

This essay addresses itself to the moral implications of a well-known biological theory which received official Soviet backing for ideological reasons but was dismissed by most Western scientists. Through a novel interpretation the author disposes of the widely held assumption that certain Biblical passages can be interpreted only on the basis of the discredited Lamarckian theory. Dr. Etkin is Professor of Biology of City College, New York, and Research Associate Professor of Anatomy at the Albert Einstein College of Medicine of Yeshiva University.

JACOB'S CATTLE AND MODERN GENETICS

A Scientific Midrash

Attempts to reconcile Biblical statements with scientific opinion when these appear to be at variance have taken many forms and ranged over a variety of subjects. Yet, curiously, one of the most direct and widely known of such conflicts has apparently been given very little, if any, attention. This is the story of Jacob's cattle and his use of striped rods laid in the water troughs to influence the character of the offspring conceived there. Jewish authorities seem to accept the validity of the obvious inference that the visual experience of the parents may determine the pigmentation pattern of the young. Rabbi Hertz, who was certainly one of the most modern in outlook of our traditionally-minded authorities, in his commentary to Genesis 30:37, says of Jacob: "He placed streaked rods over against the ewes. The sight of these rods would affect the colouring of the young about to be born."

The inheritance of maternal impressions as recounted in this story may be considered part of the general theory of the inheritance of acquired characters. This theory, often designated as Lamarckianism after the eighteenth century French zoologist who was its most prominent exponent, holds that changes induced in the parents' body by their experiences can be transmitted to some degree to their offspring. Thus, increased muscle power re-

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sulting from exercise improves the strength of offspring; ingrained habits become instincts after some generations.

Modern biology directly contradicts this theory. According to our present concepts of inheritance, the hereditary determinants or genes transmitted from parent to offspring are conveyed from generation to generation within the nuclei of the sperm or egg cells. External factors that modify the body cells cannot produce parallel and specific changes in the germ cells, as would be the case if acquired characteristics were transmitted. This modern viewpoint is supported not only by our knowledge of the method of genetic transmission but also by direct experimental tests of the Lamarckian hypothesis. All such tests have proved negative when analyzed critically. This is the prevailing opinion among Western scientists; some Communist geneticists differ.

Biologists generally seem to accept the usual interpretation of the story of Jacob as affording Biblical support to the concept of inheritance of acquired characters and thus of the fallibility of Biblical science. The eminent British zoologist, Sir Gaven de Beer, writing recently in the *Scientific American* (Sept. 1962, page 268), points up the conflict in discussing the inheritance of maternal impressions.

An example of the extent to which this fallacy is deep-seated can be seen in the Old Testament story of Jacob and Laban. When Jacob was working for Laban, it was agreed that Jacob could have any brown lambs that were born and any spotted and speckled goats born, whereas all white lambs and unspotted goats belonged to Laban. Jacob thereupon selected (he knew the importance of selection) the most healthy animals and subjected them to visual prenatal impressions by putting them in front of striped patterns of green leaves and white rods just before they conceived, with the result that they brought forth cattle ringstreaked, speckled and spotted, which of course belonged to Jacob, whereas the weaker, untreated animals produced offspring that remained true to the specifications of Laban's property.

Despite the disagreement between Biblical and scientific authorities, it becomes clear from an examination of the Biblical account that the interpretation of support for the belief in inheritance of maternal impressions is by no means necessary. In fact, closely considered, the story seems plainly to imply the contrary,

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that the pigmentation pattern was transmitted by inheritance, just as modern genetics postulates. In this article I will explain the basis for this interpretation and then indicate the importance of a proper understanding of inheritance from the affirmation of Biblical moral teachings.

Genesis 30 is the source of the misinterpretation since it does, indeed, seem to imply that Jacob succeeded in favoring his cause by means of maternal impressions, as de Beer has said. We read in verse 39: "And the flocks conceived at the sight of the rods, and the flocks brought forth streaked, speckled and spotted."

But subsequently we read Jacob's account to his wives of his troubles with Laban in which he clearly expresses his real beliefs:

And it came to pass at the time that the flock conceived, that I lifted up mine eyes, and saw in a dream, and, behold, the he-goats which leaped upon the flock were streaked, speckled and grizzled (*Ibid.* 31:10).

