THE GALTON LABORATORY: ITS WORK AND AIMS*

By L. S. PENROSE, M.A., M.D.
University College, London

I HAVE been invited to address this *Society* on the subject of the work of the Galton Laboratory. Although I am not a member, I do so with pleasure for more than one reason. In the first instance, I welcome the opportunity of outlining some of the methods of research employed by my colleagues and myself. Secondly, the Galton Laboratory investigates man and must rely on the goodwill of members of the human race to co-operate in its researches, so that it is sometimes necessary to explain what we are trying to do. Furthermore, in 1910, Galton laid it down that the business of the Eugenics Education Society, of which he was then president, should be to make known to the public the results of scientific work. It does not seem out of order to place information before their successors. Moreover, as a representative of the academic interests of the subject of eugenics, I have no hesitation in expressing the views which I hold on the subject and which probably differ considerably from those held by many of this *Society's* members. I understand that membership is open to anyone interested in eugenics; but interpretation of the term is open to a good deal of latitude and members may be interested in studying alternative points of view.

History of the Laboratory

I will deal briefly with the past work of the Laboratory. Many of the results are now well known and have become classical. A reminder on some points may be of service to those unfamiliar with the contents of the Galton Laboratory publications.

The recognition of eugenics as an academic subject was slow and cautious. The definition adopted by the University was "The study of those agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally," a formula wide enough to permit the inclusion of any scientific work on human heredity, on demography or on problems relating to public health. It is difficult to say exactly when the work of the laboratory began. Actually, the Francis Galton Laboratory was not officially placed at University College by statute until 1933, but the organization emerged gradually out of much earlier activities.

The journal *Biometrika* was founded in 1901 by Weldon, Galton and Pearson in connection with the biometrical laboratory, but the earliest numbers contained papers on human genetics. The Eugenic Record Office in Gower Street began in 1904 under Galton's own supervision. A research fellowship on eugenics was established in 1906; and the first to be appointed to this post were Edgar Schuster and subsequently David Heron. Karl Pearson, who took over from Galton the direction of the office, was appointed to a professorship endowed under the Galton bequest, in 1911. The Eugenics Laboratory publications soon emerged; the lectures and the memoir series, which are still in print, covered a wide range of problems on nature and nurture. Among them were Miss Elderton's studies on consanguinity, Pearson's on tuberculosis and Heron's on mental deficiency, followed by the analysis of intelligence as a graded character by Pearson and Jaderholm. Closely integrated with the work of the laboratory were Goring's observations on criminals, on the basis of which he was able to dispose of the notion of a special criminal type of humanity, so dear to the hearts of nineteenth-century anthropologists.

The study of human pedigree material,

* A paper read before the *Eugenics Society* on January 25th, 1949.

which had been pursued by Pearson intensively from the first, found its chief expression in the publication of *The Treasury of Human Inheritance*. The original gigantic plan, to summarize for research workers all the known facts about hereditary diseases, has been carried on steadily since 1909. In recent years the *Treasury* has owed everything to the persistent efforts of Dr. Julia Bell. The *Annals of Eugenics*, edited by Pearson, came into existence in 1925 as a natural extension of *Biometrika*. Alongside papers originating from many parts of the world on human genetics and related problems, it contained accounts of the current researches in the Galton Laboratory. Under the editorship of Professor R. A. Fisher, over a period of some ten years from 1934, it became the vehicle of a great many important papers by himself and others, many of which broke new ground in statistical theory and method. There were frequent contributions from prominent biological statisticians, such as Haldane, Yates, Mather, Stevens, and Finney. It also continued to place on record extensive data from new genetical enquiries, including substantial papers by Sjögren and Fraser Roberts.

A certain type of anthropometrical investigation was regarded as very significant by Galton. In his *Memories*, published in 1908, he drew attention to the pressing need of obtaining a multitude of measurements relating to every faculty of body and mind in more than one generation. Analysis of measurements of stature by Karl Pearson gave rise to the generally accepted correlation values of these traits in sibs. The ascertainment of measurements in two generations, however, presented difficulties. Much preliminary work had to be done in finding the distributions of measurements in the general population, the allometric relations between measurements and the effects of environmental agencies. Dr. Percy Stocks and Miss M. Karn played a prominent part in these metrical studies. There was also an anthropological aspect to the work and, in this, Dr. G. M. Morant became the undisputed authority.

