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"UNTO THE THIRD AND FOURTH GENERATION:" A STUDY IN EUGENICS

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PHRASES, be they prose or poetry, which became ours in childhood, remain as our surest possessions. They may have had little meaning for us when first heard; they may have become part of ourselves by no conscious effort, through the mere force of iteration, but all the same they are apt to appeal to us, to be a part of our consciousness in a way that expressions of later acquirement cannot nearly approach. Thus it was that, casting round for a title for my talk to you this evening, the old phrase obtruded itself that, droned out Sunday after Sunday in the little village church of my boyhood, had become part of my being.

I do not know that it is a happy title; it inevitably suggests a text; it is pretty sure to have suggested that I am to indulge in a moral disquisition, when I am going to do nothing of the sort. I shall, it is true, have to dwell upon matters which constitute the basis of morals; that is inevitable in any discussion upon eugenics. These are matters which the public is accustomed to contemplate from their moral aspect, from the aspect of the soul's good, whence it follows that the same pensive public labels everything connected with them as immoral. Medical men, on the other hand, weigh and discuss them from the point of view of the body's good.

Thus, while admitting freely that body acts on soul, and soul on body, that the health of the one depends largely upon the health of the other, nevertheless, as a medical man I must treat my subject in an unmoral manner—nay more, I believe that we medical men accomplish most for the good of our fellows when we expose the cold

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facts bearing upon heredity and eugenics without reference or recourse to morals. The cobbler does best if he sticks to his last. Wherefore I would ask you to understand that my title means merely this, that I want to discuss the effect of parental well-being upon the progeny, that I have been driven to employ this title because it reflects the almost universal confusion between sexual health and morals, and, I may add, because with that confusion, it pictures what, until the end of the nineteenth century, accurately figured the general belief, namely, that conditions affecting the parents influence the children even unto the third and fourth generation.

The last two decades, with the advent of Weismann, have registered a change in authoritative opinion. Weismann, in Germany, and before him, Francis Galton, in England, have through their writings convinced the world that properties acquired by the parent or parents are *not* inherited by the children. If we accept the doctrine of the continuity of the germ plasm (and the researches of the cytologist and embryologist show that we must accept it); if, further, we clearly recognize that that only is inherited which is or becomes the property of the individual at the moment of origin of that individual, at the moment that is, when the germinal matter of the male parent fuses with the germinal matter of the female parent and these twain become one, and that every property obtained by that individual after this event cannot be inherited, but is acquired—if we accept these two fundamental ideas, it has seemed inevitable that we must assent to this newer teaching.

Saying this I know perfectly well that in his later writings Weismann made an admission which largely modified his theory. He admitted that the germ cells might undergo modification while in the body of the parent. But your ordinary man is impatient of parenthetic qualifications. He grasps at broad general statements, and the public is to be pardoned if one important qualification has escaped it when, in successive publications, the Freiburg philosopher introduced so many subtle distinctions and qualifying conditions that it demands not a simple paragraph, but a course of advanced lectures, accurately to state the Weismannian theory of inheritance. The modern, popularly accepted doctrine is that acquired conditions are not inherited, and as a corollary, that the germ cells are unaffected, no matter what vicissitudes are undergone by the body at large—or if you will, by the body of the parent at large.

Do you see where this doctrine leads us? The sins of the

fathers, so say these latter day prophets, do not tell upon the children. They prophesy soothly that, no matter how the parent ill-treats his body prior to conception, the progeny is unaffected: a man may have tuberculosis or syphilis and provided he does not give the disease to the mother and so bring about infection of the fœtus in the womb or in its passage to the outer world, the child is likely to be as strong and healthy as that of a perfectly sound parent. This, in fact, is being proclaimed, and widely proclaimed, at this very time; that the children of the slums and of degraded parentage, provided they are brought to Canada and given a healthy life upon the farm, develop into citizens of as good quality, citizens every whit as good, as those of good parentage. "Nurture" is everything, and "nature" negligible.

If the observed facts do not tally with this view, then we are told that the incidence of particular conditions in the offspring is due to diathesis: that the parent is not to blame; he succumbed to tuberculosis or alcohol in the first place because he inherited a weakened constitution from parents who had themselves succumbed; thus both father and child possess a stigma of degeneration that originated, Heaven knows how or when, in the family history; that bad stocks and feeble-minded and vicious families (and we have pedigrees of such stretching back for many generations) have arisen either by chance (they call it "mutation"), just as, for example, Cain had bad blood in him—or are to be traced back through countless ages, presumably to a mingling of the blood of Cain's stock, after he married that very shady personage, Lilith, of the nocturnal land of Nod, with the more respectable later offspring of Adam.

Or again, we are told that the observed weakness of the child of diseased parentage is not inherent, but due to environment: the child was born healthy, but the poor food and wretched surroundings into which he was born—the home conditions in the family of the drunkard or tuberculous—have prevented a healthy bringing up. Now let me state that I am sufficiently old-fashioned to repudiate this new-fangled "Weismannism."

