THE MORTON LECTURE ON CANCER AND CANCEROUS DISEASES.

*Delivered at the Royal College of Surgeons of England on
Thursday, November 29th, 1888.*

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MR. PRESIDENT AND GENTLEMEN,—Last year Sir James Paget delivered for the first time the Morton lecture on cancer and cancerous diseases. He dedicated his published lecture to Mr. John Thomas Morton, of Caterham Valley, "with sincere respect for his benevolence and generosity," and expressed the hope, which he believed Mr. Morton entertained, that this lectureship may lead to some practical utility, "perhaps even to the finding of a method for the prevention or the cure of these diseases."

No body of men can be more anxious to assist in the attainment of this philanthropic desire than are the Fellows and Members of this College. Not one of us needs to be reminded of the almost overwhelming importance of the subject. Cancerous diseases are as heart-breaking to the surgeon as they are mysterious and terrible to the public. And additional reasons for urging the importance of their study now may be found in the fact that, notwithstanding the great advance in sanitary science and the prolongation of the average length of human life—in spite of the shortening of the duration and the lowering of the mortality of some diseases, the prevention (almost the stamping out) of others—cancerous diseases, so far from being less prevalent or less fatal, are increasing among us. The increase in the number of deaths from cancer is now, and has been for many years past, greater than the proportional increase of population. Doubts have been expressed whether this increase is real or only apparent, and due to more complete and accurate registration of the causes of death. This is such an extremely important question, that I feel bound to ask for your attention for a few minutes while I lay before you some facts which may assist us in arriving at the truth.

The forty-seventh annual report of the Registrar-General of births, deaths, and marriages in England was presented to Parliament in 1886. It contains returns of the deaths in 1884, and we find that the mortality from cancer was higher in that than in any previous year. We also learn that in three successive periods of ten years from 1851 to 1880, and in the seven following years, to 1887, there has been a gradual increase of mortality from cancer, an increase common to both sexes, but considerably greater in males than in females. Up to the age of twenty-five, the cancer mortality is small in both sexes, but at all age-periods after the twenty-fifth year the mortality is much higher of females than of males, and in both sexes there is a rapid rise of cancer mortality at all ages after twenty-five years. I am very unwilling to trouble you with figures, and yet the story they tell of increased and increasing mortality from cancer in England and Wales is so full of interest, that I feel bound to ask you to glance at the tables before you, which I have prepared partly from published reports, and partly from information kindly supplied to me officially.

The first statement I wish to place before you is the fact that the number of deaths from cancer in England increased from 7,245 in 1861 to 17,113 in 1887. We know that the population increased largely during the same period: but, making the necessary correction for increase of population, and estimating the proportion of deaths from cancer to one million persons living, we arrive at remarkable results. This table shows the number of deaths from cancer in England to one million persons living in the last twenty-seven years, and I am able, through the kindness of Dr. Grimshaw, to compare the Irish and English returns for the last eleven years.

Year.	England.	Year.	England.
1861	360	1867	392
1862	361	1868	402
1863	361	1869	417
1864	386	1870	424
1865	372	1871	423
1866	385	1872	436

Year.	England.	Ireland.	Year.	England.	Ireland.
1873	...	444	1881	520	370
1874	...	461	1882	532	370
1875	471	—	1883	546	400
1876	473	—	1884	560	390
1877	488	350	1885	566	390
1878	503	360	1886	583	410
1879	502	340	1887	606	430
1880	514	34			

I think it hardly possible that this steady increase in twenty-six years from 360 to 606 deaths from cancer among each million persons in England and Wales during that period can be truly attributed to any great extent to better registration. You see that in some successive years the mortality is almost exactly the same; but, on the whole, the increase is much more steady and regular than any modification is likely to have been in the views or habits of those who certify and those who register the causes of death.