Under Fisher's far-sighted direction, the developments in anthropometry took a new turn. Common characters which segregated began to be studied intensively and a serological unit was initiated. The success of this enterprise was immediate and the foundations were thus laid for the serological laboratory, now autonomous, at the Lister Institute, where Dr. Race, Dr. Mourant and their associates are enlarging the scope of human genetics by the discovery of new antigens at a breath-taking speed.

Present Organization

In the face of the traditions and achievements which I have outlined, it will be readily appreciated that to live up to the expectations of our predecessors—even without attempting to expand the field of research—is a severe task. My colleagues and I have, however, many advantages which enable us to proceed in an atmosphere of optimism. The *Treasury* still continues in the hands of Dr. Bell; and Miss Karn has been able to proceed with her statistical analysis of environmental agencies. We are able to maintain a liaison with Dr. Race, which is extremely profitable to us and, I hope, occasionally useful to him. It is especially significant that we are always able to obtain advice and criticism from Professor Haldane, now the Senior Professor in the Department of Eugenics, Biometry and Genetics. His basic contributions to the subject of human genetics over a long period of years together with his knowledge and experience ensure continuity with all the earlier work of the laboratory. The interplay of ideas between our own group and those who are working on animal genetics and upon biometrical problems is extremely stimulating. At the present time the trend of the researches in the Galton Laboratory is towards medical aspects of human heredity. The adjacent work of Dr. Grüneberg on genetical pathology and physiology of the mouse forms a useful bridge between medicine and the more erudite genetics of insects. Moreover, it

is our aim to continue the development of a close relationship between ourselves and our medical friends on the staff of University College Hospital. They provide us with clinical problems connected with human genetics and biometry and we try to interest them in some of the genetical and statistical ideas which turn up in our work. The same applies, of course, to a great many other hospitals and institutions with which we are in contact. Finally, we are fortunate in having in the laboratory an excellent technical and clerical staff.

Forty years ago it needed only one person to ascertain a few cases of an unusual disease for quite a good paper on human genetics to follow. But the standards are rising. In the future, teams of experts will be essential. At the present time, the personnel of the Galton Laboratory is by no means complete in this respect, but we have sufficient expert assistance to enable us to carry out quite a number of investigations under close scrutiny. I will mention a few of the lines of work which have been productive since the laboratory at University College has become active again after the second world war.

Special Researches on Heredity

The first problem in our work is the identification and accurate description of human traits known to be—or thought to be —inherited. Some of these traits are difficult to measure and improvements in technique are constantly needed if the genetical backgrounds are to be properly understood. Many of them involve psychological problems. One interesting example is the trait of "tune deafness," e.g. inability to recognize the national anthem, which Dr. Kalmus has studied in collaboration with Dr. Fry of the Department of Phonetics of the College. Colour blindness, olfactory defects, taste deficiencies and disabilities in spelling have received a great deal of attention. The less subjective characters like hair form and hair colour are also under investigation. Here again new techniques of measurement are being developed by Dr. Kalmus and Dr. Harris. Among other physical traits, the configurations of the dermal ridges on hands and feet have proved an intriguing source of information. These markings are, as Galton himself showed, influenced by heredity and they are easy to record. The type of hereditary influence is still far from being understood. Dr. Holt has done some valuable preliminary work on the variation of dermal ridge counts in the general population. In order to assess correctly the likenesses found in families and the changes associated with developmental defects, random samples, such as can be obtained from normal school-children are absolutely essential. Peculiarities of configuration found among mentally defective subjects are being studied by Mr. Fang.

One of our continual aims is to build up a large amount of material suitable for the study of genetical linkage in man. This is a long-term proposition. It presumes the establishment of a battery of tests of known marker characters, presumably unlinked with one another. When a disease with known genetics is ascertained, the battery is applied to each member of the family. The results accumulate and are finally handed over to the mathematicians to work out the most likely linkage values. Usually, I may say, the value is near zero but, sooner or later, fairly strong linkages will be found with increasing frequency.