I still hold on to the belief that the sins, so-called, of the parents against the body—or at least a very important series of such sins—may influence the progeny to its hurt. And what is more, I believe that these new-fangled ideas have their origin in the narrowness, and, if I may so say, chauvinistic provincialism of the zoologist. Those zoologists are, if I may so express it without offence, materialists of the most limited outlook; they are capable of recog-

nizing only such changes as render themselves visible in the size and shape of parts; the more subtle changes of function, of chemical and physical activity, are outside the limits of their vision and to them are non-existent. One has only to consider for a moment to realize that underlying and determining the shape and structure of parts is the chemical composition of the same. The shape, and indeed the size, of any organ or part of the animal or vegetable body is the expression of the interaction between matter of a particular composition and its surroundings or environment. Our ultimate theory of inheritance must, therefore, be not morphological, determined by the shape of parts, but chemical, if not physical, determined by the properties of living matter. The wonderful chemical investigations of the last few years indicate that the molecules of matter endowed with life are of such extraordinary complexity of composition that they may undergo, nay, are constantly undergoing, fine changes in composition in the performance of function, without their general underlying structure being altered. There may be fine changes in the composition of the living molecules resulting in change of properties of first importance for the organism as a whole, without any immediate structural change showing itself in the individual. It is only when the alteration of environment has rendered these changes fixed and permanent that we can expect to find permanent morphological changes. It follows, therefore, that the first indication of altered state of the individual and its progeny tend to be ultramorphological, and that the methods of the morphologist, that is to say of the morphological zoologist and botanist, are not fitted to unravel the problem. They do not begin at the beginning.

In order that you may grasp the problem, let me put rapidly before you in graphic form the fundamental facts concerning the physical basis of inheritance.

We know, in the first place, as a matter of universal knowledge, that the individual, be it animal or plant, is liable to inherit properties equally from both father and mother. It may happen that in one family the progeny in the main appear to take after the mother, in another they equally are seen to have a greater resemblance to the father; in yet another, perhaps in most, some children take after the one parent, others after the other. Broadly, in the act of conception, the new individual receives heritable matter from both parents.

If now we enquire more particularly into the details of the process, we find that the zygote, the fertilized cell from which the

whole future individual becomes developed, the new individual in fact, has a remarkable composition. In the fertilized ovum, or zygote, the cell body or cytoplasm is afforded by the mother—is supplied by the ovum. The amount of cytoplasm contained in the tail of the spermatozoon is so minute as to be not deserving of consideration except in regard to the midpiece which supplies the centrosome or minute portion of cytoplasmic matter which initiates cell division (Fig. 1). *The one constitutent which is afforded equally by both male and female cell is the nuclear matter.* Approximately equal portions of nuclear matter are contributed by the two parents to constitute the nucleus of the single cell which gives origin in the whole new individual (Fig. 2).

Here, therefore, in this nuclear material must be conveyed all the heritable and characteristic properties of the father and mother.

Next, it has to be borne in mind that, from the very beginning, in that process of cell division and multiplication which ends in the production of the fully formed individual with all its distinct tissues and organs, the cells which are destined to give origin to the germ cells, male or female,—to the spermatozoa and the ova,—are kept apart from those giving origin to all the rest of the body. Those other cells, as they multiply, become more and more altered in one or other direction, until some, for example, become bone cells, others nerve cells, others gland cells, and so on (Fig. 3). But the germ cells remain simple, or, as we term it, undifferentiated, throughout. At most, just prior to discharge they undergo a process of reduction whereby the chromomeres, or nuclear units, are halved in number, so that when the spermatozoon and ovum come together, the nucleus of the zygote, formed by the junction of their two nuclei, contains the number of "chromomeres" or nuclear units proper to that particular species, instead of being doubled in each successive act of fertilization (Fig. 4).

This, it always seems to me, is the central miracle of descent. Each one of us—and every living multicellular being—with all our extraordinary complexity of parts and organs, is developed from a simple undifferentiated cell—the egg—and that cell in its turn is not originated by the piecing together of minute elements from all the different tissues and organs of the parent, but is a direct descendant of the undifferentiated germ cells of the parents and grandparents. The germ plasm, as such always remains undifferentiated—the cells composing it always remain simple. This is what is meant by the continuity of the germ plasm. The germ cells give rise to the soma, and at the same time to the next generation of germ cells,

while the soma gives rise to nothing but itself, and ultimately perishes. Death is inherent in the soma; the germ cells have the potentiality of carrying on the torch of life through unending generations—or, in other words, the germ plasm is potentially eternal. These germ cells divide, and divide giving origin to similar simple cells, until such time as one of them, becoming discharged, encounters a germ cell of the other sex—and the result of the combination of the two is that marvellous complex of cells of all orders, the animal body, enclosed in which is a group of unaltered cells, the germ cells, which, in their turn, undergoing discharge, are capable, upon fertilization, of helping to give origin to another complex individual (Fig. 5). Thus, to express this order of events in scientific language, the undifferentiated germ cells or blastogenic cells give origin to the soma or body, composed of blastogenic and somatogenic cells. The blastogenic cells are passed on from generation to generation in an undifferentiated condition.

