"colour-blind" to the higher spiritual influences. And in this work of conciliation the Bible will assuredly hold its own as the great spiritual guide of humanity, and as an inexhaustible treasury of spiritual wisdom, if it be studied according to the meaning of its own simple words, and not according to the glosses that have been passed upon these by innumerable generations of contending theologians.

The physician of the future will, I believe, be much more, instead of less, inclined to make his study of the Bible than hitherto, and in this respect will differ greatly from the representative and typical "Doctour of Phisike" of the *Canterbury Tales*. But he will study it in the spirit of modern scientific freedom and of historical research, not under the influence of mere tradition and ecclesiastical authority. And thus only, as it seems to me, can the reconciliation of science and religion ever be brought about.

In the address I had the honour to deliver last year in Dublin, I reproduced a sentence from one more than twenty years old, in which I had said as regards our own historical position at that time (but only in reference to the healing art), "The day of orthodoxies is over; the day of real science is only just dawning." The whole course of that address, as well as of the one which preceded it, was directed towards the demonstration of the enormous evils that have accrued to humanity and to the medical art from a blind reliance upon the tradition of the ages, and often upon traditions wrongly interpreted. "It is so hard," writes our humorous and venerable *confère* across the Atlantic, Oliver Wendell Holmes,²⁹ "to get anything out of the dead hand of medical tradition. The mortmain of theorists extinct in science clings as close as that of ecclesiastics defunct in law." The abuses of blood-letting, of a senseless and obstructive polypharmacy, and of innumerable so-called remedies, either inert or positively mischievous, which have had to be cleared out of the way before medical science and practice could even begin to be reasonably simple and intelligible, have been a lesson to all of us, I trust, as to this "dead hand of medical tradition." How can we, of all men, fail to see that the same kind of mortmain, precisely the same or similar dead scholastic orthodoxies, have locked up the living words of the New Testament, and of our Lord Jesus Christ himself, in formulas around which the dust of ages has accumulated, till the dead letter has well-nigh choked out the living and life-giving spirit of Christianity. The beautiful story of a divine life and death, the miracles of healing, the sermon on the mount, the parable of the prodigal son, with its ever fresh lesson of the fatherhood of God; that of the good Samaritan, with its large sense of human brotherhood, are conspicuous by their absence as principles from those creeds of the church which profess to be the formulated essence of Christian doctrine; and instead of these we have the controversies of the first four centuries, marred and scarred all over with the traces of very human, very bitter, and often sanguinary conflicts; the scrambles for power of this or that bishop, "lording it over the heritage" in opposition to the very words of St. Peter, and giving to all time an example not of the "peace and goodwill" with which the first Christmas Day was ushered in, but rather of the sad prophecy "not peace, but a sword," which only too truly foreshadowed the ecclesiastical as opposed to the Christian *régime*.³⁰

The physician of the future will do well if he remembers always the pernicious despotism which has been exercised over his own art (though in a minor degree) by the fetters of these dead orthodoxies, and will therefore be very slow to acknowledge their claims upon him to any more than a historical regard, even in the realm of theology. He will say of them, in the noble words of the Westminster Confession which (but for the formula connected with it in our Scottish churches) might almost be taken as the Magna Charta of Christian liberty in all such documents—"All synods and councils since the Apostles' times, whether general or particular, may err, and many have erred; therefore they are not to be made the rule of faith or practice, but to be used as an help in both."³¹ But I desire you very specially to

remark as my own personal anticipation, shared, I have no doubt, by many of those now present, that the physician, in his character of student of Nature, will make, and in the end will establish, this claim to emancipation, not in virtue of any irreverent, much less atheistic, tendencies, but for the very reason that he has access to a revelation of God distinct from the written revelation, and requiring a wholly distinct method of investigation. In obedience to this call he will, sooner or later, absolutely decline to walk in the leading-strings of ecclesiastical tradition. And in so doing he will (far from fulfilling old Dan Chaucer's satirical description) studiously insist upon the Bible, and especially the New Testament, and above all, the recorded life, words, and works, of our Lord himself, as containing, by implication, the charter of his emancipation, and the only perfectly free religious atmosphere as yet opened to human thought and inquiry. In proof of which I will now only submit one pregnant saying, with which, if it be indeed the word of God, all those who believe it to be such are bound to find all the other words of God in entire accord:—

"Henceforth I call you not bond-servants; for the bond-servant knoweth not what his lord doeth: but I have called you friends; for all things that I have heard of my Father I have made known unto you." John xv, 15.

ADDRESS IN MEDICINE,

BY

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ON THE CLASSIFICATION OF DISEASES BY MEANS OF COMPARATIVE NOSOLOGY.

MR. PRESIDENT AND GENTLEMEN,—The place to which you have called me is a high place in any meeting of this Association; but it is a rare and singular distinction to-day to be invited to deliver the Address in Medicine in the City of Glasgow, within the walls of its noble University.

If not *par cæteris*, I am *necessitate certe superior*; if not the peer of others, certainly I am put under greater obligations by the magnitude of my call. For, says Bacon, further: "Necessity hath many times an advantage, because it awaketh the powers of the mind and strengtheneth endeavour." I must hope, therefore, that the "power of the man" may prove not wholly unequal to the "power of the moment."

Of late years my avocations have prevented an attachment to that kind of special investigation to which my earlier years were devoted; I have, therefore, none of the results of experiment to lay before you.

Happily, however, as I think, the Address in Medicine should deal rather with the larger aspects of our art—with those broader conceptions which fashion themselves in the mind ripened by diversity of experience and fed by the continual discoveries of others who still labour in the various fields of inductive science. In one large conception of Medicine my mind has dwelt for many years, and I gladly seize this time to place it before you, for I believe it to be the *Novum Organon* of Medicine, its instrument, and a clew to its investigation. I ask your permission to make a few reflections on the Classification of Disease by means of Comparative Nosology—a method which will co-ordinate the ever-increasing accumulations of our clinical notebooks and of our laboratories, and create a system which, in its turn, will direct and inspire the labours of the inductive inquirer of the future.

Twenty-one years ago, in the second volume of *St. George's Hospital Reports*, I wrote a paper on the "Classification of Disease," from which I will venture to quote some sentences. "The philosophical inquirer," I then said, "is not satisfied to know that a person is suffering from the given disease of the moment. He desires to know why he is so suffering, or, in other words, what are the processes which necessarily precede and follow it. He wishes to include this phenomenon, now isolated, in the series of which it must be a member, to trace the period of which it must be a phase. He believes that diseased processes have their evolution and laws as have other natural processes, and he believes that these are fixed and knowable. But he feels that no

²⁹ *Currents and Counter-Currents in Medical Science*; with other Addresses and Essays. By Oliver W. Holmes. Boston: 1861, p. 22.

³⁰ On the Apostles Creed (so-called), see *Histoire du Credo*: Par Athanasie Coquerel, fils, esp. p. 20.—On the Nicene Creed, Milman; *History of Christianity*, Vol. iii; *Index and History of Latin Christianity*, Vol. viii, p. 391. The creed commonly called of St. Athanasius speaks for itself, and requires no commentary. On the Westminster Confession many most interesting personal details will be found in the *Letters and Journals of Robert Baillie, A.M.*, Principal of the University of Glasgow, MDCXXXVII, MDCLXII. 3 Vols. Edinburgh: 1841.

³¹ The Confession of Faith, agreed upon by the Assembly of Divines at Westminster, etc., chap. xxxi. Of Synods and Councils, 1643.

serious efforts are made to detect these laws. He feels that he and others are looking upon diseases as one ignorant of history looks upon a map. There are certain groups marked off by little pink lines and little blue lines and duly designated by appropriate names in neat roman letters. But he does not know their real affinities; he does not know how far the little blue lines and the little pink lines coincide with distinctions of kind or are only the result of artifice. He is ignorant whether any two neighbouring groups have anything in common beside their neighbourhood, nor does he know whether the component parts of any one group are held together by an accidental bond or by a natural affinity" (p. 188). "We are in the habit also, for practical convenience, of founding classifications upon properties selected only for their obviousness. No one dreams, for instance, of attaching any scientific meaning to an alphabetical classification, or to a classification of objects by their size, colour, weight, or immediate usefulness. Names given upon such obvious and separable characters have no value beyond themselves, and do not help us to perceive distinctions of kind. A scientific classification is the very opposite of this. It disregards the obvious as such, and may place together objects at first sight distant and disparate" (p. 191). "When we classify a disease scientifically, we do so, not to group together affections having a community of site or of aspect, not for easy reference or practical need, but to express the greatest possible number of facts concerning its relations with other diseases" (p. 192). "Conversely, false or artificial classifications do mischief, not only in declaring a kinship where no near kinship exists, but also in drawing the mind away from the perception of real affinities. We are led by them to think of all diseases as isolated disturbances, not of many of them that they are phases of certain periods of bodily development. We are led to regard a sickly person, not as one working out his own mode of life, but as one full of local knots, as the chalk is full of flints" (p. 189).

On another page I formulated the following propositions, among others:—

1. That classification in the study of disease is not a technical system as it is in the practice of it, but is the expression and organ of our progress in investigation; to classify being to think of things in such groups, and these groups in such an order as will best conduce to the ascertainment and remembrance of their laws.¹

2. That life consists of a series of processes which together constitute varieties or modes of growth, that is, health, scrofula, syphilis, rheumatism, gout, rickets, tuberculosis, etc.

3. That diseases, taken severally, are often members of such series, which series may be constructed by a survey, not only of the individual, but of his collateral kin and of his ancestry, and also of other orders of the animal and vegetable worlds, a survey which cannot be made until comparative nosology becomes a recognised branch of our science.

4. Classification, then, can and must be founded on a natural method and on natural affinities, and must be the expression of them.