Linkage investigation emphasises the team character of modern research in human genetics. Take, for example, the study of ectrodactyly, a rare and striking abnormality, which greatly interested Pearson forty years ago. In reported pedigrees this condition is transmitted as a dominant mendelian trait. It does not interfere with vitality or fertility and may even enhance these qualities. We do not know all the effects of the gene but it causes malformations of the hands and feet in the cases we have studied. There is much variability in the manifestation and occasionally the hands are unaffected. The pedigree was published by Lewis and Embleton in 1908* and records of names and addresses

* Lewis, T., and Embleton, D. (1908), "Split-hand and Split-foot Deformities," *Biometrika* **6**, 26.

were lodged with the College of Surgeons Library. Forty years later contact with the family was renewed by Miss MacKenzie, and we were thus enabled to add considerably to the pedigree. The new individuals are separated by a thick line from those previously ascertained. All available members were seen, X-rayed, palm-printed and subjected to the battery of genetical tests, which included serological analysis carried out by Dr. S. Lawler. Active eugenists would tend to pronounce judgment on this family as a racial menace. Professor Kemp remarked to me that in Denmark such people would all have been sterilized. Let us look more deeply into the question. The affected members of this pedigree, if their hands and feet were not observed, would, I believe, qualify as desirable members of the human race. Furthermore, in nature such animals as sloths find too many digits an encumbrance. Even in human civilized life there are skills which do not demand the usual quantum of fingers. Ectrodactylous subjects can excel at outdoor games, clerical work, draughtsmanship and turning. The eugenic objection to ectrodactyly is mainly æsthetic—not biological.

It takes more than one family to establish linkage in human genetics and in the study of rare diseases, co-operation is sought from all those who meet with suitable cases. Recently we have been able to observe families containing myopathics, albinos, phenylketonurics, cases with multiple exostoses, congenital dislocation of the hip, polycystic kidneys and so on, which have been brought to our notice. Dr. Fraser Roberts very kindly put us in touch with a new ectrodactylous family. The defect was transmitted through two generations but arose in the first place from unaffected parents. Pedigrees are known where a dominant condition skips one or more generations, but we must also be on the look-out for indications of fresh mutation. The problem of measuring spontaneous mutation rate in the human species is made very difficult by the lack of knowledge about the reasons why manifestation varies so much in different individuals. When investigating these matters and, indeed, many others, the selection of striking cases of inherited disease is undesirable. The collection of outstanding pedigrees is useful for linkage studies but, in more fundamental work on human heredity, population samples or samples of cases not selected by familial incidence are necessary. When the whole field of ectrodactylous cases is studied, for example, the number of easily interpreted pedigrees is found to be few and most instances are unique in their families.

Methods of survey by collecting all available cases of one type of disease are therefore adopted in many of the Galton Laboratory investigations. I can refer specifically to the comprehensive study of the genetics of diabetes by Dr. Harris. Up to the present time, information on this question has been inadequate and interpretations have been unconvincing. In launching the present study, Dr. Harris has had the good fortune of the clinical advice of such authorities as Professor Himsworth and Dr. Lawrence. He has amassed a great quantity of data, which he has found possible to analyse in ways never previously attempted. It is not for me to anticipate his conclusions but I can mention that, as found in almost all accurate genetical investigations on human diseases, no simple mendelian explanation will fit all the facts. We must give up the attempt to express results in terms of presence or absence of diseases. Pedigrees with black and white blobs are useful only for crude demonstration purposes. We must think in terms of processes with variable ages of onset and varying degrees of manifestation in different cases. The environment of each individual also has to be carefully studied. The traditional belief that inherited human diseases are always dominant, recessive or sex-linked has to be greatly modified in the light of modern researches. A comprehensive study of the genetics of human mammary cancer, carried out in the laboratory by Miss MacKenzie, Miss Karn, Dr. Kalmus, and myself, gave no suggestion of mendelian inheritance though familial concentration could be proved.