It is obvious that if an adult individual loses, for example, an arm, that loss does not reproduce itself in each of the hundreds of ova situated in the ovary, if the individual be a female, or the billions of spermatozoa in the testes, if the individual be a male. *Acquired deformities*, as such, are *not* reproduced in the progeny. Weismann, for instance, cut off the tails of twenty successive generations of rats, and the twenty-first generation had as well developed tails as had the first. Nor, again, will the shrinkage of a part in the parent, brought about by want of use, lead to small size of the same part in the offspring. The woman who takes no exercise, and whose biceps as a consequence is flabby and miserably small, does not necessarily have a child with small biceps. The accompanying poor nutrition of the mother, it is true, may tell upon the vigour and vitality of the child; it may be puny and miserable; but the whole body will be affected and not one particular part.

Thus far we wholly agree with Weismann, and with his statement:[1] "By *acquired* characters I mean those which are not preformed in the germ, but which arise only through special influences affecting the body or individual parts of it. They are due to the reaction of those parts to any external influences apart from the necessary conditions for development. I have called them *somatogenic* characters because they are produced by the body or soma, and I contrast them with the *blastogenic* characters of an individual, or those which originate solely in the primary consti tuents of the germ (*Keimes Anlagen*). It is an inevitable consequence of the theory of the germ plasm, and of its present elabora-

tion and extension so as to include the doctrine of determinants, that somatogenic variations are not transmissible."

Now this, we admit, is an inevitable consequence of the theory, but let us see whether it is an inevitable consequence of the facts. In other words, is it not possible, and have we not evidence to prove, that modifications of the soma or body which originate during the lifetime of the individual independent of any inheritance, may affect the germ cells in such a way as to bring about a like modification in its body?

Let us proceed by stages. First, do we possess evidence that the germ plasm in the germ cell is capable of modification outside the body, or is it absolutely fixed and inert until such time, it may be, as it is stirred to activity by the attraction to and fusion with a germ cell of the other sex? Perhaps the clearest evidence that it is susceptible to outside influences is afforded by Bardeen's experiment.[2] It is possible to fertilize frog *spawn* experimentally outside the body by collecting and discharging over it frog *sperm* and from this fertilized spawn to obtain perfectly developed frogs. But now, if the sperm be subjected for a short period to the action of x-rays and then be employed for fertilization, the eggs segment and the early larval stages are passed through, but the process of development is arrested in a few days—the larvæ all die prematurely. None survive beyond the second week. Obviously the germ plasm in the spermatozoa is acutely susceptible to the action of this physical agent.

Next, have we evidence that the germ plasm in the germ cells is capable of modification during the time that it exists in the body of the individual prior to ripening? To this question, again, the answer must be an unhesitating, yes. Quite the most striking evidence is that afforded recently by Tower.[3] Tower made the remarkable observation that if shortly before the maturation of their germ cells, ova and sperm, he subjected potato beetles to intense environmental change, to cold and humidity, he obtained offspring widely different from the parents—and what is more the results appeared to be permanent, or at least heritable through further generations. The elytra or wing cases of the normal beetles showed one pattern, those of the progeny of the cooled beetles showed another. When crossed, these altered forms bred true, nor did they lose their acquired characters in subsequent generations. Similarly, among plants, Macdougal[4] has shown that in the evening primrose by injecting certain chemical solutions into the immature ovaries, and so by subjecting the oocytes or female

germ cells to certain chemical agents, he obtained seeds which afforded plants, some at least of which departed widely from type: he established new varieties.

In the body the germ plasm *is* capable of being influenced by physical and chemical agents. This is evidence of the first importance for us as medical men. We have long observed that intoxicants affecting the body of the parent are liable also to affect the germ cells, but our morphologist confrères, zoological and botanical, have given as much heed to our data as did the priest and the Levite to the wounded man of the parable. They have not thought them worth even twopence. And that because our observations deal almost wholly, not with morphological variations, but with functional change.

Let me indicate the data to which I refer. I have brought them forward on previous occasions and they have never been contradicted. Take Constantin Paul's figures collected in the fifties.[5] Of thirty-two pregnancies in which the husband alone was exposed to lead in the course of his work, there resulted twelve abortions, and of the twenty children born alive, eight did not survive the first year, four died during the second year, five during the third. The thirty-two pregnancies yielded only three children living beyond the third year. What can this mean other than that the lead had influenced the germ cells of the fathers. Nor is this all, Paul, Roque, Sir Thomas Oliver, and other investigators have called attention to the great frequency of epilepsy, idiocy, and imbecility in the children of workers in lead, and it is well established that such feeble-mindedness, where not of sufficiently high grade to cause barrenness, is passed down to later generations.