And if we arrange the figures in groups of years—three, five, and seven years—from 1858 to 1887, the same steady increase is even more manifest. Here is the annual death-rate from cancer to a million persons living from 1858 to 1887, with a comparison with Scotland for five of these periods:—

	England and Wales.	Scotland.
Three years (1858-60)	335	—
Five " (1861-65)	368	404
Five " (1866-70)	404	428
Five " (1871-75)	446	468
Five " (1876-80)	495	504
Five " (1881-85)	545	540
Two " (1886-87)	595	—

A glance at the first table shows that up to 1884 the mortality reached 560, and was 606 three years later. These are the returns for all ages. If we omit the earlier years of life, and examine the returns for those who have attained the age of 25 years and upwards, we are able to compare the period of thirty years before 1880 with the seven following years. Here is the comparison:—

	Both Sexes.	Males.	Females.
Thirty years (1851-80)	867	561	1144
Seven " (1881-87)	1229	895	1533

Surely this great increase in recent years, both among males and females, suggests an urgent need both for inquiry and explanation. I should remind you, before passing on, that if the English population consisted of an equal number of males and females, the annual death-rate from cancer per million of persons of both sexes, aged upwards of 25 years, would be for the last seven years 1,214 instead of 1,229.

In order to compare England with Ireland I have examined the last report of Dr. Grimshaw, the Registrar-General for Ireland, and with his obliging assistance have prepared this table, which shows what the total deaths from cancer have been in Ireland in the eleven years 1877-1887 at all ages:—

Year.	Deaths in England and Wales.	Deaths in Ireland.
1877	12,061	1,873
1878	12,594	1,913
1879	12,722	1,782
1880	13,210	1,775
1881	13,542	1,909
1882	14,057	1,882
1883	14,614	1,995
1884	15,198	1,947
1885	15,560	1,925
1886	16,243	2,029
1887	17,113	2,067

On the whole, a smaller increase in eleven years than in England, and in some years a diminution. If we inquire how this is affected by the number of the population, we find that an increase of the number of cancer deaths from 1,873 to 2,067 corresponds with a diminution in population of nearly half a million.

If we calculate the death-rate from cancer, not in persons of all ages, but in those aged 25 years and upwards, we find that the deaths from cancer registered in Ireland during the seventeen years 1864-80 are equal to an average annual rate of 676 per million of the living above 25 years of age; while those registered during the seven years 1881-87 yielded an average rate of 873 per million. Pray observe—before 1880, 676 per million, and since 1880, 873—surely a remarkable increase, though not so great as in England.

The only years for which I have yet been able to compare Scot-

land with Ireland and England are 1883 and 1885, and the figures are:

Year.	England.	Scotland.	Ireland.
1883	546	550	400
1885	546	569	390

These figures represent the *proportionate* number of deaths from cancer to each million of living persons. If we ask for the *total* number of deaths from cancer, we find that in 1885 there were in Scotland 789 male and 1,384 female deaths—equal to 560 in each million living at all ages—slightly larger than in England, and much larger than in Ireland. In Scotland, with a population smaller by about one million than the Irish, there were some 200 more deaths from cancer. Dr. Cunynghame, in his Report to the Registrar-General for Scotland, remarks that the mortality is highest in Edinburgh and the large town districts, and the proportion varies very much; for while in Edinburgh 49 of every thousand specified deaths are from cancer, in Aberdeen there are 43; Perth, 35; Dundee, 28; Glasgow, in different districts, 21 to 19. Considering that there are large hospitals both in Glasgow and Edinburgh, the fact that deaths from cancer were in 1885 proportionately more than double in one than in the other is a matter for careful inquiry. By referring to the table of cancer mortality in groups of years from 1861 to 1885, a comparison may be made with the English returns for part of the time—the general result agreeing pretty closely with the Scotch—and both showing a considerable excess over Ireland.

In the United States the recent increase of mortality has been as great as in England. According to Dr. Fordyce Barker, whose reputation here is as deservedly high as among his own countrymen, the mortality from cancer in the city of New York has risen from 400 to the million in 1875, to 530 to the million in 1885. Discussing this increased frequency and mortality of cancerous diseases "in those nations which are the most advanced in civilisation," Dr. Barker says that in America these diseases are much less frequent in the coloured than in the white race. Hence the mortality is less in the Southern than in the Northern States. "It causes the greatest proportion of deaths where there is the greatest proportion of people of advanced age—that is to say, in the New England States. Hence, in any given locality, a large proportion of deaths from cancer indicates, to a certain extent, that the locality is a healthy and long settled one, and has a large proportion of inhabitants of advanced age." In this country it would appear that although the liability to death from cancer advances rapidly with age, as does the liability to death from other causes (in the words of our Registrar-General), "The characteristic feature of cancer mortality is not its increase with advance of years, for this it shares with other fatal affections, but its disproportionate increase in the middle periods of life."