Special Researches on Environment

The specific investigation of environmental influences as causes of congenital disease is a rapidly growing field. The effects of maternal age and order of birth are comparatively easy to examine objectively. They have been considered in several papers published in the *Annals of Eugenics*. The interrelations between these variables and the problems of maternal and infant welfare present fundamental eugenical problems. Statistics of premature birth, neonatal mortality, duration of pregnancy, spacing of births, etc., have hitherto been insufficiently analysed from the biological point of view, and familial data are scanty. Experiments by animal biologists have repeatedly shown that "phenocopies" (apparently genetical abnormalities) can be produced by poisoning or infecting the embryo in very early stages of development. Mumps and german measles, affecting a woman in early pregnancy, are known to be capable of inducing abnormality in the fœtus. There are also suggestions that incompatible antigens may be damaging to early development. Clearly the correct evaluation of the genetical and environmental agencies in fœtal disease is a problem worthy of close study. It is most unlikely that simple mendelian rules will account for more than a small fraction of the cases. Besides environment we have to think of new mutations and chromosome abnormalities as possible causes of such conditions as anencephaly, mongolism and congenital heart disease. Whatever the cause, one practical point emerges, namely, that the optimal maternal ages are about the same, both from the point of view of the mother and of the child. For minimal risks, the first child should be born at about 22 years and the remainder, up to about five altogether, spaced at intervals of approximately two years. It is noteworthy that the twentieth-century decline in family size tended especially to eliminate the children born at late maternal ages. From the point of view of the incidence of fœtal malformation it must have actually been a eugenic process.

A favourite method of distinguishing between the effects of heredity and environment, initiated by Galton's own work, is the investigation of twins. For elementary purposes, it is obviously necessary to be able to separate binovular and monovular types. The biometrical and serological techniques, such as are in use at the laboratory, are helpful to this end. The amount of genetical information obtainable from twin studies is, however, considerably more restricted than is often supposed. The facts can also be most misleading for a variety of reasons, which I cannot elaborate here. Suffice to say that we are extremely interested in twins and Miss McArthur is working in the laboratory on the genetics of multiple births; but our approach differs very much from the traditional analysis of collections into concordant and discordant pairs.

The Teaching of Eugenics

Besides carrying out a full research programme at the Galton Laboratory we are obliged to give instruction at the post-graduate level on the subject of eugenics and its related fields. An important branch of teaching is concerned with the application of statistics to genetical data. We are fortunate in having Dr. Cedric Smith on our staff to deal with this subject, to expound established methods and to invent new ones as occasion arises in the course of research work. The instruction given in the laboratory is integrated with that given in the rest of the Department of Biometry, Eugenics and Genetics, so that students attached to the laboratory can obtain a balanced knowledge of nearly all branches of genetical work. The department has its own library.

One of the ends served, I hope, by this breadth of approach, is to make those who will study and teach human genetics in the future aware of the immense complexity of the subject. The results of experimental animal genetics must be fully appreciated, yet great caution is required in their application to human problems. The human race resembles a wild population and is not a herd of domestic or laboratory animals. It has often astonished me that advocates of

race improvement are so often unaware of the difficulties in the tasks which they set themselves. Eighty years ago it seemed reasonable to Galton, on the analogy with the breeding of dogs and horses, to expect to be able to produce a superior race of men in a few generations. But knowledge of medicine and of genetics has increased enormously since that time, and with it has grown the perception of our ignorance. It is much easier than formerly to give an accurate prognosis of the likelihood that a certain well-defined rare disease will be repeated in a given relative. Problems of this sort are constantly occurring in medical practice. Many reach the laboratory though not all can be satisfactorily solved. To lay down any general rules for improvement of the human stock in the light of modern knowledge, however, is pretentious and absurd. It is my personal opinion, after much experience in research work, that active eugenical propaganda is, on the whole, inimical to the advance of scientific knowledge. It is premature and assumes that knowledge is a static and not a growing structure.