We have identical data regarding workers exposed to the fumes of nitrate of mercury. (Lizé.[6])

	Number of Cases.	Number of Pregnancies.	Abortions, Premature labour, and Still-births.	Surviving Infants.	Remarks.
Mother alone exposed.....	3	7	4	3	
Father and Mother exposed.....	2	14	5	9	Of these, only three survived fifth year.
Father alone exposed.....	?	12	4	8	Of these three died before fourth year. One alone vigorous.

How about the commonest of all intoxications, the alcoholic? You will know, perhaps, that there is waging at the present time, an active discussion upon this subject—that Karl Pearson,[7] for instance, the notable statistician and Galtonian Professor of Eugenics in the University of London, has compiled some remarkable statistics to show that the children of alcoholics in Edinburgh are if anything superior in capacity to those of abstainers. "Auld Reekie," we admit, is a great city, and its inhabitants are popularly said to consume much alcohol, but this has been a little too much to swallow, and so Sir Victor Horsley[8] has followed upon Professor Pearson's tracks, has seized upon his figures and rent them in a manner fearful and wonderful to behold.

Let me admit that the subject is so complicated that it is difficult to arrive at a clear comprehension of the exact state of the case. The home misery and poverty, for example, brought about by alcoholism, place the offspring at a disadvantage from the very onset. If the mother be an alcoholic, then the child, nourished by the maternal blood, is liable to malnutrition and to show intoxication while growing in the womb. When, however, we come to compare the family statistics for confirmed alcoholics and for the ordinary temperate population, there can be no doubt but that alcohol is responsible for an appalling amount of early death. The vitality of the offspring is gravely affected and, for myself, from families of alcoholics observed by me, I cannot but feel that the children of confirmed drunkards show an increased susceptibility to the action of relatively small amounts of alcohol.* It is, however, by experiment in which we can cut out all complicating factors that we gain clear proof of the deleterious action of alcohol upon the germ cells, and so upon the next generation. Only recently Stockard,[9] has published some most conclusive observations. Employing guinea pigs, he placed them in a state of chronic alcoholism by treating them for six days per week with alcohol fumes almost to the point of intoxication. Forty full term matings of various combinations were made with these animals. Treated males were paired with normal females, treated females with normal males, treated males with treated females. Altogether twenty-five out of the forty matings either gave no result or the embryos aborted early and were eaten by the mother.. Fifteen matings produced in all twenty-five young (in place of about seventy), of which at the time of writing, two had reached maturity, four were young

*A view amply supported by the more exact observations of Legrain *Heredite et l'Alcool*, Paris, Doin, 1889.

but seemed normal. Of the remaining nineteen, eight were still-born or aborted, seven lived for a few days after birth and then died in convulsions, four were in utero when the mothers were killed, and of these one was deformed. Professor Stockard has been so good as to write to me the exact details of what is the crucial test of this action of alcohol upon the germ cells, namely, of the pairing of treated males with normal females—crucial because in the opposed pairing of treated females with normal males it may be objected that the ill effects are due to the disturbances induced by the maternal blood while the offspring are in utero, are acquired and not inherited. There were twenty-four such matings.

RESULTS OF TWENTY-FOUR MATINGS OF ALCOHOLIZED FATHER WITH NORMAL MOTHER (GUINEA PIGS)

14 matings gave early abortions or were negative
5 matings gave still-born litters (in all 8 young).
5 matings gave living litters (in all 12 young).

Of the twelve living young:

Died in convulsions soon after birth	7
Survived	5

The twenty-four matings yielded five surviving young, and when two months old these five survivors were half the usual size. *The average litter of the healthy guinea pig is between four and five.* Therefore under the influence of alcohol twenty-four matings only produced as many surviving young as might be expected from a single pairing of two healthy animals.

There could be no clearer, more positive evidence afforded of the effects of alcohol upon the next generation. The accompanying table by Dr. Mott shows that parallel results are encountered in man. (See page 11).

Let us pass to the consideration of another group of poisons. Nowadays I take it every school boy knows that the bacteria and other microbes of infectious disease produce their effects by the chemical substances which they liberate into the blood during their growth in the body or when they die in the tissues. The infections, therefore, are one form of intoxication. Do the bacterial poisons circulating thus in the blood influence the germ cells? Here, again, the general sense of the medical profession, the accumulated result of individual observations, has long been to the effect that they surely do.