This account is repeated in verses 11 and 12:

And the angel of God said unto me in the dream: "Jacob!" and I said: "Here am I." And he said: "Lift up now thine eyes and see, all the he-goats which leap upon the flock are streaked, speckled and grizzled."

There is no word in this account of the rods laid in the drinking trough. Clearly at the time of the telling, after some twenty years of service with Laban, Jacob knew that it was not by the mottled rods but by the action of genetic transfer from parent to offspring that the speckled young had been produced. It might be thought that Jacob originally believed in the efficacy of the rods, but even this is open to doubt. Even though we concede that Jacob might have been confused regarding the genetic mechanism, it is perfectly clear that the angel of the Lord was not. If, therefore, any scientific inference is to be drawn from the account in Scripture, it is the one consistent with modern genetics rather than the contrary Lamarkian interpretation.

The Biblical story is, of course, not intended to explicate the genetics of skin patterns in cattle. It treats the matter in so vague

a fashion as to permit the common misconceptions of folklore to pass unchallenged as though deliberately to avoid entanglement with scientific doctrine. It is only when the moral significance of the story requires it that we are given, and then only incidentally, a glimpse into the true mechanism involved. It is, perhaps, because they realized the irrelevance of the scientific details that the Rabbis pay so little attention to this aspect of Jacob's actions. My inquiry among students of the Talmud failed to uncover any serious discussion of the difference in the versions of the story as given in the two chapters of Genesis. In fact the entire incident is strangely neglected. Even in the *Midrashim* only some scanty far-fetched and strained interpretations are offered. (See the footnotes in *The Soncino Pentateuch* edited by A. Cohn). If in the face of this neglect we permit the modern mind to speculate on the events so cryptically alluded to in the Biblical stories, I think we can derive an intriguing modern *midrash*.

The pivotal question for such an interpretation is the timing of Jacob's dream or dreams. This is nowhere specified. First it is said to be when the cattle conceived, which might be taken to refer to the initiation of the arrangement with Laban. But the second telling of the dream implies that it occurred when Jacob was commanded to leave Laban's service many years later. Since the dream is thus told twice with differing time references, we may assume that it was itself repeated. Indeed, if we inquire why the behavior of the rams was revealed at all we can only conclude that it was given on two separate occasions as part of the instruction to Jacob regarding the methods to be employed in dealing with Laban. In other words we may conclude that before Jacob permitted his wages to be changed in the manner described he had learned in the dream that the insemination of the herd by the marked rams had already taken place. The method of payment proposed was eagerly accepted by Laban because, in his cupidity, he thought he would be the inevitable gainer since the arrangement began by his removing all marked animals from the herd. Indeed, unless we believe that Jacob had had prior information, it is difficult to believe that as an experienced herdsman he would ever have agreed to a bargain which was initiated by removal of the potential fathers of his sheep. The dream contained no reference to the

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peeled rods.

In this interpretation Jacob need never have believed in the magic of the rods. Why then did he perform the elaborate business at the watering troughs? If we think for a moment, we realize the difficult position that he was in. If after Laban had removed all the marked sheep, the herd nonetheless proceeded to produce marked animals in abundance, Laban would suspect fraud on Jacob's part. Therefore, Jacob had to provide an alternative explanation that would satisfy Laban. By carrying out the action at the watering troughs openly and in public he allowed Laban to draw his own conclusions on the basis of a common superstition.

We are thus led to suspect that it was Laban rather than Jacob who subscribed to the doctrine of maternal impressions. And we find interesting confirmation of this view in the internal structure of the Biblical account. In the first telling, which includes the incident of the rods, the terms of the agreement between Laban and Jacob are said to have originated with Jacob (Genesis 30:31-32).

And he said: "What shall I give thee?" And Jacob said: "Thou shalt not give me aught: if thou wilt do this thing for me, I will again feed thy flock and keep it, I will pass through all thy flock, removing from thence every speckled and spotted one, and every dark one among the sheep, and the spotted and speckled among the goats; and of such shall be my hire."

This account is thus told from Laban's point of view with the entire blame for the disastrous agreement placed squarely on Jacob's shoulders. Yet in the second account Jacob does not regard the proposal as his at all, for he says to his wives (Genesis 31:7-8):

And your father hath mocked me, and changed my wages ten times; but God suffered him not to hurt me.
If he said thus: "the speckled shall be thy wages," then all the flock bore speckled: and if he said thus: "the streaked shall be thy wages," then bare all the flock streaked.