The fact that these diseases destroy their victims during the most active and useful periods of life surely adds to the importance of studying their causes. When we learn more of their natural history, we shall know better how to avoid or prevent, perhaps to cure them—and we require more information, not only as to the geographical distribution of these diseases in general, as compared with the ages, sexes, and occupations of the populations of different areas, for a sufficient number of years; but it is of equal, perhaps of greater, importance to ascertain how they affect different organs according to locality, race, and habits. For example, cancer of the breast and of the womb may be more accurately recognised during life and after death than many other forms of cancer; and if increasing mortality of these seats of the disease were registered in any country or district, it could hardly be denied on the plea of erroneous diagnosis. I may mention a very remarkable fact which seems to prove that, in one city at least, deaths from these two forms of the disease are not increasing. The city of Frankfort-on-the-Maine is renowned for the completeness and accuracy of its statistics of population, and Hirsch says, in his valuable work on *Geographical and Historical Pathology* (translation for the New Sydenham Society, p. 508): "There has not only been no increase during the twenty-one years, 1862-82, in the frequency of those forms of cancer which can be most accurately diagnosed during life or after death, namely, mammary and uterine cancer, but indeed a considerable decrease when we allow for the fact that the population has almost doubled during that period." The British Medical Association addressed the Registrar-General last year, arguing that "the only means which offer a reasonable prospect of discovering how far the increase in the deaths from cancer is real or only apparent, lies in the tabulation, through a course of years of the

cancers of each part of the body separately." In support of the application for such additional returns, the Association urged that they might lead to further knowledge of the causes of the disease, and said: "Your returns have already shown that the increase is greater among men than among women; you may further discover that men of certain trades and employments are more liable than others to the disease, that cancer of certain organs is increasing, while that of all other parts of the body remains stationary, with similar information of equal, or even greater, value" (BRITISH MEDICAL JOURNAL, November 12th, 1887).

The Registrar-General, in his reply, relied upon what he called "the great and regrettable lack of precision with which very many members of the medical profession state causes of death in their certificates," as one reason for not tabulating under any but "wide and general headings." Another plea, that he cannot entertain any proposal which would lead to the employment of additional clerks, is surely feeble. No government could refuse some slight addition to the Estimates for a really useful purpose. The opinion, as stated by Dr. Ogle, that some part of the increased mortality under the heading "Cancer," is due to "improved diagnosis and more precise statement of cause" may be quite true; but it is believed that more detailed statistical returns would assist us in determining whether these reasons account for little or for much of the increase, and for how much. I can hardly doubt that the required information for England and Wales will be obtained if the Registrar-General has sufficient funds placed at his disposal by the Government. Dr. Grimshaw, the Registrar-General for Ireland, has already begun to obtain and supply the needful information. In his report for the year 1887, he has published a table which shows the deaths from cancer registered during the year, by sexes and age-periods, arranged according to the part of the body affected by the disease, so far as that information was contained in the returns. In 406 cases, the organ or part of the body affected was not stated, and it is important to note that of the 1,661 cases where the required information was given, 507 (or nearly a third) were from cancer of the stomach, and as 29 cases are returned for the pylorus, the proportion is still larger. There were 203 (or about an eighth) from cancer of the breast, and 161 (about a tenth) from cancer of the uterus. Next in order follow the liver, tongue and lips, throat, intestines and rectum.

When we are able to compare such returns from Ireland with similar information from England, Wales, and Scotland, we may surely be assisted in our study of the causes and prevention of these diseases, and may be assisted by attention to the remarkable charts of Mr. Haviland, which show how very different is the geographical distribution of cancer and of phthisis in Great Britain.