EXAMPLE OF DRUNKEN FATHER AND INSANE OFFSPRING

FATHER. Born 1830. No family history of insanity, fits, or nervous disease. Chronic drunkard from boyhood. In asylum, June 12th to July 11th, 1876; and January 19th to February 8th, 1892.				MOTHER. No history of insanity in family.				
Daughter. Born 1859. Admitted to asylum Oct. 24th, 1874. Discharged and readmitted on subsequent occasions. Still in asylum.	Daughter. Born 1860. Admitted to asylum Oct. 6th, 1874. Discharged and readmitted on subsequent occasions. Still in asylum.	Son. Born 1862. Admitted to asylum June 29th, 1877. Discharged and readmitted and discharged on two subsequent occasions.	Daughter. Born 1869. Admitted to asylum Jan. 2nd, 1892. Discharged and readmitted. Still in asylum.	Son. Born 1872. Admitted to asylum Nov. 11th, 1888. Died of tuberculosis Sept. 4th, 1902.	Son.	Daughter.	Daughter.	
					Not been in asylum.			

Time and again the practitioner has observed a relationship between chronic or acute infection suffered by either parent and abortion, blighted ovum, still birth, or monstrosity. And we have more exact observations; investigators like Gheorghiu, come to our support. Gheorghiu[10] made an extended enquiry into the

health conditions of the parents in a long series of monstrous births occurring in the Paris hospitals, and his statistics show most convincingly that there is a direct relationship between parental tuberculosis, syphilis, and acute infections affecting one or other parent and these gross examples of maldevelopment.

Time and again, also, the ordinary practitioner has been convinced that the children of those suffering from tuberculosis and syphilis are not merely of lowered vitality, more liable to succumb to childish ailments, but, notably in the case of tuberculosis, exhibit a peculiar liability to succumb to the same parental disease, exhibit in short a diathesis. But here again conditions are so complicated that it is difficult to secure a series of absolutely decisive cases. Not only have we to weigh carefully the possible influence of the disturbing factors noted in connexion with alcoholic intoxication—influence of maternal malnutrition upon the growing embryo, of bad nutrition and environment during childhood, and so on, but in addition there has to be discounted the possible direct acquirement of the infection by the fœtus from the mother during pregnancy or parturition, or again by the suckling infant. For a sure answer we have once more to appeal to experiment—and experiment once more gives an affirmative answer. Carrière, for example, inoculated a series of guinea pigs, both male and female with the toxines or soluble products of the tubercle bacillus.[11] Here are his results:

TUBERCULOUS TOXINES—CARRIERE

	Still-born.		Died before 16th day.		Survived.		Total
	No.	Per cent.	No.	Per cent.	No.	Per cent.	Births.
Male and female both inoculated	13	52·0	7	28·0	5	20·0	25
Female alone inoculated.....	7	26·9	9	34·6	10	38·4	26
Male alone inoculated.....	5	16·6	3	10·0	22	73·3	30

You will see from this table that the circulating toxines have had a very definite effect in reducing the numbers of the litters and increasing the numbers of the still-born progeny.

Similar results have been obtained by Lustig[12] working with chickens, and Watson,[13] working under Mott in London, employing guinea pigs, when they made successive inoculations of a very toxic vegetable extract, abrin, which in its properties closely resembles the bacterial toxines. Both obtained diminished fertility, increased number of monstrous births, poor vitality—and both, like Carrière

in the case of tuberculin, note particularly that the offspring of the animals subjected to these toxines, instead of being rendered more resistant to the particular vegetable poison, were, on the contrary, distinctly more susceptible. This is wholly on a par with the common observation of medical men that the children of those suffering from advancing tuberculosis are more liable to succumb to tuberculosis than are those of healthy individuals.

Let me now for a moment gather up the threads of my argument. I have proved to you: that the essential germ plasm which conveys the heritable characters from generation to generation is not inert and incapable of being influenced, but on the contrary is susceptible to physical and chemical agents affecting the body and circulating in the blood; that intoxicants and the poisons of infectious disease have a deleterious effect upon the offspring; that they are apt to cause relative infertility, still-births, monstrosities, and imperfect developments, lowered vitality with tendency to death during infancy, instability and imperfect development of the nervous system showing itself in convulsions, epilepsy, imbecility, and insanity; also that with some intoxications the offspring are rendered more susceptible to the action of the particular agent which had poisoned one or other parent.

It is rather a ghastly record. The only comfort to be extracted is this, that if there are agents which thus act deleteriously upon the germ cells, while in the bodies of the parents, it is equally certain, that there must be other agencies capable, in favourable conditions, of benefiting the germ plasm and improving its qualities. Favourable environment thus leads to improvement of the race and progressive evolution.