An artificial system, on the other hand, is based on separable attributes of size, locality, appearance, duration, usefulness, etc., which are not distinctions of kind.

Passing over intermediate essays, I said again, when President of the Section of Medicine in 1882: "To find new arms against disease, we must have a truer conception than we mostly have of the genesis of disease. No mere enumeration of symptoms or of pathological detail will suffice for this, nor even a full description of diseases severally. We have to work out the genetic affinities of diseases, their origins, parent stems, and alliances, as well as their issues. We can have no complete therapeutics until the science of comparative nosology is in great measure constructed—a science as yet scarcely begun—nay, as yet scarcely recognised. As Professor Geikie tells us, the modern geologist has to see that Europe and Asia were not created, but grew; and now that the whole phenomena of life, animal and vegetal, are comprehended as one, and this one is proved to have developed from the simplest beginnings, its diseases will appear as morbid varieties of growth, and its laws of dissolution will be discovered. With the manifestations of the higher forms of life, the most complex diatheses will be co-ordinate, and will present more and more heterogeneous phenomena; and with the full diversity of life in man we shall realise the correlative display of its manifold modes of undoing. Yet further: our comparison even of human diseases cannot be bounded by the study of our nearer brethren—of the men of our

time and country. We have to learn how diseases vary with the conditions of time and place, of season and soil, of race and temperament; for it may turn out that the races which enter into the composition of our own nation bring each their own tincture of decay." In the same address I referred also to the embryological interpretations of disease, these being based either on arrested development, as in the facial type of the idiot, or in retrogressions such as leucocythæmia. For the comparison of embryonic periods in the same and in different animals may be a master-key even to the diatheses themselves, as may be suggested, for instance, in lithiasis, wherein the formation of uric acid, and in diabetes, wherein the formation of glucose, are the resumptions of states normal to inferior types. M. Quano² says, in respect of primary progressive muscular atrophy, that there is a correlation between degree of predisposition to waste and the degree of the rapidity of the development of the muscles. In this disease, as in pseudo-hypertrophic palsy and facial hemiatrophy, muscles suffer in a certain order. Clearly, in them and in the nervous centres there is a connection between pathological anatomy and embryology. The strumous diathesis, again, seems to be an arrest of development which can be artificially made by deprivation of light and other forces. In 1864 that powerful medical thinker, Dr. Laycock, showed, with instances, that some basis of organic classification of disease was to be sought in a comparison of diseases as they originate in the several layers of the embryo—a hypothesis which has thrown a brilliant light upon the genesis and kinship of neoplasms. Dr. Laycock also says in general terms: "Perhaps no morbid change happens to man which is not a normal process in other organisms, animal or vegetable, and the nature of which may be known by a study of such analogous normal changes." A good example of this is the shedding antler of the deer, which is a huge sequestrum, a case of normal necrosis.

To my own advanced pupils I have long been accustomed thus to convert an old aphorism: "Nihil in pathologiâ quod non prius in physiologiâ"—Pathology contains nothing not previously in physiology.

Since my earlier words were written I gladly admit that some advances have been made in the ways which I have indicated, but the advance has been far less than in these days it should have been. To this moment comparative nosology is a term hardly heard, and although Sir James Paget, Mr. Bland Sutton, and others have dealt with the matter, and although the laborious investigations into minute life have lately taught us much of its simplest modes, yet we have made no real effort, as a profession, to cast off our anthropocentric point of view. From veterinary science we are now drawing new and valuable knowledge,⁴ and shall draw more and more benefit from it; but its professors, able as some of them are, only differ from us in standing at a hippocentric instead of an anthropocentric point of view. We are thus in the position of anatomists before Cuvier and Von Baer. We have made a minute clinical study of human nosology; perhaps, indeed, no extensive discoveries remain to be added to this field of research. But the parts into which disease has been dissected are not the elements out of which it has grown. Nearly all remains to be done in tracing the homologies of disease throughout the animal and vegetable world; in studying its phenomena under the various and simpler conditions of lower organisms; in tracing its development upwards through the macrocosm of all life and through the microcosm of the embryo; in pursuing disease also through its variations in space and under changed climatic conditions; in registering the effects of change of function upon change of structure as these changes pass by hereditary transmission from the dynamic to the static form, and in so tabulating pathological sequences in family, race, or country as to detect the latent affinities of diseases apparently unkindred.

Hitherto our motto has been "*ὁν γνῶσις ἀλλὰ πράξις*," and our nosological systems schedules constructed for immediate purposes; our method, admirable as it has been for the accumulation of detail and the drilling of the practitioner, is yet, as a method, what Bacon calls "*mera palpatio*;" it conveys no knowledge of the system of ideas which represents the world of disease, and has, indeed, little or no speculative value.

Robert Houdin used to fix above his doors on the Boulevard the whole alphabet, but he would only illuminate occasional

¹ Mill, *Logic* (Edn. 1872), vol. ii, page 271.

² *Lancet*, March 17th, 1888.

³ *Medical Observations and Reflections*, p. 254.

⁴ *The new Journal of Comp. Pathology*, Edin., 1888.

groups of letters. The cabalistic words thus revealed mystified thousands nightly. Of the alphabet of disease we see such scattered fractions, yet, accidental or arbitrary as they may appear, under the flowing robes of Nature there is an inflexible and insoluble continuity. Painfully I feel how little I can do, with the slender material at my service, even to indicate the lines on which we must work to fill up these gaps and to work out these new problems—painfully I feel that my subject is too deep for words and yet too strong for silence. “*Prudens questio dimidium scientiæ.*” I earnestly call, therefore, for your help to indicate the lines of a natural classification of disease by affinity which shall supersede our present Linnean method of classification by clinical features. We shall thus reveal the laws on which diseases have developed themselves from the simplest deviations in the simplest forms of life on the globe up to the complex and heterogeneous maladies which are seen in ourselves. Such a natural classification will coincide with those mental processes by which such knowledge ought to be acquired, retained, and enlarged, and will give us deductively, in specific instances, that diagnosis and prognosis upon which all therapeutics must intimately depend.⁵

As Dr. Laycock observed, “When men complain that medicine has no principles, they forget that their complaint extends beyond medicine.” They must extend their complaint not only to nosology but to biology, of which it forms an essential part. We must study the pathology of structure and function in the entire series of organisms, a study scarcely begun; and in them recognise the retrocessions of structure and function from higher modes of life, not forgetting also the reversions of the higher mental faculties through the instincts and propensities of the brutes.

For example, let us for a moment consider that factor in the highest organisms which we call the nervous system, the functions of which have been of late years so ardently studied. The attainment of higher degrees of organisation has been gained by means of a correlative development of this system until the whole and every part of the organism are so interfused with it, and the influence of it, that local autonomy has been gradually controlled. Omitting the intermediate term, we may say that the increasing power and complexity of the nervous system and the integration of diverse functions in it are correlative, on the one hand, with an equivalent complexity of disease, and on the other with a subordination of local morbid changes to the balance of systemic forces. Thus it is that diseases tend more and more to take a neurotic quality.

In man the nervous system has gained a development so enormously beyond that of the highest pithecoïd forms, that the diseases of man are correspondingly heterogeneous. As we descend from pithecoïd types to lower forms—to dogs and cats, for instance—we shall find their diseases to be simpler and more localised. Everyone who has had dealings with animals knows how long they may live, and even recover with great local lesions, even of organs we should call vital.⁶ If we descend further we shall find local autonomy becoming still more evident, until in many reptiles we observe a reproduction of amputated limbs, and in still lower organisms a reproduction of their wholes from aliquot parts. For example, a systemic thermotaxy can come only with a certain extension and integration of the nervous system, so that thermotaxy, or fever, is a nervous phenomenon, as recent observers have established. The earlier form of thermotaxy was, no doubt, an ebb and flow, of which a trace remains in the diurnal variations of normal human temperature, and which appears again in the reductions of disease, and is, as we should expect, more visible in the remittent form of the fevers of the child whose nervous system is less organised. So as we descend the scale of warm-blooded animals, and simplify the nervous system, we approach those organisms in which fever cannot be, and local lesions have no constitutional symptoms. In man, on the other hand, so readily are local vibrations propagated, and in so many directions, and so profoundly in him have local autonomies been supplanted by nervous governance, that modern observers are beginning to say that in man, not fever only, but all maladies are primarily or secondarily neurotic. I have elsewhere indicated at length the nervous factors of phthisis

and of granular kidney, and many writers have expressed a conviction that gout is a neurosis. By this we mean, not that these diseases are generated primarily in the conducting machinery itself, but that the different organs and tissues of the body have become so entirely subordinate to the nervous system and so bound up thereby with all and several parts of the body, that local disturbances cannot remain isolated but, exciting sympathetic changes in all other parts, they put on the complex features of general maladies, and necessitate indeed the readjustment of all other parts. Central lesions, on the other hand, may put on the characters of local disturbances in so far as they precipitate change of function in any part or parts over which they exercise influence. For each part no longer suffices for its own nutrition, but all conspire to the nutrition and function of each; the “trophic action of a nerve” on a part being but the converse of the mutual support of all by each; it is division of labour which makes boycotting effective. Hence, as the nervous system develops in higher animals, all diseases must take on a “change of type,” become more systemic, more complex, more sympathetic with disorder elsewhere; must tend to be, in a word, primary or secondary neuroses. This tendency is more or less perfectly compensated, and steadfastness secured by that integration which technical physiologists call inhibition. The same process may be traced from man to man, from the lower to the higher examples of nervous organisation in him. Nervous organisation has, of late years, progressed at a vastly accelerated ratio by means of quickened speech and locomotion; a higher scheme and also a higher average of nervous structure being thus attained. It is a matter of common observation that many functions of mind, especially the social functions, are now firmly organised, which some centuries ago were instable or scarcely organised at all. And these higher and higher strata, being more and more instable, bring further degrees of mobility and of capacity for change into the nervous system of modern peoples, and give a more neurotic character to their disorders. This is in part the so-called “change in type of disease,” which I think has been unreasonably denied, but which is only another aspect of the variations of disease in nations of different age, blood, and circumstance—as the English and the French, for instance—such variations being first visible, of course, in the nervous elements of disease, that is in the highest and least organised tissues, which are at once most complex and most readily disturbed, and are the last to be submitted to inhibition. For the most recent strata of organisation are, from the nature of the case, not inhibited at all.