It would be unjust to Dr. Ogle if I were not gratefully to acknowledge the value of much that he has already done, and accept it as a proof that more will follow. His observations on the varying mortality from cancer in the different counties of England, on the high cancer mortality in London and the surrounding counties, and in many of the counties on the eastern half of the kingdom, and his cautious examination of the truth of the widely-spread belief that "cancer mortality is lowest on the western side and highest on the eastern side of England," merits our hearty thanks. If the Registrar-General have power enough, and the expenditure of his department is not stinted, there is ample ground for hope that all required information will be obtained and given. But we must also do our own share of the work. Complaints, not altogether unfounded, are made that the profession does not supply the necessary data for accuracy of statement. It is said that not only country general practitioners, but men of high standing in London, and officials in our great hospitals, are very careless in the matter of filling up death-certificates, and yet are angry when they cannot find the precise detailed statistics they desire to obtain. All this is worthy of your careful consideration, and I cannot think I am wrong in the confident belief that hereafter members of our profession, in all parts of the country, as well as our associations and medical societies, will assist the Government by freely giving their careful attention to the accuracy of the returns they make as to the causes of death, and will assist willingly and to the best of their power in the attainment of an object of such national importance. Although some inquirers have not yet obtained all the statistical information they want, I do not think it can be denied that—in regard especially to cancer—there are no statistics in the whole range of medical literature which can be compared, for fulness or for accuracy, with those given in our Registrar-General's last annual report. Not

only are those returns founded on a far wider basis than any others, but they stand alone as the only statistics of cancer in which the necessary correction for age-distribution has been made—a correction without which all statistics as to the comparative frequency of cancer in the two sexes, or in different geographical areas, are comparatively valueless.

The time and attention you have given to these figures, and the inferences drawn from them, will not be lost if you are led by the belief that cancer and cancerous diseases are increasing to ask: Can the increase be checked; and what are our duties as surgeons in relation to these diseases in general, and to their surgical treatment when different organs or parts of the body are attacked by them?

Upon the general question of the nature and causes of these diseases, of their prevention or the means of checking their increase, I can only speak in the most hasty manner—partly because I could add very little to what Sir James Paget said last year and to the concluding sentence, Mr. President, of your own Bradshaw lecture in this place. You there said: "Before we shall ever be able to answer the question, Why or how do tumours form? we must be able to solve the problem of normal growth and development, and to answer the question, Why or how it is that these continue up to a certain point, and then suddenly cease?"

If I were to attempt to add to this, it would be necessary to review the progress of scientific pathology in our own time, and to criticise what is known, or believed, or taught in our schools, of the processes which lead to the formation of new growths, especially of those growths which are in their character infiltrating, spreading, invading, encroaching upon or supplanting surrounding structures, and which may secondarily affect distant parts of the body. The problem is how these growths take the place of normal tissues or structures, how their cellular elements appear in the interstices of normal textures, how the normal cells are altered or transformed, how the infecting cells are only misplaced and proliferating epithelium, not new elements, but imperfect or morbid epithelium which has acquired the power of infecting the neighbouring cells, or of impressing upon them an epithelial type

You see in this drawing "cancer-cells" arising interstitially from connective tissue-cells which had reassumed their embryonic plastic character. This is the teaching of Virchow, and though not easy to explain seems to be in accordance with what the microscope shows us. If we go a little further back and study the whole cycle of changes from the cellular rudiments of organs and tissues through their normal growth and development towards their natural decay or death, and bear in mind the liability of some of them to premature obsolescence, the occasional persistence of or return to embryonic form or powers, and the risk attending the survival in the body of rudimentary structures, we open a fruitful line of inquiry. These are problems which it would be hopeless to attempt to discuss in a single hour. And if we combine the study of this elemental or cellular pathology with that of the changes in the blood and blood-vessels and in the nervous system, modified or not by the influence of hereditary tendencies, and associated or not with the action of chemical or organic agents introduced from without, with the inoculation and multiplication of micro-organisms, and with the poisonous animal alkaloids or extractive compounds which they secrete and leave behind after their work has been done, we are only on the threshold of a new world, a boundless sphere for continuous research. I know of no path of original research where more advance is to be hoped for, and none where the assistance freely offered to earnest workers in the new laboratories of this College, which are the first-fruits of the bequest of Erasmus Wilson, is more likely to be rewarded by profitable discovery.