I have still, it will be seen, to take up the question as to whether, not these introduced poisons but influences primarily affecting the body can, secondarily, have their effects upon the germ cells—in other words whether there are any orders of conditions acquired by the body of the individual—somatogenic changes—that can affect the germ cells and so affect the offspring, producing the same order of change as had been brought about in the parent. Not to beat about the bush, let me recount to you two recent observations, one from the animal, one from the vegetable, world. Sumner[14] has shown that if similar broods of young mice be brought up, the one in a warm temperature (about 21°C.), the other in the cold (about 5° C.), they show recognizable differences in growth. The mean (average) length of tail, of feet, and of ears of those brought up in the warmth is distinctly greater than of those kept

in the cold. And here is the important fact: the young of the two groups, although reared together in a common room, all, that is, subjected to the same temperature, continue to present the greater or lesser growth of tail, foot, and ear acquired by their parents. Bordage's observation is of the same order.[15] Ordinary peach trees planted in the warm climate of the Island of Réunion or Mauritius from being deciduous gradually acquire an almost evergreen habit —and now if seedlings from these trees be grown elsewhere in a cooler climate, these seedlings manifest the same tendency to be evergreen and not deciduous. Of course it may be urged, it has been urged, that in both these cases the germ cells were subjected to the same temperature changes as were the bodies of the parent individuals, that these are not, therefore, necessarily examples of inheritance of properties of *somatogenic* acquirement. Quite so. But certainly, in the first place, for our purposes, whether they are instances of the somatogenic or blastogenic inheritance of acquirements is of minor importance, and, in the second place, they afford further proof of the susceptibility of the germ cells to modification in their properties. For us as students of medicine the point of especial interest is that the work of the last decade has developed greatly our knowledge of what we term the internal secretions. We find that many of the glands of the body, such as the thyroid, the adrenals, the pituitary, the ovaries, and testes, not to mention the liver and the mucous membrane of the intestine, in their normal activity discharge into the blood substances which, carried to other organs, not merely influence their work but are absolutely essential to the proper carrying out of their function. We recognize, in fact, a series of diseases due to the excess or the defect of these internal secretions—conditions such as exophthalmic goitre, myxœdema, Addison's disease, acromegaly, and so on—while other so-called metabolic disturbances, such as adiposity, gouty states, etc., are being increasingly recognized as closely allied. If the cells of particular organs are highly susceptible to these "hormones" and other active principles of the secretions of other organs, surely is it not likely that the parent germ plasm, the cell matter which by its active growth is capable of giving origin to all these organs and tissues, should likewise be susceptible to their action, and influenced by their excess or deficiency? Nay, should we not expect that bodies of this nature developed by the cells in their activity should act with greater ease upon the living substance of the germ cells than extraneous drugs are likely to act. As a matter of fact, alterations in such glands as the thyroid, the pituitary,

the adrenal cortex, the pineal, are found to have a profound influence upon the sexual function. In certain cases this is arrested, in others stimulated to premature activity. I will only say here that evidence is accumulating to prove that influences acting upon these organs of internal secretion, conditions acquired by these organs, tell upon the germ cells, and are apt so to modify them that the offspring in their development show excess or deficiency in the function of the glands implicated in the parents, that so conditions acquired by the parents reproduce themselves in, and become inherited by, the offspring. I will not say that this is wholly proved—it is not—but I would lay down that it is along these lines that the direct inheritance of morbid states will most surely be demonstrated.

But this *inheritance* of disease is far from being everything. There is, from the point of view of eugenics, another equally important section of my subject. I have only so far discussed true inheritance, conditions in which disturbances impressed upon the germ cells before fertilization affect the offspring. I must at least glance at the terrible effects of congenital disease, and more particularly of infections conveyed to the growing individual while in the womb or during parturition. With a fuller realization of the frequency of these congenital diseases, of the havoc these are playing upon individual lives, the misery, ill-health, and ruin that they inflict; with the surer recognition of the presence and after-effects of what euphemistically we speak of as the contagious diseases, brought about by more exact methods of diagnosis, such as the Wassermann reaction and the actual recognition under the microscope of the gonococcus and the spirocheta pallida, we have, during the last decade more especially, come to a realization of the hideous frequency of these diseases and their ill-effects upon the innocent of the second generation.

When it is accepted that at least a half of gynæcological practice is due to gonorrhœa and its results, that a large proportion of the cases of infantile blindness is of gonorrheal origin, that, as demonstrated by the Wassermann test, practically all cases of locomotor ataxia, and nearly all cases of general paralysis of the insane are of syphilitic origin; when we know that most cases of multiple successive abortions are syphilitic, and recognize the puny, miserable parodies of humanity doomed in most instances to an early death, that too often are the result of syphilitic disease in the parent; when we realize the preventible ills that follow in

the train of these venereal diseases, I wholly agree that the time has come when we should no longer refer to these matters by circumlocutions, when for the good of the coming generations we should openly wage war against gonorrhœa and syphilis, and above all should, for the safety and welfare of our children, instruct them as to the dangers they must ward against—not merely on account of their own health and happiness, but for the sake of the generations yet unborn.