The diseases of lower races of men will thus differ, and as a matter of fact do differ, from those of the higher, as we shall see presently.

In order to attain to a true system of classification, a *διακρίσις* or marshalling of diseases of men, animals, and plants, on a basis of affinity, we must pursue at least four different methods of inquiry, namely, the hereditary, the historical, the geographical, and the experimental methods. These methods of inquiry, which touch each other closely and cannot on all sides be logically dissociated, must however be separated for convenience of handling.

The Hereditary Method.—I will consider first the phenomena of heredity in disease, “to our ears The murmur of a thousand years.” We are only on the threshold of knowledge as to the vast significance of the doctrine of heredity, says a recent author.⁷ Our survey of family history, even in these days of records of the generations of civilised man, is, of course, very limited, and very imperfect within these limits. When we disregard the conventional trail of descent in the male line, and remember how rapidly the family tree expands backwards, even in the van of time, we find our scrappy pedigrees so flimsy that we may tend to undervalue the little light which “tradition, time’s suspected register” has hitherto undoubtedly afforded. Yet for any fulness of knowledge, the nosology even of a nation is inadequate; we must pierce beyond the human race itself, and pursue our inquiries into the diseases of animals, yea, even of plants likewise,⁸ before we can establish our system. Nor is this sufficient. Dividing, as well as we may, the autogenous diseases, such as gout or cancer, from the extraneous such as small-pox or ague, and these again from diseases like phthisis in which the extraneous cause is a touchstone of diathesis, we have to investigate the embryology of men and animals, and the diseases of the young which betray reminiscences of earlier forms. The phenomena of arrest again must be observed, distinguishing arrest from atavism; nor must we

⁵ Into the question of nomenclature I cannot enter now, but the great need of revision and accuracy in our nomenclature is well set forth in a brief and popular way by a leader writer in the *BRITISH MEDICAL JOURNAL*, June 30th, 1888. Our terms tend not only to express but also to dominate our meaning.

⁶ Bland Sutton, *Proc. Zool. Soc.*, March 13th, 1884.

⁷ *Cloak's Story of Creation.*

⁸ Compare here the Bradshaw Lecture, by Sir James Paget, in 1884.

forget to trace the heredity of morbid function in separate parts, even in the leucocytes, which, when so far specialised as in man, are said to have less individual power of fight in them. We have to note, also, the effects on subsequent generations of such external agents as syphilis, alcohol, or depressing passions. Again we have not only to record single affections, but to compare subgroups of affections—diatheses, as we call them—learning to place them in subordination, distinguishing the more simple, universal, and elementary diatheses such as struma, from the more special and complex diatheses such as the nervous; as we distinguish the more simple and elementary neoplasms, such as exostosis, from those of a more special character.

At certain stages of this great inquiry we shall mark the emergence of the larger kinds of morbid process, such as the explicit capacity for fever, which, as I have said, can only come with the explication of that part of the nervous system which makes for thermotaxy.

Now when we look for the facts of hereditary disease in man, even within the limits of modern records, we find that observation has been almost wholly directed to the detection of the recurrences of the same form of malady in one family tree. In my search for recorded facts, I can find much information concerning the heredity of phthisis, for instance, of asthma or of cancer, but the words of Bacon are forgotten, "*Nemo alicujus rei naturam in ipsa re feliciter perscrutatur.*" To know the affinities of asthma, let us say, we must trace the records not only of asthma, the *res ipsa*, but also the records of all other morbid reversions in the same stock. Thus we may find in this stock not only angina pectoris, which is like it, but gastralgia, which is less like it, and eczema, which is less like it still. Unhappily, this kind of search has not yet been made. Mr. Galton, Dr. Isambard Owen, and Dr. Billings tell me that when we desire something more than the notes of the family history of the same disease, when we ask for a scheme of all the diseases, fatal and non-fatal, found in one family, we desire that which does not exist. The only persons indeed who could make adequate records of this kind are family medical advisers who have watched over the same households for long periods of time. Public opinion is not yet alive to the importance of such records, and as busy doctors decline in years, they are less willing to embody the invaluable results of their experience. Thus a synopsis of all the maladies current in one family tree is rarely or never met with; although we admit that the individual is but one link in a chain. In nervous diseases indeed, such groupings are attempted; insanity (the kind often not defined), epilepsy, chorea, and neuralgia may be recorded in one tree; but the fact that phthisis and rheumatic fever often concur with these and with each other, and link them to, or cross them, let us say, with mental diseases, rheumatoid arthritis, and gout, is neglected, and trivial disorders are unnoticed altogether. Into the causes of hereditary variations, for such are many diseases, I need not enter. The inherent tendency of organisms to vary—"Nature's bent for inequality," to use Matthew Arnold's words—is well known, if not yet explained, and if organisms be exposed to changed conditions for two or three generations a structural effect becomes visible in those which adapt themselves (Darwin *A. and P.*, ii, 270).

To use Herbert Spencer's words, "The belief is not to be resisted that the inheritance of functionally produced modifications takes place universally."⁹ Pathological races, if I may use such a word, thus tend continually to appear, a tendency as constantly disturbed by atavism. Virchow speaks of atavismus "als discontinuirliche Vererbung." But he says, "*wahre Atavismus ist stets erblich*" (Virchow's *Archiv*, vol. ciii), and is to be distinguished from mere arrest of development from, let us say, a theromorph heart due to intra-uterine endocarditis. Thus again, in a microcephalic child, we must distinguish between "pithecoïd atavism" and "pathological pithecoïsmus," a distinction not always easy; and, again, say, between slight degrees of hypospadias and the alleged inheritance of circumcision.

Once more we have to distinguish not only between theromorphism and atavism, but between maladies essentially and accidentally related, as, for instance, in hemiplegia, between a palsy due to embolism and one due to rupture of a diseased artery, and again between groups of maladies which are essentially connected in the individual but accidental to his family. For instance, tabes dorsalis is often seen in association with diseases of the heart and aorta, but this association may be due to the

introduction of syphilis, and the establishment of a new series thereafter. It is only by the careful record in pedigree of every malady great or small, and the comparison of many such series, that we shall learn thus to distinguish and to separate the accidentally from the essentially related members of them.

For example, Dr. Stephen Mackenzie, in some recent remarks on cutaneous diseases, sketched out some part of a rheumatic series when he declared that kinds of purpura, of urticaria, of pemphigus, of erythema are associated with peri- and endocarditis, chorea, and arthritis, but that the sudamina and miliaria which come with them are phenomena of wider signification, and tend to occur in all series in which there is profuse perspiration. If we establish and complete such a series, calling it, let us say, rheumatic, we should then inquire if any such phenomena appear, and, if so, in what series, in lower animals, as, for example, in horses or birds, and many others. In these the series will vary, and will become simpler as we descend, until we reduce it to some relatively simple and general term, probably to some inferior mode of oxidation.¹⁰

Again, we may group—say under the name of gout—a series which would contain kinds of dyspepsia, of arthritis, of phlebitis, of arteritis, of nephritis, of angina pectoris, of migraine, of hypochondriasis, of insanity, of eczema, of glycosuria, of neuritis, of bronchitis, of tonsillitis, of hæmorrhoids, and so forth, including probably many other terms which have not as yet been so attributed, such as hæmophilia, as suggested by Mr. Hutchinson. It is obvious that to complete such a series as this or the former, not only would an individual life be inadequate, but so would be the best of clinical pedigrees. It could be completed only by the comparison of a vast number of family histories, and these not within the limits of one family or of one race, but of many, and not on one plot of the earth's surface, but on all. The comparison of such a human series with those obtained by observation of animals will lead us to the uric acid mode of oxidation in birds, a state normal to them, as Dr. Laycock reminded us, so that gouty families may appear to be a kind of birds.¹¹

Again, a neurotic series may consist of other kinds of insanity, of chorea, of eczema, of pruritus, of angina pectoris, of gastralgia, of asthma, of sneezings, of flatulence, of catarrhs, of migraine, of hysteria. I was once called in consultation to a father and three children whose maladies were as follows: carcinoma, lymphadenoma, pernicious anæmia, and pseudo-hypertrophic palsy; and I have noticed that families containing phthisis often produce weakly, ill-thriven, neuralgic members who do not become phthisical but have some defect which underlies both conditions. In this way we shall construct series and series as symptoms group themselves, hunting about any apparently unrelated morbid phenomena in any man, animal, or plant, until we drive them into their place to reveal their kinships. Such a compulsion we see in the intention of an able leader-writer in the *Lancet* (April 28th, 1888), who says, in the language of a genuine and fruitful philosophy, "Whilst recognising the great differences between osteitis deformans, leontiasis ossea of Virchow, myxœdema, and acromegaly, it is impossible not to be struck with some similarities or points of contact between these so variously-named affections. To our mind the connection between this remarkable acromegaly and the abnormal state of the thyroid observed in almost all of the cases is one fraught with significance. It cannot but be that the trophic agency of the nervous system is in some way or other concerned in the pathogeny of the disease. The tendency of malignant tumours of the thyroid to recur in bone—a fact emphasised by Mr. Godlee—must be borne in mind also. The experiments of Filehne on the influence of the medulla on the thyroid body should be considered, as also the changes in the cortex of the brain following extirpation of the thyroid."