Although the hour is rapidly approaching its end, I must not

pass over without remark recent discussions as to the supposed microbic origin of cancerous growths. Cases of acute cancerosis or miliary cancer, analogous to acute tuberculosis or miliary tubercle, have led to the search for a specific microbe or bacillus. Scheurlen believes he has found one, but nearly all those who have examined his statements have been led rather to negative than to confirm his conclusions. Senger, indeed, has almost proved that Scheurlen's cancer bacillus is nothing more than a potato bacillus—one which grows readily on slices of potato, and is often accidentally found there. So far as inoculation experiments, or grafting of portions of cancerous growths upon sound parts of the body, have hitherto gone, they are certainly against the microbic doctrine. We can only admit that any disease is caused by a microbe when the micro-organism has been isolated, has been cultivated outside the human body, and then, when the cultured organism has been introduced, it has led to an identical form of disease or growth. Unless these three things are done we have no positive proof that a disease is due to specific germs.

Knowing how keenly such questions as these are now discussed, I was anxious to know if the great leader of German pathologists has yet arrived at any definite conclusion regarding them. So I wrote to Professor Virchow, and he replied on October 25th last, sending me a paper published in his *Archives* on the "Diagnosis and Prognosis of Carcinoma," and adding: "Since I wrote that paper last December, the only progress in the knowledge of Scheurlen's bacillus was its detection growing on potato sections without cancerous origin." Professor Virchow also refers me especially to a part of his paper which expresses his present belief that "the most scrutinising investigations have not yet arrived at a convincing demonstration." But, with equal caution, he adds that the possibility of the existence of such a micro-organism cannot simply be denied; and that the discovery of a specific bacillus would be of the greatest importance in the diagnosis and prognosis of carcinoma—because, he says: "The attempt to explain all the stages of cancer proliferation with dissemination and metastasis by the dispersion of cancer cells is by no means so certainly supported by anatomical or experimental proof as to exclude any other mode of explanation. Nor, on the other hand, is the need for a cancer bacillus so great that without it we are deprived of the possibility of understanding the process. Animal or human cells, quite as well as bacteria, have the power of influencing metamorphosis, and of producing effective secreted matters of the most various kinds. Why, then, should such an influence be denied to cancer-cells, which in many, and especially in the worst, cases are in such a marked degree endowed with the character of gland-cells?"

The time at my disposal is so very short that I must at once pass on to the consideration of our duty as surgeons in treating sufferers from cancerous diseases, and I propose to ask you to reflect at your leisure upon certain questions about which the mind of the profession is still not definitely settled, rather than to accept any conclusions of mine.

The first of these questions is whether a cancerous growth alone, or the whole of the part or organ which it has invaded, should be removed; and I think the time has come to agree upon some general rule or principle of treatment. With regard to cancer of the breast, two very opposite opinions are held by men of high position as hospital surgeons. Mr. Nunn, after very large experience at the Middlesex Hospital, in his admirable treatise on *Cancer of the Breast*, says (p. 32). "When an operation has been decided upon, the removal of the entire mammary gland must be complete—any partial removal is not only useless but worse than useless: the occurrence of the slightest speck of cancer in a gland declares that the whole organ is more or less ready for special degeneration." Mr. Butlin, whose experience at St. Bartholomew's is also very large, and whose work on the operative surgery of malignant disease is rich in facts carefully tested and in conclusions drawn with remarkable judgment and freedom from prejudice, takes a very different position to that of Mr. Nunn. He says that in many cases the tumours are "at first of small size, limited to a part of the breast, often situated towards the margin of the gland" (p. 381), and he adds, "Just as good reason could, I am sure, be given for the removal of both breasts in every case of cancer of one of them as for the removal of the entire mammary gland in every instance." Time prevents me from entering further upon this important practical question than to say that my own practice, and what I have actually seen of the practice of others during the past thirty years, would lead me to remove the entire

breast in every case of cancer, except where the growths are small and close to the margin of the gland, or only affect outlying portions of the gland. And when such growths are found, not in the gland but in the axilla, I should strongly oppose removal of the breast, because I think such tumours may be neither of the breast itself nor of the axillary lymphatic glands, but of a certain class of sweat-glands which have been the subject of a paper by Dr. Creighton. I believe it is only necessary to direct more attention to this inquiry to lead to the recognition of a new and a large class of tumours of the axillary and pectoral regions.