At the Dominion Day dinner in London the other day, after listening to Mr. Foster's magnificent oration, the agent-general for Australia, strong at heart in the knowledge of what the Commonwealth was accomplishing in the matter of imperial defence, said drily that if it depended only upon Canadian talk then surely the safety of the Empire was assured: there would be Dreadnoughts to spare. We have to confess humbly that in more than one matter, while we are talking, Australia has been doing. Melbourne has led the world in a census upon the extent of syphilitic infection in her midst.* At the meeting of the Australian Medical Congress two years ago a resolution was passed to the effect that syphilis is responsible for an enormous amount of damage to mankind, and that all preventive and remedial measures against it are worthy of the utmost consideration. This resolution was presented to the government of Victoria accompanied by the statement that there was a sharp difference of medical opinion respecting the extent and distribution of the disease. Acting under the advice of its chief health officer, Dr. Ham, the government sanctioned a collective investigation with the aid of the medical profession in Melbourne. The government thereupon appointed an expert, Dr. Conrad Hiller, to make the official tests; syphilis was made a compulsory but impersonal, notifiable disease for a period of twelve months within the Melbourne area; medical men were instructed to report cases and send a specimen of the blood to be examined by Dr. Hiller. Certain suspicious conditions, like thoracic aneurysm, multiple abortion, death of three children in a family under five years of age, were also to be notified.

In all, fifty-five hundred cases were reported during the twelve months. For four months, at the end of the period, all the cases visiting two of the hospital clinics (eye, ear, nose, and throat cases) were tested. The results showed that out of a hospital population

* I see from "Problems in Eugenics, paper communicated to the first International Eugenics Congress," received while this article was passing through the press, that Scandinavia now enforces compulsory notification of venereal disease, but am uncertain whether the action there preceded or followed the movement in Melbourne.

of five hundred and fifty, at least thirteen per cent. were syphilitic. The hospital population was superior to most hospital populations, the majority presenting themselves for minor ailments having nothing to do with syphilis.

What is more, Dr. Barrett,[16] who studied the eye cases, lays down as the result of this routine testing, that it was striking how the syphilitic taint was responsbile for bad after results in operation upon the eye, for lowered vitality and liability to secondary infection. If a cataract or other operation failed to heal, and became infected, he almost constantly found that the patient gave a positive Wassermann test, or a history of previous syphilis. Thirteen per cent.—one in every eight persons!

Have we any right to suppose that Edmonton, Calgary, Vancouver, Winnipeg, Toronto, or Montreal are in this respect any better than Melbourne? Surely with the knowledge that we now possess—if only with the knowledge that we as a profession possess, of the means of remedy—the time has come for us to unite in eradicating from our midst a scourge which brings in its train such hideous after-effects.

In support of my plea let me say that New York is already dealing with the matter. Upon May 1st of this year, the board of health of that city—a body which has led the municipal anti-tuberculosis campaign on this continent—put into effect a well thought out scheme along similar lines, whereby the officers in charge of all public institutions of the nature of hospitals and corrective institutions, are required to report promptly all cases of venereal disease, and all physicians are requested to afford like information regarding private patients under their care, excepting that the name and address of the patient need not be reported. All information so obtained is to be treated as absolutely confidential and not to be accessible to the public. The department of public health is prepared to make free bacteriological examination and diagnosis of material submitted when the data required for registration are furnished, and provides and distributes circulars of information in relation to these diseases.

It may be objected that all this is not a matter for dinner and after dinner conversation—that like your fashionable preacher I should have chosen for this popular address something so choice that it would offend the susceptibilities of none of my hearers, and let me add, have done no good to anybody. But I say that when a false scientific theory has been disseminated, and is being popularized and applied wrongly to the hurt of the future generations,

it is the physician's right, nay, it is his duty, to call a halt and expose the truth. When it is being taught that parents may subject themselves to intoxications and infections and that their offspring in their bodies and in their health pay no penalty, that the race does not directly suffer from the follies of individuals, that it is perfectly sound policy for this young country to welcome as citizens those of degraded or depraved parentage; then I hold that it is the duty of the physician to tell the truth as he knows it; and to explain in clear, unveiled language the basis of his belief.

I have brought forward these matters to-night, not on moral grounds, not for the soul's salvation of any here present, though I would say let him that readeth understand and apply what I have said, but because with all who have the interest of this great country at heart I want it to be realized that clean living makes the great nation; that if the parents eat sour grapes the children's teeth, ay, and much more than their teeth, are liable to be set on edge, that evil living must tell upon the race even unto the third and fourth generation.

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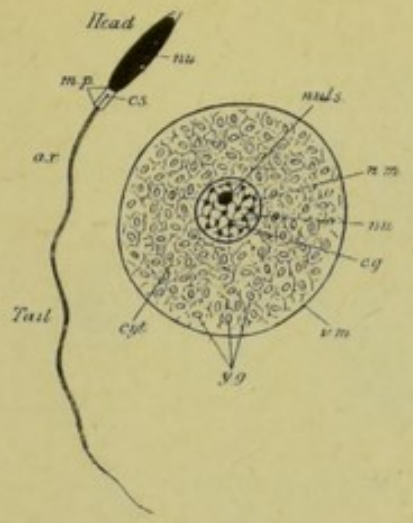


FIG. 1.—Diagram of typical Spermatozoon and Ovum, the former much more highly magnified than the latter.