To the above remarks I would add that the embryology of the thyroid, its correlations with the development of other parts, the formation of myxomata and cysts, and the mucoid degeneration of neoplasms must also be studied. And that these features must be comparatively studied in different races and in different climates and in animals, for, as Mr. Bland Sutton points out, the connective

¹⁰ Those persons who have not studied questions of heredity and dissolution are often disposed to argue as if the series we describe were linear series, and to expect a human disease to revert to a canine or a reptilian, as they expect to find transitions from man to monkey and from monkey to cat. Darwin's arguments have done much to dispel this prejudice, so that in the field of nosology we do not expect such reversions any more than we expect a minister in decay to break up into parish churches. The laws of the dissolution of both must be sought in the weatherings of the cliff whence they took their birth.

¹¹ Mr. Bland Sutton states that tophaceous podagra has been found rarely in birds.

tissues of the foetus consist almost entirely of soft, mucin-yielding substance, and mucin is developed abundantly for the purposes of some animals. Moreover, many other affections, trivial or grave, will be found to run in families with those already noticed, and will form a series with them. Thus we may complete a survey of the great mucin regression so honourably associated with the name of Dr. Ord. On the negative side such researches would point out to us when the association of certain affections is accidental, and possibly still further that some affections are never concurrent; which chapter of possible incompatibilities we can but glance at curiously and pass by. "It is quite conceivable," says Professor Huxley,¹² "that every species of constitutional disease tends to produce varieties of a limited number and kind, and elective affinity in the constitution of the race or individual towards certain causal and concurrent factors of disease favours the development of some and opposes that of others along their predetermined lines of development."

The phenomena of "metastasis" also are to be noted, not in the individual only, but also in the family; and in nosology as in anatomy the study of aberrant cases—morbid teratology, may I call it?—may often indicate lines of development which are latent in ordinary cases.

If for lack of material I cannot trace out the affinities of disease as detected in the pedigree of man, still slighter must be any attempt to indicate these affinities in the pedigrees of horses, cattle, or other animals and plants. That special groups of diseases would be notable in such pedigrees I already believe. Roaring, for example, associated no doubt with other special morbid peculiarities, occurs in horses of certain strains. Certain breeds of dogs, such as white terriers, are more liable than others to distemper;¹³ bassetts are very subject to eczema; and breeders of families of horses, sheep, cattle, dogs and so forth, would be able to tell us that in animals of definite pedigrees each strain tends to present morbid phenomena in more or less definite and contrasted groups; but as few animals have been subjected to artificial selection, such comparisons are only possible in those few species. It might perhaps be easier to prove definite morbid proclivities in varieties of plants, but in such a case as "gumming," for example, it may be difficult to distinguish between an autogenous malady and an inherited affinity for some external morbid agent, a large subject which may interest us presently.

The Historical Method.—Passing from heredity, as time compels me to do, we have three other methods for our use, namely, the historical, the geographical, and the experimental. The historical method leads to the philosophical in all studies, and no less in nosology. Unhappily, this study has scarcely yet emerged from the prehistoric period. We have to learn how changes of function become in generations change of structure, and how there-with come variations into less useful or "morbid" function, and this soonest in the highest and least organised parts, that is, in the nervous system, the adapter and organiser.

Of heterogeneous maladies we must not, indeed, forget in how many low forms of living organisms are concerned which may vary more than higher organisms, and thus change the sufferings of their victims. Nay more, it would seem that between the infective and passive organisms there is some law of equivalent adaptations ending in the curious immunities of individuals, families, and races, which seem to correspond with the wonderful impregnations and sterilities of sexual congress. Scanty and indefinite as are the records of human diseases in earlier times, of the diseases of plants and animals we have little or none. That the diseases of men, of animals, or even of plants, have been the same in the far off past as we now see them is contrary to the evidence of more recent time, and to the cognate evidence derived from the comparison of racial types.

The slower or quicker accumulation of changed characters which results from the action of environment and variation on successive generations must have been visible on the morbid as well as on the normal side of life. But in comparing human disease as it is now with its history in the past we must remember this, that in ruder states of man, as among animals, morbid variations were continually eliminated in the struggle for existence. Not only were organisms of inferior vitality constantly abolished, and their seed with them, but even the more vigorous were for the most part cut off as they passed their prime, so that those inherent morbid proclivities, such as gout, whose period of development belongs to later life, had no opportunity of presenting them-

selves. Nature's experiment was thus left incomplete. But when human societies attain a high degree of development we begin to see the converse of this order. In them arises a civil consciousness and with it the disposition and the power to react upon themselves, to interfere wisely or unwisely with their own growth and their own media, and thus to modify, not only the society at large, but necessarily also the individuals of which it is composed. Thus natural selection is modified by deliberate counterplots; bad strains are preserved, which in former times would have died out, and higher social qualities are developed at the cost of some retardation of physical improvement.

On the opposite hand, societies attain physical improvement and eliminate morbid tendencies by many means, among the chief of these being the sanitary means, which are described in such early records as the Pentateuch. By removing dirt, which is the agar-agar of saprophytes, the Jews banished those pestilential germs of whose very existence they were ignorant, and favoured the vitality of the survivors. Bodily improvement may, however, be sought at the cost of the higher mental and affective organisations, as, for instance, in the prevention of marriage in diseased stocks. "Artificial selection may some day replace Cupid with his random darts;" but we must remember that this prevention would have deprived us of some of the greatest geniuses who have lived for the service of man, not a few of whom have handed down their nervous organisation to later generations.

Again, civil societies may interfere directly or indirectly with multiplication. So far as we can see, every vigorous race tends constantly to expand, and to cease to expand is to retrograde. As the race is benefited by cross fertilisation, so it is benefited by change of environment, and by expansion this is secured. It must be constantly enlarging its boundaries, invading different areas, fighting new battles, and kindling its fires with new conflicts. This means new differentiations of structure, new variations in progeny, and new sources and modes of social and individual variation and dissolution. By some such pressure of the environment races of man must have been established; but those races or varieties have qualities and differences so tenacious that periods of time, very far beyond historical records, must have elapsed since the fixation of those main stocks, which, in anthropology, we must accept as ultimate factors. It is probable, for instance, that the populations of Asia and Africa were twenty centuries ago what they are now. On the other hand, the potency of the environment must increase at a far greater ratio as organisms become more complex.

Comparative nosology has to investigate the morbid characters of the races which recent anthropometrical research has done so much to distinguish; but beyond the records of certain striking immunities and susceptibilities, nothing has been done in this direction, and I find myself almost without material for the discussion. Dr. Joseph Coats, of this city, justly observes¹⁴ that Hirsch not only avoids this aspect of comparative nosology, but minimises the influence of racial peculiarities as much as possible, though he is compelled to admit many facts of the kind against his own inclination in favour of the action of the environment. This, of course, is the attitude of an ardent geographer; and indeed, in a new subject, it may be that all true causes should be pushed to extremes that we may see what they will cover. But shrewd observers have said for many a day that "breed is stronger than pasture;" and we cannot fail to see how alien races, on the same ground, may and do differ in their features. Putting aside their normal attributes as foreign to my purpose, I will take a few homely instances of racial characters in disease.

I wrote to Dr. Beddoe, of Bristol, whose practice lies near the marches where racial types are more distinct, to ask him what contrasts, if any, are to be seen between the maladies of the older and newer races in the west of England and Wales. He replied that the phenomena of disease in the "Celts" "differ undoubtedly and, in some ways, curiously" from those in the "Saxon." He goes even deeper, and suggests certain elections in the maladies themselves, attributing cancer rather to dark-haired people, and after them to the rufous, and noting in dark people melancholia but not especially other forms of insanity, and noting chorea and epilepsy in the two extremes of light and dark.

Investigation of racial characters may then bring together two maladies apparently so unkindred as melancholia and cancer.

In another letter, Dr. Beddoe says that radical difference lies lower than Welsh and Saxon, "the breed is more complex than that." "There is, in Wales, a Mongoloid type, generally dark.

¹² *Science and Culture*, Macmillan, 1881.

¹³ Darwin, *A. and P. D.*, contains many such facts.

¹⁴ *Lancet*, January 14th, 1888.

mixed with a long-headed Basque type; and there is the true Celt of Broca, also dark but broad-headed." "It is the dark races as a whole" which give the special characters to the Welsh." Dr. Beddoe, in commenting upon a valuable private letter to me from Dr. Davies of Aberceri, agrees with Dr. Davies as to the "difficulty of rearing fine, well-developed, fair children in towns, especially in the lower ranks." Dr. Davies gives also independent testimony to the fact that, in Wales, we must go down to the main division of light from dark races, in order to obtain any marked contrasts of morbid proclivity. A proclivity to scrofula and tubercular phthisis Dr. Davies finds in both divisions, but refers it to a common dampness of dwellings, to a common hatred of fresh air, and to other sanitary defects. But, he adds, "the Welsh Basque element is increasing in the west of England by a slight natural selection. In Bristol mixed parents often have one child of a fair Saxon and another of a dark Basque type, and the chances of survival of the dark child are better than those of the fair one. Spasmodic croup and other convulsive diseases or chest affections will often kill the latter and leave the former. Dr. Davies goes on to say that even in the well-to-do classes it is a comparatively difficult task in Bristol to rear a well-developed fair child. He says, further, "that the abdominal rings are tight in the Welsh Basque type; few cases of rupture occur among them in Bristol and few about Newcastle Emlyn, whereas, at a Midland charity, I dispensed about eighty trusses a year, and fitted them on myself, so that there was no deception. . . Welsh people, when they migrate to Bristol, most readily assimilate to the natives of the city." I may add that Dr. Davies was Medical Officer of Health in Bristol, and had, therefore, a large field of observation. On the other hand, I am disposed to think that hernia is common among the more phlegmatic Teutonic peoples, among the Dutch, for example, who are not tried, as a rule, by any greater severity of corporeal labour.