Before attempting to improve on nature and defeat her at her own game, we must understand her methods very thoroughly. Some of the processes of natural selection are very baffling and often appear superficially dysgenic. For example, genes which appear to be very harmful are constantly arising in healthy stocks by spontaneous fresh mutations. No amount of eugenic effort can prevent this from occurring. Mutation rate can, of course, be speeded up experimentally by radiations and other methods and the implications of the fact may be of great significance to future human generations. Incidentally, this aspect of genetics is not neglected in the Galton Laboratory, where the experimental production of new hereditary characters in cultures of fungi (basidio mycetes) is being studied by Miss Mittwoch. However, mutation is not necessarily a bad thing. Indeed it is a valuable asset for species to be able to experiment with new forms.

Developments of Eugenical Theory

Since the discovery of the prevalence of maternal and fœtal incompatibility, new light has been thrown upon the mechanics of elimination of harmful genes. In some circumstances, as shown by Haldane, selection against a gene increases the frequency of the fœtal disease which it causes. Another difficult eugenic situation is concerned with the relation of inbreeding to the production of rare recessive traits. A simple way of reducing the frequency, say, of phenylketonuria, would be to recommend the abolition of cousin marriages. The tendency for inbreeding to grow less during the last fifty years in European communities may have reduced the actual numbers of lethal recessives in the population. But simultaneously the carriers have probably become slightly more prevalent than formerly. Even more disturbing to any complacency, which may remain in the minds of eugenists, is the problem of heterosis (or hybrid vigour) and my remaining remarks will be devoted to this topic.

When breeding pure lines of plants or animals, it has been found fairly regularly that physical vigour and fertility are likely to be diminished. The vigour is restored by outcrossing. In the case of maize, the standard method of obtaining maximal yield is to cross two pure lines, individually both inferior to the resulting hybrid. The phenomenon of hybrid vigour or " heterosis " is not an isolated phenomenon and it may well apply to man. If it does, attempts to inbreed for purposes of producing eugenically desirable pure lines of men are likely to fail. There are also other objections to pure stocks. It is advantageous for a species to be variable—to possess both good and bad genes. Bad genes in a new genetical context or in another type of environment may become good. The collective quality of variation—the energy of the species, as Fisher termed it—is the greatest asset in the long run in the struggle for survival. We do not know what environments the human race has yet to face. The present evidence suggests that there will be no lack of variation to meet them unless some political lunatic succeeds in

eliminating everyone except those belonging to a pure stock. Fortunately, human lunatics are variable and do not all have the same delusions. Differences of opinion about the requirements of the master race will probably make its realization impossible.

To come back to more immediate considerations, it is easy to show that improvements in health can be much more rapidly, efficiently, and pleasantly brought about by altering environment than by altering heredity. In the meantime, the action of natural selection is slow and, for most practical purposes, the population can be expected to be in genetical equilibrium. Now, equilibrium can be stable, when there is heterosis, that is, when heterozygotes are more fertile than homozygotes. A typical example, suggested by Haldane, is this. Juvenile amaurotic idiocy is a condition caused by a lethal gene in homozygous form. The carriers, or unaffected heterozygotes, need only have one per cent more children as compared with non-carrier parents to keep the gene in circulation indefinitely (with random mating) without having to rely upon new mutation. This one per cent increase in fertility might be associated with an imperceptible lowering of mean scholastic intelligence of carriers. I will now proceed ruthlessly to generalize this conception.

The *Eugenics Society* has for some time past busied itself with the examination of what has been called the " social problem " group. This " submerged tenth " of the population is alleged to have, in some degree, the following properties. Intelligence is grossly below the average; fertility is high, more than doubled as compared with the rest of the population; the mental disabilities of the parents are transmitted to the offspring; there is much infant mortality; finally, assortative mating, which is very marked in human populations as far as intelligence level is concerned, ensures that the members of the group usually marry one another. Eugenists themselves are not likely to be members of this class and it is customary to regard it as composed of inferior stock. To my mind this is a contradiction in terms and I prefer a more objective attitude. If these people are really the most fertile, then they must, *ipso facto*, be most biologically fit and the superiority of the infertile intellectuals is illusory. I will not press this point because I want to emphasize something else. In spite of appearances, a population composed of two such elements, one group intelligent and the other less so but more fertile, can be in stable equilibrium. A nation with a social problem group having the properties outlined is not necessarily " silently rotting at the core " as has been feared; it might even be improving.