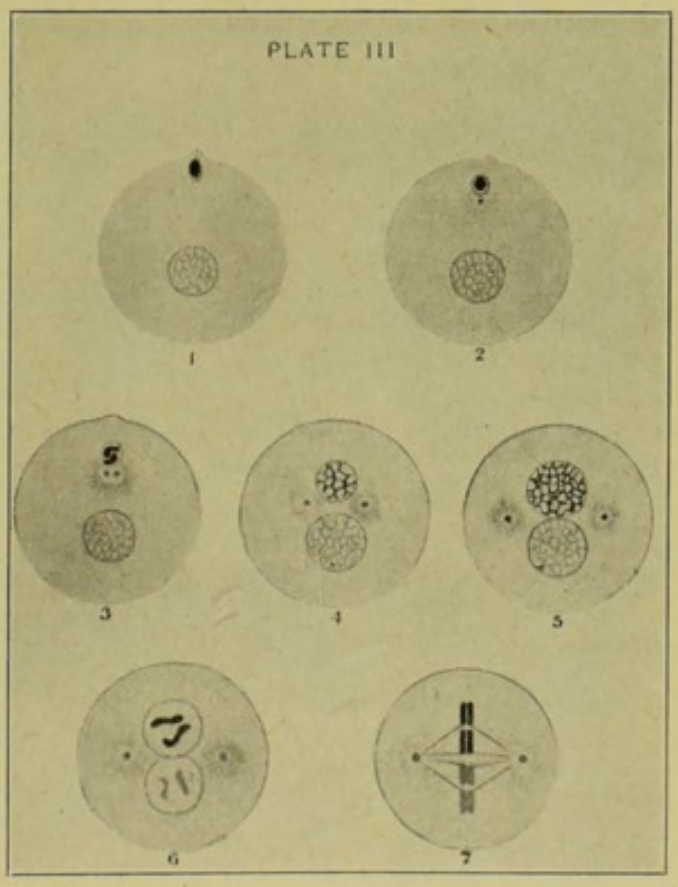


FIG. 2.—Schematic representation of the succession of events in the process of fertilisation, from the time of entrances of the spermatozoon (*sp.*) into the oocyte, until the fusion of the nuclear chromosomes of the male and female cells to form the single nucleus of the ovum.

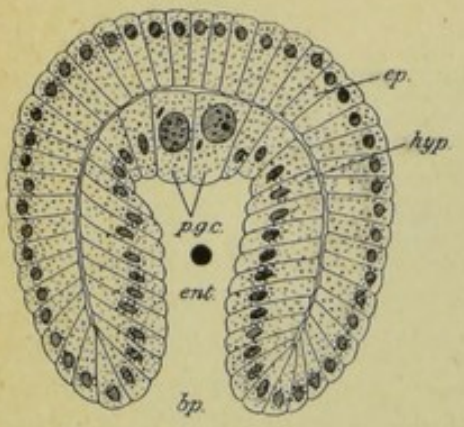
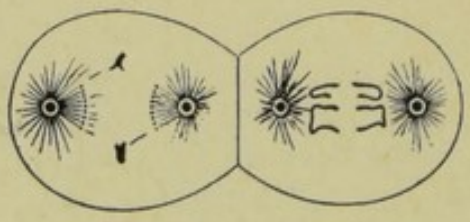


FIG. 3.—Section of the Gastrula of an Arrow Worm (Sagitta) showing the primordial Germ Cells. (After O. Hertwig.)

b.p., blastopore; *ent.*, entcron; *e.p.*, epiblast; *hyp*, hypoblast; *p.g.c.* primordial germ cells.



a *b*

FIG. 4.—Two cells of segmenting egg of *Ascaris megalocephala*. *a*, Destined to give rise to body cells, shows diminution and casting out of some of its chromatin. *b*, The germinal blastomere shows no such reduction. (After Boveri.)

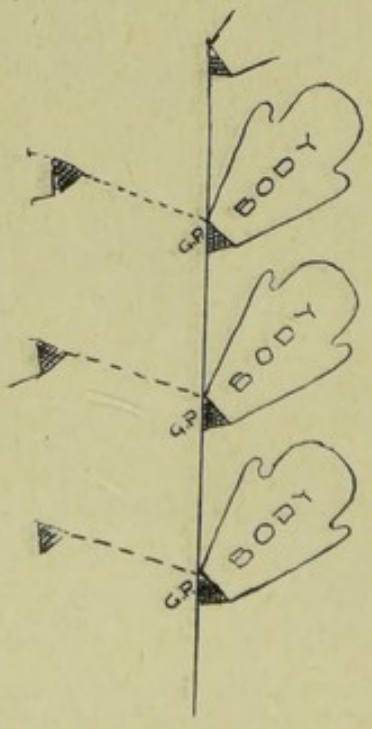


FIG. 5.—Schema of descent, illustrating the continuity of the Germ plasm, (G.P.)