simple raw materials...

But the most extraordinary attribute of living organisms is their capacity for precise self-replication, a property which can be regarded as the very quintessence of the living state.

By all these criteria, the zygote - the first cell which results from fertilization of the egg by the sperm - is a living organism. It is certainly complicated and highly organized and it contains numerous complex molecules including nucleic acids and proteins. Its most important nucleic acid is deoxyribose nucleic acid (DNA), the product of the father's and the mother's contributions to the individual's conception.

The highly individual structural pattern of this DNA - the individual's personal genetic code - is determined in that first cell at the very moment of conception. Thus, in accordance with its code and by interacting with its environment, the DNA controls every phase of development of the individual from conception to death.

It does this by sending to the outlying parts of the cell transcripts of segments of its genetic code in the form of smaller molecules of nucleic acid known as messenger ribose nucleic acids (mRNA). These messengers carry instructions from the DNA for the synthesis of the specific proteins which are essential for the growth and vital processes of the cell. The amount of mRNA in the cell is an index of the activity of the cell, especially of its production of protein.

Almost from the moment of conception, great quantities of these biochemical messengers appear in the cell, indicating that at the direction of the DNA the vital processes of the new organism have swung into action.⁵ Very quickly, this is reflected in the developing individuality of the newly-conceived organism. Even when this organism consists of only one cell, researchers have been able to

demonstrate the presence of two new proteins - complex molecules which were not present in the unfertilized egg.

Soon the single-cell organism divides into two cells, then into four and so on. By the two-cell stage, ten new proteins can be identified and more continue to appear even at this early stage of life - before the newly-conceived individual has completed his or her passage from the fallopian tube to the uterus.⁶

Thus, from the moment of conception the organism contains many complex molecules; it synthesizes new intricate structures from simple raw materials; and it replicates itself. By all the criteria of modern molecular biology, life is present from the moment of conception.

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HERBERT RATNER, M.D. *

In a very telling characterization of modern man, the late Bernard Berelson "a distinguished sociologist and vice president of the Population Council" and his associate Gary A. Steiner state:

Perhaps the character of behavioral science man can best be grasped through his orientation to reality. He is a creature who adapts reality to his own ends, who transforms reality into a congenial form, who makes his own reality... In his quest for satisfaction, man is not just a seeker of truth, but of deceptions, of himself as well as others." (*Human Behavior: An Inventory of Scientific Findings*. Harcourt, Brace & World, 1964, pp. 663 - 4)

There is no better illustration of the above than the gynecologists' and social engineers' recent redefinition of the beginning of life to accommodate the use of abortifacients for population control. In changing the definition from fertilization to implantation they manifest a tendency noted by Berelson and Steiner in modern man when confronted by a reality which he prefers not to accept:

When man can come to grips with his needs by actually changing the environment, he does so. But when he cannot achieve such 'realistic' satisfaction, he tends to take the other path: to modify what he sees to be the case, what he thinks he wants, what he thinks others want. (p. 664)

In contrast to the claim that life begins at implantation, we have the conclusion of the world's most authoritative embryologist, who has studied this question for over thirty years, Erich Blechschmidt:

...the evidence no longer allows a discussion as to if and when and in what month of ontogenesis a human being is formed. To be a human being is decided for an organism at the

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moment of fertilization of the ovum. For this reason we have to regard the intrinsic quality of the fertilized ovum as an essential prerequisite, decisive for all future ontogenesis." (*The Beginning of Human Life*. Springer-Verlag, New York, Heidelberg and Berlin, 1977, p. 17)

The universality of this teaching, that human life starts with fertilization, can be documented in virtually all educational materials at any level of the curriculum. Thus, the most widely used of contemporary high school textbooks on sex education, states: "Human life begins when the head of the sperm cell, which carries the nucleus, unites with the nucleus of the ovum or egg cell." The late Alan Guttmacher, then President of Planned Parenthood-World Population and a foremost crusader for "abortion on demand," is credited as a consultant. (*Modern Sex Education*. Julian, C. J. and Jackson, E.W., Holt, Rinehart and Winston, Inc. New York) In the best seller *From Conception to Birth: The Drama of Life's Beginnings* (Robert Rugh and Landrum B. Shettles, Harper and Row, 1977) the authors define the beginning of life as the "fertilization of the ovum by the spermatozoon, thus initiating the development of an embryo and starting pregnancy." (Glossary, p. 237) Earlier and shortly after the Supreme Court decision of January 22, 1973, Professor Landrum Shettles, a test-tube experimentalist, in a letter to the *New York Times* of February 14, 1973, commenting on the Court's indecision as to when life begins, stated: "... a new and composite individual is started at the moment of fertilization" and concludes: "To deny a truth should not be made a basis for legalizing abortion." Clearly, the producers of test-tube babies refuse to be denied their success in originating life at fertilization.

George Orwell of 1984 fame, in an essay entitled "Politics And The English Language" (*The Orwell Reader*. New York, 1956, pp. 355 - 6) warned us that "... if thought corrupts language, language can also corrupt thought." It is not too harsh to transfer to contemporary medical language his blunt conclusion about political language: that it "is designed to make lies sound truthful and murder respectable, and to give an appearance of solidity to pure wind."

This is a day and age when violence surrounds us and is mounting, and we are faced with a widespread loss of respect for life in

our society. Can we honestly make ourselves believe that we can redefine life to suit our convenience? Such manipulation of language may be welcomed as an opiate by the self-styled intellectual; it will not deceive the common sense of the average citizen.

The average citizen soon learns that many alleged contraceptives are really abortifacients, that they do not prevent a human life from beginning but destroy human life after it has begun. He sees that the self-announced experts and leaders of public opinion are urging the principle that when others are an inconvenience to one's life it is acceptable to kill them off. What an awful principle for the medical profession and representatives of the people in government to promote!