Sir William Roberts writes to me as follows:—"Easterns, of whom there are many in Manchester, are markedly more susceptible to neurotic troubles than the English, I speak of the males. Greeks, Syrians, Armenians and Eastern Jews are very much inclined to hysteria, 'visceral neuralgias,' as you would call them, and so forth. I have known all the children of a Greek family pass through a period of profound hysterical disturbance, both boys and girls, extending over the two or three years about puberty, and then pass on to a more steadfast nervous equilibrium. In a like degree I have observed that Welshmen are unduly inclined to be *malades imaginaires*." My own experience strongly supports these opinions.

We may inquire whether the nervous instability of Anglo-Orientals is due to their transplantation to new conditions of life. Possibly even in the Welsh the pressure of an alien civilisation may have set up an instability extending over many generations, for, reversely, we know that a relative organic perfection of body and mind was attained by the Attic Greeks. Now this people, a pure fixed type of Pelasgic Ionians, had occupied Attica from pre-historic times, and from the sixth to the fourth century B.C. was an exceptionally homogeneous stock, autochthony being held sacred, and the only legal form of marriage being between citizens.¹⁵ Yet we know that every distinct nation has its own temperament, and the colour of its health must also be the colour of its disease. Mr. Hutchinson¹⁶ says, "To distinguish between temperament and diathesis, we may say that the former is a matter of physiology and the latter of disease."

The Dutch are so near akin to the English, that their contact with us involves little clashing of temperament, and little change of circumstance. Yet the Dutchmen, whom I see occasionally from Axholme, Crowle, Epworth and other parts of eastern England, seem to have a seal of morbid as they have of normal constitution. They tend to long life and to the deposit of fat. They are rarely the subjects of irritative neuroses, but rather to mesoblastic deteriorations—to dilated heart, venous stagnations such as chronic oedemata, varicose veins, and hæmorrhoids; to apoplexy and to chronic senile dementia dependent on vascular defects. They seem to be a people of stable nervous equilibrium, not very liable to disturbance from without, and who die, so to speak, rather by gravitation than "driven from their orderly spheres."

Dr. Macdougall, whose home is now in Carlisle, but who has experience both in the Highlands and in the Lowlands of Scotland, tells me that the Scotch Celt when he is sick is "essen-

tially a despondent man.....hope vanishes with the onset of disease.....that this is in many instances due to the lack of nerve force," he adds, "I have little doubt." This is curiously like Dr. Beddoe's account of the Cumbrian Celt who "lies down and gives way to disease, while the Englishman, similarly brought up, is more patient and courageous." The Breton seems to accept disease in the same apathetic or fatalist manner.¹⁷ My own experience of the Celtic Irishman, of whom we see much in large towns, is otherwise. His disease fires and alarms; he is loud and voluble in his complaints, and as disorderly in his story of them as the Anglo-Dane is orderly and systematic; but by sheer buoyancy he is saved; he protests and transfigures his ailments, and glows with superstitious faiths undisturbed by knowledge until he would seem to deceive himself into recovery.

Of the Scotch generally, Dr. Macdougall notes a "relative rarity of purely nervous diseases, believing this people to have stronger, and more stable nerve centres as gifts of heredity, derived perhaps from a slower speed in the race of life."

"Cancer," he says, "is unquestionably more common in Cumberland than in any other of the Border Counties." The exceeding rarity of gout in the Scotch he does "not regard as a fixed racial attribute—seeing that the impress of gout is still obvious in those older families whose pedigree may be retraced to days when smuggled wines were cheap, when the use of them was as free as their effects were prejudicial." This is a most interesting observation, and it has lately been publicly made also by Dr. Martin, of Portlaw.

In the vital statistics of the United States census of 1880¹⁸ Dr. Billings finds that cancer is rarer in coloured peoples, which traverses somewhat our experience of the readiness of pigmented moles to set up melanotic cancer. Still the conclusion is well supported. Of a population of 29,000,000, including 6,000,000 negroes, 6,321 of whites died of cancer, and 790 of the negroes, the proportion being 27.96 per 100,000 in the white to 12.17 in the coloured race—that is, more than twice. After allowing for disturbing causes, it seems that of the whites the Irish and the Germans are more liable to cancer than the rest. To redress the balance, apoplexy and palsy are more common in the white than in the coloured people, and in the German than in the Irish. Among the Indians diseases of the nervous and circulatory systems, bronchitis, and pneumonia are less common, but scrofula and consumption are very prevalent.

I need but refer, as I pass, to the many strange and extreme forms of hysteria seen in the French people and described by Professor Charcot, forms and degrees of it which are rare in England, and rarer in our northern counties than in the southern. Hysteria, in its eminent types, is seldom met with in Yorkshire. Historical matter of this kind exists abundantly, and should be brought together; and, although my direct speech to-day is of constitutional states, yet of these extraneous diseases may also be a test; for in truth, if we go more closely into the subject, all morbid phenomena are the outcome of reactions between the mediate actions of the environment stored up in the organism and the immediate actions of the present: so that, if the present be constant, variation must depend upon the innate. Now such variations are known to be manifold, and should be brought together systematically. I will mention a few cases. To the immunity of negroes from yellow fever I have already referred, and this immunity does not depend upon survivals, as does their relative immunity from paludal fevers and sunstroke: for, as Dr. Coats says,¹⁹ these latter immunities do not lie deep, but wear out on removal of the individual to a healthy locality; so that he and his descendants tend to lose such immunity. Moreover, the resistance to yellow fever is common to all negroes, whether inland or coast bred, and is transmissible by them to mixed progeny so far as their admixture goes. Their immunity from syphilis²⁰ is likewise a deep-set quality. On the other hand, the negro is very susceptible of cholera and small-pox, elephantiasis and tetanus, and is also liable to prolonged suppuration. The Arab, Dr. Bertherand says, is not liable to tetanus. The poison of *Peri-beri*, oddly enough, does not attack Europeans until they have lived in the district of it for some time; then they become liable to attack. But for all Aryans—for Europeans and Hindus, let us say, whose habits are so different—its death-rate is low: the average death-rate for all races being 34.6 per cent., and even 51.9

¹⁷ Souvestre, *Les Derniers Bretons*, Paris, 1843.

¹⁸ *Tenth Census of the United States*, 1880, vols. xi to xii.

¹⁹ *Lancet*, January 14th, 1888; *vide et Corre*, *op. cit.*

²⁰ *Vide Hirsch in loc. cit.*

¹⁵ *Vide* interesting paper by Dr. Rally, *Rev. d'Anthropologie*, 1887, p. 408.

¹⁶ *Pedigree of Disease*, Churchill, 1884, p. 4.

for Chinese; for the European it is 28.6, and for the Hindu 27.8; for the Japanese it is only 12.4. Mr. Darwin thinks that these fixities of inheritance are not merely results of antiquity, but are necessary correlations of growth.

The curious facts made out by the late Mr. Denny, of Leeds, and others, concerning the inability of certain lice to live on other varieties of man or species of animal than their own, are of the same kind, though in some of these cases the inability to attach themselves may be simply mechanical. Pasteur tells us again that Cochin China fowls resist chicken cholera, and that the field mouse resists the septicemia so fatal to the house mouse; with this a "concomitant variation" has been shown by Koch, who finds that the normal blood of the latter forms crystals with difficulty, whereas that of the field mouse gives crystals readily.²¹ Darwin²² tells us that white cocooned silkworms resist the disease which devastates the yellow, Chauveau, that Algerine sheep are not subject to anthrax.²³ Cattle and swine are very subject to pearl-eil, while the goats which graze beside them escape. The dog is almost insusceptible to glanders, but the ass and the guinea-pig take it readily.²⁴ Peptones which prevent the coagulation of the blood in carnivora have not that power in herbivora; carnivora again are said to be subject to cancer, and herbivora not to be so.²⁵ Cattle in marsh lands seem indifferent to the marsh poison, and so do dogs; but individuals of different races of the same species, if brought into the district, become infected.²⁶ Mildew, curl, and aphid rather attack fruit trees in which the glands under the leaves are absent. Mildew selects also white onions and verbenas, and the paler grapes. New sorts of potatoes, as I am told at Goole, are at first disease-proof, but in ten or twelve years, although these varieties stand as to appearance, they lose the immunity, and new seedlings have to be raised. Magnums and Beauty of Hebron are expected to lose immunity gradually. So new apples die out. Ribstons are failing in constitution, though not in character, and are very subject to extraneous disease.