It needs no depth psychology to perceive that this version is told from Jacob's point of view. The Bible attempts no resolution

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of the personal differences in the two accounts any more than of the scientific issue there involved. We may imagine the negotiations to have been prolonged with many offers and counter-offers, as befits so important a contract, according to Middle Eastern custom. There may well have been abundant justification for both versions of the contract including, following Jacob's dream, a sudden acquiescence on Jacob's part to the extreme terms urged by Laban regarding the removal of the marked males.

The reader may at this point feel that a modern scientist can hardly claim the freedom of imagination in dealing with Biblical verses accorded to ancient rabbinic authorities. Perhaps so. But the problem of inheritance discussed above is a very serious one from both a moral and sociological viewpoint. It is important that we recognize that our tradition does not support in any way the doctrine of inheritance of acquired characteristics. Properly understood, such a doctrine can be seen to run contrary to the entire stance of Biblical teaching.

Darwin himself believed that some aspects of evolution could only be explained in terms of the inheritance of acquired characters and he made free use of this concept, particularly in the later editions of his work. He devised the rather elaborate pangene theory according to which each part of the body sends tiny particles transmitting its characteristics to the germ cells. Thus, if a part becomes changed during an animal's lifetime, the particles would be altered and the alteration thus transmitted to the next generation.

Today we know that Darwin's pangene theory is entirely erroneous. The factors (genes) which determine inheritance are in reality safely stored in the nuclei of the germ cells from one generation to the next and are out of reach of the changes in the body's organs. They are protected from changes due to the vicissitudes of life to which the body tissues are exposed. Therefore each generation has a fresh start in life irrespective of the experiences, physical or mental, of its parents.

Though we rarely stop to consider it, this concept is fundamental to much of human organization. Judaism takes it for granted in many respects. It has often been pointed out in discussions by biologists that circumcision practised by Jews for so

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many generations has had no influence on the structure of the new-born of later generations. From the Jewish point of view, inheritance of acquired characteristics would make the Covenant of Abraham meaningless after a few generations. So, too, it would become less and less necessary to teach Torah if the fathers and mothers could transmit biologically to their children what they have so deeply absorbed. But the *mitzvot* are commanded to us "until all your generations;" they can never be inborn.

Let us contrast this with the secular wisdom of Marx and Engels. They accepted the idea of inheritance of acquired characters which was an open scientific possibility in their time. As a consequence Communist doctrine made this policy official both in pure science and in its agricultural applications, in contrast to Western thinking. Lysenko and others who advocated Lamarckianism were given official support in the U.S.S.R., though the degree of this support varied from time to time.

The appeal of Lamarckianism (Lysenkoism) to the Marxist mind lies in its promise of rapid advances in agriculture and social life. By the transmission of the benefits of improved agriculture from generation to generation the Soviet theoreticians hoped to produce varieties of plants and animals suited to Siberian or other difficult conditions and so greatly outstrip Western scientists who insist on the slow and limited methods of genetic selection. They similarly thought to improve their people by the transmission of the effects of good socialist training from generation to generation. In a world created by Marxists, the inheritance of acquired characteristics would certainly have been included in the mechanism of inheritance for, superficially, it seems like the easy way to perfection.

If the Marxists had thought a bit more deeply they would have seen how unsatisfactory, even from a materialist-socialist viewpoint, such a world would be. If, for example, the effects of good environment and training were to be cumulative from generation to generation, then so too would the defects produced by bad conditions. In short over the last centuries, the aristocracy would have been getting better and better in hereditary endowment since it had all the advantages, while the proletariat would have degenerated in body and mind. In such a world there would be no

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hope for the less fortunate, and suffering would lead only to degeneration.

This point brings us closer to the heart of the matter of the ethical importance of valid ideas of the genetic mechanism. Basically this is that the concept of inheritance of acquired characteristics lends itself readily to support of doctrines of class and race superiority.

Every group of human beings shows strong tendencies to regard itself as possessed of special virtues transmitted to it from its ancestors and, of course, each group resents this inference in others. The Jewish concept of the Chosen People has been a source of criticism not only from the outside but from within Judaism as well. We know that the Rabbis, both ancient and modern, have gone to considerable lengths to disclaim special privileges and have on the contrary emphasized the burden of obligations it imposes.