FIG. 1

MODEL POPULATION IN STABLE GENIC EQUILIBRIUM WITH ASSORTATIVE MATING AND DIFFERENTIAL FERTILITY

Type of Parental Mating	Relative Frequency	Offspring per Mating	Types of Offspring		
			Normal **AA** (I.Q. 108)	Defective and Fertile **Aa** (I.Q. 66)	Defective and Infertile **aa** (I.Q. 24)
AA × **AA**	9	1·89	17	—	—
Aa × **Aa**	1	4·00	1	2	1
aa × **aa**	0	0·00	—	—	—
Total Offspring			18	2	1

Stability in a Model Population

Intelligence is commonly believed to be inherited like an additive (intermediate) character because the mean level of children agrees with that of the parents. Members of the social problem group, when they mate with one another, naturally must have offspring with average ability for that group but there will also be variations above and below this level. Some time ago, I demon-

strated a model of an imaginary population* with all the main properties alleged to apply to the normal and social problem groups, which I quote here with slight alterations, in Fig. 1. Imagine a race composed of three main types determined by a single intelligence gene. The type **AA** is supposed to be normal; we will say it has an I.Q. slightly above 100 and people of this type make up about nine-tenths of the population. Their net fertility is too low to keep up their numbers and I suppose them to have an average of less than two children per family. There is, next, a social problem group making up about one-tenth of the population, all the members of which are heterozygous for a gene **a**. This gene produces intellectual defect and is associated with a greatly increased fertility—about double the normal and implying an average of four children per family. The individuals homozygous for **a** will be mental and physical weaklings, incapable of reproduction. Owing to the additive nature of the gene, their mental grades must be too low to be compatible with mating or even survival in most cases. Now, we assume perfectly assortative mating, so that no unions take place between the normals and the defectives and we set the system in motion. We find that it has genic equilibrium. This is due to the fact that the defectives' matings not only maintain their own numbers among their offspring but also contribute to the superior group; the proportion of weaklings produced implies a large infant mortality in addition. The I.Q. levels of the groups have been chosen so that the mean for the whole population at birth is 100. In Fig. 1, the proportions of the groups are such that there is exact replacement in each generation. Furthermore, the equilibrium is stable. If we should suppose that the size of the normal group were suddenly halved, the mean I.Q. would fall below 100. However, in each succeeding generation it would rise appreciably until it finally settled again at 100 after the complete rebuilding of the normal group. Conversely, if there were initially too many normals, their numbers would gradually diminish until the same stable proportions were reached. In the region of equilibrium the rate of change per generation would be extremely slow. The defectives are the genetical backbone of this population. If an efficient sterilization programme were instituted against this submerged fertile tenth, it would diminish the total fertility of the whole group and eventually lead to extermination of the whole race.

* Penrose, L. S. (1948), "The Supposed Threat of Declining Intelligence," *Am. J. Ment. Def.*, **53**.

Conclusions

The analogy between this model and human society is probably not close but it should perhaps give food for thought. It supplies a reason for rejecting eugenical theories, which assume that the group to which the propounder belongs is necessarily at the centre of the human biological universe. The truth may be the very reverse of this and the traditional Ptolemic system of eugenics may have to give way to a Copernican conception, where the infertile intellectuals are found to be peripheral to a nucleus of fertile labourers. The essence of this suggestion is that differential fertility in human populations is a phenomenon due to heterosis. The example given is only a very simple case of a type of problem, which has to be tackled by students of evolution and which sometimes involves difficult mathematics.