Not only may we accumulate many more such instances, but we may add others from the phenomena of poisons of lower series. The black pigs spoken of by Darwin as unaffected by the blood-root, and the white pigs which are injured by buck-wheat, and most curious of all, the horses which are poisoned by honey-dewed vetches and by fools' parsley only in respect of the white parts of them, come to mind.²⁷ The tolerance of morphine by rabbits again is well known; but to my mind the strangest of these cases is that of the tsetse fly, which is only fatal to domestic animals, such as the domestic ox, horse and dog, while the buffalo, zebra, and jackal, bitten at the same time, graze on unharmed.²⁸ Man is bitten, but does not suffer; nor do dogs reared wholly on game; but if fed on milk they die, yet all young sucking animals are safe so long as they suck only. Inoculation is no defence, nor any length of life in the district. By the study of concomitant variations there is some law to be found here which will explain, not only these cases, but a whole group of cases in which morphological and even racial similarity are compatible with enormous physiological differences; deductions cannot therefore directly be drawn from the results of experiments in one animal to another; such experiments serve rather to promote the building of a series. The differences probably consist in some simple and general condition, such, for instance, as the quantity or intensity of oxidation; in any case it is erroneous to say that the phenomena of disease must differ clinically according to class, and it seems as if we must learn some other perspective of facts than the scale of life and death. But at the same time we must not forget how many are the pitfalls to be avoided by the inquirer, how many the conditions to be observed. For example, Mr. Sutton has shown that avian tuberculosis is not essentially peculiar to graminivorous birds, as was supposed, but is propagated rather in them by the manner of their feeding.²⁹

Finally, I will refer with the utmost brevity to some facts in

the constitutional diseases of animals; and herein I would especially acknowledge my debt to Mr. Bland Sutton, not only for his facts and his large views of pathology, but also for the generosity and tireless pains with which he explains them to pertinacious correspondents. The quadrupeds, though so near to man, cannot bear a low temperature. They do not die of phthisis, as commonly asserted, but of bronchitis with atelectasis, and this the more as they are exceptionally liable to rickets. Indeed, rickets and rheumatism are so common in animals as to seem fundamental diatheses. Rheumatism attacks in animals, as in man, the left side of the heart almost exclusively,³⁰ and pericarditis is also a common complication. Rickets in animals leads to far more terrible results than in man. But," says Mr. Sutton, "in mammals each group seems to exhibit predisposition to some maladies and absolute immunity from others" (Extract from private letter, June 5th, 1888). For instance, we find pulmonary affections thus distributed: (1) Primates (excluding man); bronchitis, atelectasis, lobular pneumonia. (2) Carnivora; bronchitis, double pleurisy, lobar pneumonia. (3) Ruminantia; bronchitis, pearl-eil, parasitic bronchitis.³¹ Sclerosis, both in tracts and disseminate, peripheral neuritis, and perforating ulcer are found in animals,³² the so-called "chorea of dogs" being due to sclerosis. Dogs are also subject to tabes.

Chronic nephritis, either as a sequel of acute, or as an independent affection, is found in horses, and "arterio-capillary fibrosis" may in rare cases be associated with it.³³ Dr. Dickenson has recorded chronic interstitial nephritis in cattle, but he does not know that cardio-arterial disease accompanies it. This leads me to the most remarkable and interesting fact that vascular degenerations are practically unknown in animals. This was my own belief, and Mr. Sutton, on far wider data, confirms the generalisation. Atheroma and aneurysm, as known in horses, are due to parasites. Surely it is of deep interest to man to learn from animals the secret of this immunity. Phlebitis in non-traumatic forms is also unknown, and gout scarcely known. I cannot discover how rare vascular degenerations may be in wild men and in those whose ancestry has known neither alcohol nor syphilis. Syphilis is unknown in the animal world, and cannot be inoculated in any animal. Mr. Sutton has never seen primary calcification of an artery in any animal other than man, and cirrhosis of the liver is equally unknown. Long suppurations are rare in animals, and amyloid disease is, I believe, unknown. Scirrhus cancer is very rare in animals; Sutton can quote but one mammary case. If such cancers are abortive glandular formations, how do animals escape? Epitheliomata are equally rare; perhaps no well certified case is on record. But I must now close these random illustrations, and the interesting but unsolved questions to which they give rise, and conclude this section with Mr. Sutton's "main conclusion," which seems to be this: "Evolution has played as important a part in pathology as in biology, and structural peculiarities, pathological in their origin, have been transmitted as race-characters in more than one group of animals. Every great class of animals is distinguished by anatomical details, habits of life, and surroundings from other groups. These differences involve liabilities to some diseases, immunity from others. So far as our present knowledge extends, we know that certain diseases occur with extreme frequency in one class of animals and are rarely seen in another."³⁴

In this section I have used the word "history" in the sense in which we speak of natural history. Historical records of disease in the past are, however, full of matter of the greatest interest, which will extend and illustrate the laws of comparative nosology. But these materials, like all recorded evidence, can be better estimated and used when investigations of a more direct and certain kind are farther advanced.

Geographical Method.—How have the morbid varieties of man arisen? The answer to this question, like that of the origin of races, lies in the dark backward and abyss of time. We can only say in general terms that as we look backward we find the natural variation of organisms to be more and more under the control of external circumstances, so that, to study the geographical con-

²¹ Professor Griffith, of the Yorkshire College, has referred me to a paper by Drs. Sterling and Brito, showing that human blood, after digestion by the common leech, gives hæmoglobin crystals, *J. of Anat. and Phys.* Ap. 1882.

²² *A. and P. D.*, i, 321.

²³ *Vide et Coats loc. cit.*

²⁴ M. Nocard, *Revue de Méd. Vétérinaire*, December, 1887.

²⁵ I state hereafter that this generalisation seems to have been otherwise explained in the case of birds by Mr. Bland Sutton, but Dr. Braithwaite adopts it in his paper on Cancer, in the *Lancet* of July 8th, 1888.

²⁶ *Vide Corne, op. cit.*

²⁷ Darwin, *A. and P. D.*, c. xxv, ed., 1888.

²⁸ *Vide* Livingston's *South Africa* and Anderson's *Lake Ngami*; London, 1856.

²⁹ *Journal Comp. Med.*, October, 1889.

³⁰ J. Bland Sutton, *Diseases of the Vascular Mechanism in Animals*, *Path. Trans.*, vol. xxxvii, p. 573.

³¹ Sutton, *Path. Trans.*, vol. xxxvi, p. 548.

³² Sutton, *G. Path.*, p. 27.

³³ Sutton, *Path. Trans.*, vol. xxxvii.

³⁴ Introduction to *General Pathology*, p. 379.

ditions of variation, we must have especial regard to areas long undisturbed, and must register in these the phenomena of morbid variation with the qualities of soil, aspect, seasons, atmosphere, food products and so forth. Again, as we must not confound nations with races, so must we not confound kingdoms with physiographical areas. Mr. Haviland, whatever the ultimate value of his propositions, based as they are upon the features of a mixed, highly modified and shifting population like our own, has, at least, impressed these principles upon us with great industry and originality.³⁵ We have also to observe the effect on long-settled tribes of their removal to new areas, such removals, if harmless to individuals, being often attended by morbid consequences to the race of a very remarkable kind,³⁶ and likewise the rapid changes which follow a break in the uniformity of external conditions, as, for instance, when a more adaptable race penetrates into the area of a race which has grown into its own climate and has hardened under simple rules and customs into a fixity of type.³⁷ A close study of the diseases of isolated savage peoples may thus indicate to us simpler stages of our own maladies. For in the migrations of tribes, certain races would succumb to climatic changes which others would surmount and would gain thereby a greater flexibility and development and a greater capacity for further change, the highest parts of the highest organisms being the most mobile.³⁸ These changes, with their intimate correlations of growth, teach us the lesson again that as in various families so in various regions we must work out in each not only the prevalence of diseases taken singly, but more especially the schedules of its diseases, noting both coexistences and respective degrees of intensity. We must not only note, for instance, as Hirsch notes, the almost universal prevalence of rheumatism; but in each area we must observe the kinds and degrees of it and the associated maladies in man and in animals—nay, in plants also, for rheumatism is so universal a disease it may have its correlative in plant life as scrofula probably has. M. Boudin well says, “De même que chaque pays possède son regne végétal et son regne animal caractéristiques, de même il possède aussi son regne pathologique à lui: il a ses maladies propres et exclusives de certaines autres.”³⁹ Hitherto the effects of climate have been studied in man almost exclusively, and in him with regard almost wholly to the prevalence of external poisons. Dr. Aitken sums up the geographical factors, in the second volume of his *Practice of Medicine*, from this point of view, and he indicates and elsewhere sets forth, as Dr. Creighton has also done, large and philosophical views of the origin and transmutation of organised and organic morbid agents. In the monumental work on the *Vital Statistics of the Census of the United States in 1880*, edited by Dr. Billings, of Washington, there is a mass of tabulated material on the geography of disease, with very discriminating comments thereon, to which I cannot now do more than refer my hearers. Dr. Billings sums up the seventh section thus: “In concluding this subject of the relation of special causes of death to topographical features of the country, the general results of the study may be summed up in saying that the conditions of the climate, the amount of annual rainfall, the amount of low-lying and swamp land, age and sex, the distribution of the people, and the proportion of the coloured and foreign population, appear to be the chief causes of the differences between the several grand groups, or between different portions of the same group. Except in so far as it influences climate or drainage, the geological formation of different regions does not appear to have a marked influence upon the proportion of deaths from various causes, with the exception of goitre, urinary calculus, lead poisoning, and perhaps diseases of the digestive organs, due to inorganic impurities in the water supply.”⁴⁰ For the schedule of the diseases severally, I must refer to the work itself.

Dr. Billings notes (page xxxviii) that: “In a general way, where the proportion of deaths from enteric fever, from cancer, or from consumption is the highest, there the proportion of deaths from malarial fever is the lowest and *vice versa*.” That the malarial fever of one district should be the enteric of another will interest

Sir W. Aitken. But how curious is the absence of phthisis from malarious regions, a disease which so many observers associate with damp. Dr. Billings is, however, supported herein by Dr. Livingstone, who says of the Barotze Valley⁴¹ that the site is flat and damp, and “fever” bad there, but that phthisis and scrofula are unknown, and insanity and epilepsy rare. Sir George Paget tells me that in the English fens there was a tradition that phthisis avoided the region; he himself was unable to verify it, partly because before his time ague had much subsided, and is now nearly extinct. Mr. Sutton states that his tubercular mammals nearly all came from the “delightful climate” of his neo-tropical region.⁴² Livingstone adds that cancer is also absent from the Barotze Valley, which supports the conclusion of Dr. Billings. Dr. Billings says, moreover, that the cancer statistics of the United States support Mr. Haviland's views of its geography. The United States statistics and Mr. Haviland's inquiries seem to be the only serious attempts yet made to study the genetic affinities of constitutional diseases by the geographical method. The field is enormous, the discrimination of facts most difficult, and general conclusions almost impossible at present—“Qui respiciunt ad pauca facile pronuntiant.”