Yet folklore concepts of Lamarkian inheritance, whether conscious or not, have crept in to confuse thinking in this matter and to foster feelings that the Jews claim superiority as an inheritance of the virtues of their forebears. One can hardly carry on any discussion of the ethics of Judaism with a contemporary audience without encountering this problem. For this reason alone it would be well to recognize that the Biblical story of Jacob's cattle is not in accord with the Lamarkian theory of inheritance. What the Jews inherit is a social pattern and obligation, not an inherent biological advantage.

But important as avoidance of the Lamarkian fallacy may be, appreciation of the significance of valid concepts of genetics is of greater consequence. In modern theory not only are the genes themselves protected from environmental influences, but the mechanism of their distribution to the offspring is also similarly isolated: the assignment of the genes to the germ cells is by a process of uncontrolled randomness. The laws of gene distribution are purely statistical. We each have two sets of genes, one set from each parent. In forming germ cells the genes of these sets are sorted out to the cells, each germ cell getting one complete set of genes. This sorting is at random so that there is no way by which a particular combination of genes can be assured to

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a particular germ cell. In human terms this means that we cannot determine which combination of the genes we will transmit to our children. Thus we can neither modify our genes by our actions (by a Lamarckian mechanism) nor regulate their distribution to our children. We recognize this in the unpredictability and uncontrollability of the transmission of human characteristics to the individual.

What we often fail to recognize is that in the last analysis the moral nature of man rests on this indeterminacy of his individuality. Of course, genetic factors are not the only ones entering into the determination of individual character and we need not overestimate the role of heredity. Yet we must concede it considerable significance in personality development along with factors of training and experience. Nor do we have to be too much influenced by the cavils of rationalistic philosophy or scientific sociology with regard to human freedom. It is sufficient to recognize that pragmatically the indeterminacy of human character remains the foundation of social responsibility and the moral sense of man. If we could predetermine human nature, there would be little meaning to ethics. It is significant, therefore, to recognize that the contribution of inheritance to an individual's personality is in effect beyond our control by virtue of the isolation of the genes from life's experiences and the random nature of their distribution to the offspring.

Our generation has well learned the lesson that knowledge is power. But unfortunately we have also had to learn the fact that power is more easily used for evil than for good. As has so often been pointed out, the only thing that has kept man from destroying himself in the past has been the lack of the means to do so. If, indeed, it were possible for man to regulate his own inheritance, would that power have been used constructively? Or is it more likely that man would have used that power to distort his own nature even as he now stands on the threshold of self-destruction with his knowledge of atomic energy? Would he not have fragmented the unity of mankind and, by control of his own inheritance, created permanent classes of masters and of slaves? Indeed, would not the inevitable result of human short-sightedness operating in the control of his own nature have been the complete

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dehumanization of mankind, creating an ant society of efficient machines? Is it not the fact of the uncontrollability of the genetic process that has protected man against his own inhumanity and given each new generation a new chance in life? If, through the Lamarkian or other mechanisms, mankind would have an easy access to control of his own inheritance, freedom and the opportunity for individual moral development would long ago have been lost. It is the security against tampering with its inheritance that protects the governed from their governors and makes a democratic and ethical society an open possibility.

But we must remember that the role of the genetic mechanism is purely negative. It does not close the door, as Lamarkianism would, to the moral freedom of each generation. Yet neither does it compel moral development. In the same agonizing way in which Scripture leaves open scientific questions, so science does not decide moral issues. To my mind this openness of the universe, to which our intellectual probings everywhere lead, is the most moving as well as convincing basis for our acceptance of religious faith. This is faith that man faces a genuine moral challenge in life, a challenge in which we turn for guidance to One beyond our own intellectual powers.

It may be well to ask in closing what may we expect next? Science is unravelling the secrets of heredity. Each day records new insight into the chemistry of the material basis of heredity (DNA). Will not man soon be able to control his own genetic mechanism? And will he not then have the awful power over his own nature as mentioned above? This may indeed be the case, although in my estimation we are only at the beginning of our penetration into the mysteries of genetic action and no such crisis is imminent. Yet, of course, this is part of the great adventure of our times, in which science emerges as the key to the religious experience of modern man.