This particular demonstration arose from an examination of the probable fallacies in arguments predicting a decline in national intelligence level from observations on differential fertility. It seems inherently improbable that rapid changes should be taking place in the distribution of "intelligence genes" in the population and not at the same time in the frequencies of other genes. For this and numerous further reasons I regard as invalid the conclusions usually drawn from the negative correlation between sib number and intelligence. Naturally, the results of the experiment which repeated tests on Scottish children after a lapse of fifteen years were of great interest to me. Physique and intelligence are positively correlated and a slight

improvement in the mean intelligence level was to be expected on analogy with the results of enquiries showing gradually improving physique. I fully agree with the interpretation that the improvements found are due to non-genetical causes. But, if the results of the Scottish tests had gone the other way, there might have been a difference of opinion. A significant drop in the mean level would have been hailed by most people as a confirmation of their worst fears, whereas I would willingly have attributed it to environmental agencies or inaccuracies of measurement.

In this lecture I have outlined the history and the present aims of the Galton Laboratory. I have also explained some of my personal views on eugenical theory, for which, of course, my colleagues cannot be held responsible. In conclusion, it is fair, I think, to emphasize that the orientation of our work is towards medical research; five people working in the laboratory are medically qualified. The genetical constitution of the human race is unlikely to be changed appreciably in the foreseeable future as a consequence of our findings. We expect, however, to be able to make useful, if modest, contributions to medical science.

DISCUSSION

Professor Major Greenwood, Dr. C. P. Blacker, Professor Aubrey Lewis and Dr. Eliot Slater took part in the discussion, the two latter welcoming the expression by Professor Penrose of views which were at variance with those held by the *Society*.

Professor Major Greenwood said that his apology for accepting the chairman's invitation to speak on a subject of which he had no expert knowledge was that Professor Penrose had stirred pleasant memories of his youth. He was certainly not the oldest surviving pupil of " K. P "—that distinction probably belonged to Mr. Udny Yule, who was nine years his senior—but he spent the academic year 1904-5 under the wand of the magician, and 1904-5 belonged to a vanished age. In that session he was a youth just through the undergraduate medical curriculum and 50 per cent of the audience of " K. P.'s " lectures. The other 50 per cent was " K. P.'s " assistant, John Blakeman, whose name was still associated with a long obsolete criterion of linear regression.

To any moderately well-educated young man or woman of 1949, continued Professor Greenwood, the notions young people in 1904 had of heredity, or genetics, must seem as odd as the clinical medicine of Thomas Sydenham seemed to a newly qualified medical man in 1904. It was true that Mendel's work had already been rediscovered, but the biometric laboratory of University College was not quite the best place in which to learn Mendelism, although the best place in which to learn how Francis Galton's ideas could be, first, mathematically formulated and then arithmetically applied to data. For young people like himself, whose mathematics beyond " intermediate " standard were self-taught, " K. P.'s " insistence that no algebraical result was of value which could not be tried out arithmetically was encouraging. He was a very great teacher. He encouraged young people to master what was, to them, difficult algebra because he convinced them it was useful. Of course they were uncritical, but he taught them to work. His own humble share of the eugenic researches of that epoch was to help in the compilation of a bibliography of human albinism, and doing so under the eye of the master taught him a good deal. He learned how to use a library and how to abstract. He thought his gradual lapse from Carlovignian orthodoxy was emotional rather than intellectual; an increasing distaste for the sharp antithesis of Nature against Nurture; a cynical suspicion that correlation coefficients which favoured " Nature " would not have to submit to the third degree, or Sovietic, scrutiny which would certainly be the fate of any statistical evidence that seemed to favour " Nurture." Well, now, forty-five years on, Professor Penrose told them that such emotional reactions had, and have, an intellectual justification. Both Biometricians and Mendelians of 1904—to use the old battle cries—erred and strayed from the ways of Nature, or the Nature of Things, but not quite like lost sheep. The

biometricians, inspired by the Master Biometrician, forged the intellectual tools—vehemently rejected by the Mendelians of 1904—which the geneticists of 1949, who were, he supposed, the spiritual children of the old Mendelians, found indispensable. If, in one sense, the old biometricians fought a losing battle, in another equally real sense they won a great victory. Even in their, as it seemed now, naïve exaggerations of what they called Nature they were not wholly mischievous. Professor Penrose had told them that the orientation of the Galton Laboratory was towards medical research and that he and his colleagues expected to be able to make useful, if modest, contributions to medical science. Professor Greenwood was sure they would succeed in this undertaking, indeed had already succeeded. In 1904 the medical profession was but faintly interested in heredity and not interested at all in statistical methods. In 1949 the picture was changed. He thought that Karl Pearson's studies of tuberculosis and polemics against eminent physicians forty years ago were the first writings to make the "doctors" believe, or perhaps fear, that there might be something in biometry. Indeed this was acknowledged by Osler in his once-famous textbook as early as 1912.