Experimental Method.—Finally, let us consider the results of experiment. Experiment likewise will teach us that drugs and poisons do not vary in their clinical effects upon living beings by gradual augmentation of differences, but by “leaps and bounds,” as “musical flames” respond to scales of vibration; it will teach us thus once again that clinical types can be no basis of nosological classification.

Great diversities, contrasts, and strange conjunctions of morbid phenomena do not necessarily signify great divergence of nature in morbid agents, and a classification of disease cannot, therefore, be made only or mainly by putting together like groups of morbid phenomena, but must be made by putting together those groups which, however disparate outwardly, belong to the same series. Can we, then, experimentally test the affinities of morbid groups so as to sort out the like and the unlike, to separate those which only mimic each other from those which are *αὐτοφύως δμοιοι*—alike to the core. Dr. A. M. Brown notes the startling fact “that the most terrible poison (cyanhydric acid) forms the chemical skeleton of that cellular nucleus which is the most active phenomenon of vitality. An internal change which converts a benignant or anabolic molecule into one of dire and destructive malignancy may be exceedingly small. This seems to be equally true whether we consider the products of normal or of abnormal metabolism, or the effects of poisons in the body. How strange it is that as the highly organised molecules of our bodies fall into lower orders, giving way to the ascending series, these lower substances take, not a relation of indifference or of mere inconvenience to the former, but of positive and violent antagonism; so that by virtue only of incessant excretion we incessantly escape destruction by those of our own household. It seems to me that as ptomaines and leucomatines are classified⁴³ and their generation detected and distinguished in diseases springing from various causes, and from the various organs of the body, and as these substances again are synthetically obtained, they ought to serve as one test series for our purposes. A fundamental distinction of this kind seems to have come out already, namely, that poisoning by extractives in general is attended by hyperthermia, and that poisoning by animal alkaloids is attended by hypothermia.”⁴⁴

Hoppe Seyler has extracted another substance having peculiar attributes from the spleen, which he has called adenine. Gautier, again, has shown that there is a distinction between alkaloids formed by bacterial and those formed by normal bio-chemical action,⁴⁵ though, no doubt, intermediate substances may exist in any or every degree. The phenomena of isomerism suggest to us how large differences in effect may come about with a rearrangement of molecular groups, and without any change in the sum of their chemical composition. No doubt the highly complex molecular units of tissues in the different varieties and species of animals have a large play of this kind, and may admit of various internal recompositions, and show reactions as various as we see in the relation of saliva to the poison of serpents.

³⁵ *The Geographical Distribution of Heart Disease and Dropsy, Cancer and Phthisis. With Maps.* By Alfred Haviland. London, 1875.

³⁶ Darwin, *D. of M.*, i, 291, et seq.

³⁷ Vide Bagehot's most interesting essay on Physics and Politics, 8th Ed., 1887.

³⁸ The brain of civilised man is nearly 30 per cent. larger than that of the wild man.

³⁹ *Traité de Fièvres Intermittentes*, Paris, 1842, p. 69, quoted by Daremberg.

Hippocrate, 1855, p. 303.

⁴⁰ *Loc. cit.*, vol. iii, p. 22.

⁴¹ *South Africa*, pp. 504-5.

⁴² Bland Sutton, *Path. Trans.*, vol. xxxvi, p. 546-7.

⁴³ I trust these legitimate forms may be accepted, and replace the barbarous words “ptoma-ines” and “leucoma-ines.”

⁴⁴ Dr. A. M. Brown, quoted by Sir W. Aitken, *Animal Alkaloids*, 1887.

⁴⁵ Vide Sir W. Aitken, *loc. cit.*

My friend Professor Thorpe, in discussing this matter with me and the strangeness of it, points out the fact that even so simple a body as kakodylic acid, which contains 70 per cent. of arsenic and is perfectly soluble, is yet a non-poisonous body; and he refers especially to the cyanides and carbamides as complex molecular aggregates showing widely different reactions to one or similar agents.⁴⁶

Dr. Weyl⁴⁷ shows that chrysarobin is powerfully poisonous, while its near relation, anthrarobin, has absolutely no action on the living organism, however administered. Although anthrarobin has a great affinity for oxygen, yet it is detected unaltered in the urine. The albuminoids, of course, have these characters in increasing degrees, but are more difficult to handle.

Professor Smithells, of the Yorkshire College, has kindly explained to me the new method of chemical notation in space of three dimensions; and showed me, in molecules of these higher groups, how wide may be the functional changes resulting from slight atomic dislocations. Not only may atomic substitutions have such consequences, or the incidence of sympathetic vibrations as in the case of unorganised ferments, but alien atoms may enter temporarily into a compound molecule, and cause a dislocation of its atomic system, leaving the group again as the dislocation is effected. Such a dislocation reminds us of the effect of the protective poisons, such as small-pox and scarlatina, which, thus temporarily entering the tissues of some organ or organs of the body, may shift the components of their molecules into a system of somewhat less stability, which system may be stable enough to synchronise with the vibrations of that poison for an indefinite time, but which would tend sooner or later, in the individual or his descendants, to revert to the original and more antipathetic form. In proportion to the extent of this reversion would return the liability to disturbance on a renewed impact of the poison. When we remember how long a step it is from the most complicated of delineated molecules to the simplest of living protoplasms, we prepare ourselves to apprehend the infinite adaptability and convertibility of the latter. Professor Smithells thinks chemical analogy would rather indicate that reversion to susceptibility may consist in the formation of all new molecules, after the poisoning, on the original type, so that the old and distorted ones are gradually outnumbered. My own impression, however, derived from the phenomena of physiology and heredity, is rather in favour of the former hypothesis.

Those animal extractives and alkaloids which have as yet submitted themselves to the chemist are of no high degree of complexity, and are probably common to a very large part of the animal kingdom, and work on planes far below those on which the highest functions are developed. We should not, therefore, expect to find any test reactions from them which would differentiate human diseases from those of organisms a little or even much lower in the scale. The behaviour of bodies of lower degrees of complexity may be better studied in humble forms of life and in plants, in which latter organisms the simpler alkaloids play a very important part.⁴⁸ If we first learn what special orders of oxidation there are for the generation of motion in the several classes of plants and animals, beginning with the simplest, we shall see how the perversions of such oxidations may differ in the different classes.

The general factor which becomes of next importance to Isomerism is Inhibition. As we rise to higher and higher planes of function we enlarge the office of inhibition. Every higher order of motion regulates, or in other words inhibits, that of the order below; so that, if we could discover a series of counter-potent agents, corresponding in catabolism to the successive planes of complexity in warm-blooded animals, let us say, they would give us the means at each stage of neutralising the dominant function on that plane, so that we should be able in plane below plane to liberate each in order, and thus to reveal a series of morbid states caused by the enfranchisement of orders of activity proper to lower stages of life.⁴⁹

Drs. Fraser and Crum-Brown revealed to us years ago the great conversions of activity resulting from small molecular substitutions, and the change of selective affinities for animal tissues shown by molecules thus artfully varied in one or a few atoms. Drs. Brunton and Cash⁵⁰ tell us that the distinctive action of the lower members of the fatty series is their stimulant and anæsthetic action on the nerve centres. The members of the aromatic series also affect the nervous system, but more the motor than the sensory centres, causing tremor, convulsions, and palsies. Again, a substance has been isolated from the spleen by Morell, which has a paralyso-motor action with powerful effect on the medulla oblongata,⁵¹ and this substance should be carefully and repeatedly tested upon animals in which the homologue of the medulla is the upper centre, as well as upon all others. Some drugs have a large reducing power, such as curare, by means of which a mammal may be reduced to a cold-blooded animal whose temperature varies with the atmosphere. By testing such agents over a large series of animals, and by systematic replacement of molecules, we might find the means of subtracting inhibition on successive planes, and so discover some serial order in the resulting diverse morbid phenomena, and form a table of genetic affinities which would show how the proximate principles of higher organisms are the ultimate of the lower.⁵²

Wide and untrodden are the marches which still lie between organic bodies such as those and the mobile and complex molecules of living matter. In these the potentialities of change are as infinite as their functions. We have little common measure as yet for chemical and vital reactions, but we see, as we have seen already in our discussion on races, that as the same chemical or vital agent or even different doses of the same agent may exercise, and in numberless cases does exercise, an enormously different influence upon organisms which are very closely related; so closely allied organic substances may cause reactions seemingly very different in the same organism. Mazy and dissolute as from outside these phenomena may appear, they have nevertheless radical and ramifying laws, and classification by genetic affinity is one method at least of discovering them, and of explaining to us wherein consist those changes, so vast physiologically, so small phylogenetically and morphologically. Moreover, diatheses or morbid varieties may be tested by drugs so as to establish hereditary qualities and their reactions. In the graphic method again we have found a potent means of detecting the distinctive kinds and the more secret transitions of those vital motions in which ultimately all normal and abnormal vital phenomena have their being.⁵³ The relative weights of every organ in all animals should also be ascertained, and the chemical characters and correlations of such transitory and primitive organs as the Wolffian bodies correctly estimated in various animals. Thus, by following what Aristotle calls the double track—the track of the one into the many, and of the recombinations of the many into the one—we shall analyse and reconstruct the problems of life.