It was easy to point now to weaknesses in "K. P.'s" arguments and to recall that his belief that the rate of mortality from tuberculosis would increase in the next generation had been signally falsified; but the speaker's own generation of obscure medical biometricians profited from his onslaughts. After all, "K. P." was the first "layman" of eminence who ventured to treat what the public called "eminent Harley Street Specialists" *de puissance à puissance*, over a medical issue and to do so effectively. Certainly our views of heredity were very different from those of Galton and "K. P.," but, in these days of bettered environment and progressive social medicine, the problems of medical genetics were, so he had been told by a distinguished worker, not less but more important than two generations ago. That, however, said Professor Greenwood, brought him to a field on which he would be a trespasser. His only excuse for speaking was a desire to remind the elderly and to tell the young of battles forty years ago. Helmholtz said that to come under the influence of a great researcher changed one's whole scale of values. That was the effect "K. P." had on all young people who came within his sphere of influence. It was a very wide influence. The affection he inspired *and* the anger he provoked both did good. H. G. Wells wrote a delightful story of a man of science whose life work was based on a desire to disprove the conclusions of another scientist he disliked. The history of modern biometry provided illustrations.

Dr. C. P. Blacker also expressed appreciation of the lecture. He recalled that in January 1948 we had listened to Dr. Henry Harris, who was a member of Professor Penrose's staff; Dr. Blacker hoped to establish a precedent by which, each year, the January meeting should be an occasion for a lecture from a research worker in the Galton Laboratory.

It was understandable that workers in the difficult field of human genetics, wherein new complexities were being continually disclosed, should be hesitant about eugenic policies. Misgivings were especially felt by those who were preoccupied with rare segregating characters rather than with the common, metrical and graded characters such as were represented in Professor Penrose's ectrodactyly pedigree. But it was possible to get so lost in obscurities as to forget the workings of simple background principles. The biochemistry of the simplest muscular contraction was so complex as to make understandable the remark of the young lady who said that she had never appreciated how much cleverer her body was than her brain. Preoccupation with the complexities of genetics could cause us to forget that evolution had taken place blindly by natural selection; and that it had been by a selection almost as blind that our ancestors, from time immemorial, had shaped in accordance with their needs, our domesticated animals and plants. Our ancestors knew nothing of the laws of Mendelism, of chromosomes or genes. They proceeded on the simple rule that like

produced like. We would not go far wrong in applying the same rule.

Science could not determine our values: it could not influence the choice of what qualities we thought good or bad. Our eugenic values to-day were not as simple as they had been for some of Galton's followers and camp-followers. We no longer thought in terms of race or class. But the difficulty presented by the evolution of our values should not be confused with that arising from the application of our knowledge. Science was ethically neutral and could be made to serve bad ends as well as good.

Galton's outlook on eugenics, though remarkably stable throughout his life, had changed in perceptible ways which he had described in his *Memories*. He had come to recognise, in his last decade, that it was not as easy as he had first thought to translate science into policy. Dr. Blacker quoted the following passage, written by Galton in 1904:

> Over-zeal leading to hasty action would do harm, by holding out expectations of a near golden age, which will certainly be falsified and cause the science to be discredited. The first and main point is to secure the general intellectual acceptance of eugenics as a hopeful and most important study. Then let its principles work into the heart of the nation, who will gradually give practical effect to them in ways that we may not wholly foresee.

This was a cautious statement which we could as readily accept to-day as when it was written. It represented the standpoint of the *Eugenics Society*.