Thus, gentlemen, have I regarded comparative nosology and the classification of disease. I have said that to know disease or any other matters we must think of things in natural groups, and, as Comte told us,⁵⁴ and Darwin afterwards proved and illustrated, these natural groups must be arranged in natural series. Even if there be some varieties, of which the place be dubious or which appear equally bound to two groups, yet, as Dr. Whewell admirably says, "this does not destroy the reality of such groups any more than the scattered trees of the intervening plains prevent our speaking intelligibly of the distinct forests of two separate hills."⁵⁵ Our knowledge of the properties of a Kind is never complete. We are always discovering and expecting to discover new ones, the common properties of a true Kind being inexhaustible and significant of a common parentage.⁵⁶

Classification by Types, on the other hand, was a service of temporary value, and of ultimate mischief, which still pervades our textbooks, though Dr. Whewell was the last philosopher of im-

⁴⁶ I may remind the reader in how many ways mere iron may be modified and varied in its properties. Mr. Hadfield, of Sheffield, says: "Steel is but particular states of iron, produced by the union of this metal, not with carbon only, but with many other bodies of different nature." *Proc. Inst. of Civil Engineers*, vol. xciii, pt. iii.

⁴⁷ *Nature*, June 7th, 1888.

⁴⁸ Cf. Mr. Walter Gardiner, *Proc. Roy. Soc.*, November 24th, 1887; *vide et article on Vegetable Rennets, Nature*, July 19th, 1888, wherein "the essential similarity of the metabolism in plants and animals" is illustrated, and the vegetable alkaloids are compared with the animal ptomaines.

⁴⁹ Compare Dr. Hughlings Jackson, *Croonian Lectures*, 1884.

⁵⁰ *Proc. Roy. Soc.*, March 31st, 1887.

⁵¹ *Proc. Roy. Soc.*, March 31st, 1887.

⁵² The evolution of the nervous system is of course but one part of the whole inquiry. Dr. MacMunn has traced elements of mammalian blood even so low as the sea anemones, and other investigators are opening out like paths of discovery (*vide MacMunn, Proceedings of the Royal Society*, No. 296, 1883, and *Philosophical Transactions*, 1885).

⁵³ *Proc. Roy. Soc.*, March 31st, 1887; and Professor Lauder Brunton's *Pharmacology*, 1885.

⁵⁴ *Mill, Logic*, vol. ii, p. 280.

⁵⁵ Whewell, *Novum Organum Renovatum*, p. 280.

⁵⁶ *Mill, loc. cit.*

portance who ventured to defend it. For the most obvious properties of things may be of trifling importance compared with those which are not obvious, as we acknowledge when, for example, we divide plants into dicotyledons and the monocotyledons.

Yet, when I say this to the physician, who, as a man of science, must constantly reopen the theorems of physiology, I do not forget that the practical physician, like the farmer, must have rules suitable to common cases—rules which point out the “least perilous way.” As Dr. Whewell observes (*Novum Organum Renovatum*, p. 286), “a plea that human laws which mention fish do not apply to whales would be rejected at once by an intelligent judge.” Health and disease are both equally functions of living bodies, and, scientifically speaking, one is as good as the other. But in art we must have rules and precepts as well as natural laws; we must have a teleology to dictate not what is but what ought to be. Yet such precepts or axiomata media, if they are to serve us well, must continually be altered as we push forward the discovery of those natural laws which are the Institutes of Medicine. Again, when I say that a knowledge of disease must base itself upon a complete survey of both the great kingdoms of life, and when I say that every disease and disorder of man has been evolved from the variations of lower animals and plants, and must, in every shade of them, be developed from the implicit properties of the ovum or even of protoplasm,⁵⁷ yet I admit no less readily that, as in the lowest forms of life these actions are rudimentary or feeble, we should study their variations best in man, in whom they are most explicit and have their highest intensity, were it not for that old source of error: “Errare non modo affirmando et negando, sed etiam sentiendo.” Were I worthy to use the irony of Socrates well might I cry, *ἄκων εἶπὲ σοφός*. While we are theorising of diseases the fates prevail over our counsels. Nevertheless, with such intellectual powers as we have must we “go sounding on our dim and perilous way through words and things.” As said a great critic of the third century, “Of what did those divine ones take regard..... As well as of many other things they had regard of this—that Nature did not judge man to be a mean or ungenerous animal, but introducing us into this life, into this universe, as into a great assembly, to behold her contests and to be keen competitors in her rivalries, she implanted in our souls an irrepressible love of whatever is great and nobler than ourselves. And therefore the whole world is not enough to satisfy the speculation and apprehension of human understanding, but our reflections will often travel beyond our environment.”⁵⁸ Thus have my reflections wandered to-day, “striving to attain by shadowing out the unattainable.”

Gentlemen, many of us too well know conditions and times of abasement; times when we see Nature beautiful, magical, but remote, unmindful, pitiless; when we humble ourselves in silence before “Him who fastened the foundations of the earth, who spread His light upon it and balanced the clouds of the air, who binds the sweet influences of the Pleiades and guides Arcturus with his sons; who gave to the horse his strength, and goodly wings unto the peacocks, and who is King over all the children of pride.” But the time and circumstance of this Convocation bring not these moods of awe and withdrawing but surely those of hope and uplifting even to victory; for, like Jacob at Peniel, we have striven with the Great Unknown, not without prevailing. Our mood to-day is rather that of Sophocles in the well-known words of the Chorus of the *Antigone*, “Wonders are many and none more wonderful than man; the power that crosses the white sea, driven by the stormy south wind, making a path under surges that threaten to engulf him; and Earth, the eldest of the gods, the immortal, the unweary, doth he wear, turning the soil with the offspring of horses, as the ploughs go to and fro from year to year..... And he masters by his arts the beast whose lair is in the wilds, who roams the hills, he tames the horse of shaggy mane, he puts the yoke upon its neck, he tames the tireless mountain bull. And speech, and wind-swift thought, and all the moods that mould a state, hath he taught himself; and how to flee the arrows of the frost and of the rushing rain; yea, he hath resource for all; without resource he meets nothing that must come: only against Death shall he call for aid in vain—*νόσων δ' ἀμύχανον φυχὰς ἐμπέφρασται*—but from baffling maladies he hath devised escapes.”⁵⁹

⁵⁷ Vide the researches of Gaskell, Walter Gardiner, Spencer Moore, and others.

⁵⁸ Longinus, *De Sublimitate*, ed. Valden, Bonnæ, 1857.

⁵⁹ *Antigone*, 332-364, Jebb's translation, 1893.

ADDRESS IN SURGERY,

BY

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ON THE PROGRESS OF SURGERY DURING THE LAST HALF CENTURY.

GENTLEMEN,—Deeply sensible as I am of the honour done me in being entrusted with the Address in Surgery on this the first occasion on which your great and important Association has visited this city, I am nevertheless overwhelmingly conscious of my inability to do justice to a position which has been on previous occasions filled by representatives of all the great schools of this country. Your indulgent kindness can alone sustain me in my attempt to follow in their footsteps.

It is my wish, in the time devoted to this address, to attempt a brief epitome of the leading advances which Surgery has made during the auspicious reign of Queen Victoria, as that period is naturally suggested by recent events, and is one over the greater part of which my own recollections extend. It is fully admitted that in every department of human knowledge our half century has been signalised by a progress greater, more momentous, and more permanent than any other in the world's history; and in this advance medicine in all its branches has so largely and bountifully shared that even a bare recital of what has been done fires the imagination and makes the heart throb with triumph.

Since 1837 all the collateral sciences on which medicine so largely leans have been in a great measure reconstructed, and the very foundations on which our art is built have been in no small measure relaid.

It is with pardonable pride that one speaks of medical science in this northern land, where for so long a time it has acquired a high place by the fruitful labours of many devoted men; and with no department of the one great and indivisible art have the names of Scotchmen been more honourably associated than with that which I to-day humbly represent. We are met in the city where Peter Lowe early sowed the seeds of surgical knowledge and founded one of the oldest of the corporations, and we are within the walls of the University where that modern steam engine was born which has more than trebled man's physical power, and has so largely contributed to the national success and the well-being of mankind.

In this ancient institution, originally “part of the great corporation of the learned men of the world,” and the daughter of that far more venerable University of Bologna, which has just celebrated her eighth centenary, men celebrated in all the departments of mental and physical science have lived and taught. Not a few who afterwards largely contributed to the reputation of other schools (Cullen, Black, Charles Hope, Wm. Gregory, Thomas Graham, Granville Pattison, Ure, Hooker, Balfour, Lister) began their career here as medical teachers—men who have gone elsewhere, like the wandering Scottish surgeons of the Middle Ages, who in their time helped to enrich so many Continental colleges. We cannot forget that the immortal Hunters were educated in Glasgow, and that from regard to his old school the elder brother bequeathed to us his museum, and in 1765 proposed to Cullen the establishment of a medical school, for which he offered to build a theatre, and teach for no other motive than the love of his art. The early history of surgical anatomy, too, owed much to Allan Burns, whose premature death deprived Glasgow of a man of the greatest promise. My time, however, will not allow of further local references, though one other fact I will state, as it may tend to show with what fervour and enthusiasm learning and medical science is regarded in Scotland. While in England 1 in 5,000 attend the universities, in Scotland 1 in 600 avail themselves of that privilege—a remarkable fact when it is remembered that the universities here at first possessed no endowments but the privilege of teaching, and the scholars no claim but ambition to learn. Of the 1,639 medical students registered last year in Great Britain, no fewer than 666 belonged to the Scottish schools.

To understand aright the position of surgery in 1837, a few preliminary leading facts must be stated. Before 1800 much had, no doubt, been done in anatomy by “the great masters,” but as a