The tumours to which I allude are found at the outer border of one or both breasts, and the surgeon is doubtful whether the breast itself is or is not involved in the new growth. When the growth is between the outer border of the mammary gland and the corresponding axilla, the fear is felt that the axillary glands are involved in the breast disease; and opinions are given that both the axillary tumours and the breast should be removed. Such a case came before me scarcely a month ago. On the 25th of last month, a married lady, who had never been pregnant, aged 46, came to me from Wales, having had a strong opinion that her right breast should be removed without delay. I found both breasts larger and harder than usual, both nipples unusually large and prominent, but the only distinct tumour to be felt was between the upper and outer border of the right mamma and the axilla. Extending from this border, below and behind the pectoral muscle, was a round, movable, tender tumour about three inches in lateral and two in vertical measurement. It was in close connection with the mammary gland, but I thought I could separate one from the other. The patient felt sure that a blow

This drawing shows the two kinds of gland structure exactly as they are seen in one of Dr. Creighton's preparations. To the right is seen a portion of a mammary lobule in a resting state; and, on the left, an aberrant deposit of the so-called sweat-glands, with muscular basement membrane.

from a tennis ball two years ago had been the cause of the swelling. I advised that neither of the breasts should be removed, but that the tumour or tumours, whatever they might be, should be removed without delay. Meeting Dr. Creighton later on the same day, I mentioned the case to him, and he at once suggested that the tumour might be neither of the breast nor of the axillary lymphatic glands, but of certain sweat-glands below the skin of the axilla which he had referred to in connection with tumours in a paper which was read at the Royal Medical and Chirurgical Society, six years ago, and may be found in the sixty-fifth volume of the *Transactions* of the Society. In that paper he shows that the special layer of glandular substance more or less developed in the human axilla corresponds to a conglobate form of gland not previously described, in one of the lowest mammalians, with an

investment of unstripped muscular fibres in parallel order around each crypt, so as to constitute a basement membrane upon which the epithelial cells are seated. These sweat-glands differ in important respects from the ordinary skin-glands of man. They are not usually in the substance of the skin, but adhere to its under surface, lying between the skin and the axillary fascia, and sometimes extending to the lateral and anterior regions of the chest. They are variously developed in different individuals, and must be regarded as a sort of survival or rudimentary organ, and subject to all the risks of such survivals or rudiments. Dr. Creighton says: "I have, in one instance, found perfect examples of them in intimate association with the breast structure."

I show you here the tumour which I removed entire on October 30th, as well as the fragments of the other somewhat smaller tumour, and the tissue I removed in dissecting away the investing membrane after the interior had been cleared out. Dr. Creighton was present, and made a careful examination on the same day of all that I removed. The smaller or pectoral tumour was so closely connected with the breast, that I removed with it a small piece of the outer border of the gland, enough to show that the breast itself was quite healthy. In order to be sure of removing the whole of the tumours, I removed some of the surrounding fat also, and Dr. Creighton reported to me that he found embedded in the fat round reddish bodies about the size of a large pin-head. "One of these, easily extracted from the surrounding fat, proved to be a coil or cluster of the tubular axillary glands of perfectly normal structure, in which the characteristic palisade-like basement membrane of unstripped muscular fibres, the mosaic of polyhedral epithelium resting on the latter, and the conglobate windings and crypt-like recesses of the tubule were easily seen in a preparation of the fresh tissue. The capsule of the smaller and more friable new growth adhered along the axillary side of the piece of fat, the normal reddish cluster of glands lying in the fat about an eighth of an inch deeper. The capsule was everywhere infiltrated with blood; its inner surface was not uniform, but subdivided into a number of round areas or recesses of unequal size, one or two of which were specially marked by their black pigmentation. The examination of that capsular tissue, and of the friable tumour tissue which was removed from it by the finger during the operation, discovered satisfactory evidence of the same glandular structure as in the small reddish body embedded in the adjoining fat—namely, unstripped muscular fibres, spherical or polyhedral epithelium, with or without brown or black pigment, and, in sections, traces of the tubular glands themselves."

"The larger mass of tumour was situated deeper in the axilla, and was unconnected with the portion nearest to the breast, except by loose tissue. It was extracted by the fingers entire, an encapsulated lobulated oval body, about two and a half inches in its long axis, and an inch and a quarter across at its thicker end. The surface was everywhere dark red, giving it some resemblance to a small kidney. In its lobulation it looked like a packet of lymphatic glands. On section it proved to be a whitish medullary substance with a few small areas of pigmentation, and with a general foliaceous or lobulated arrangement of the stroma. In microscopic preparations of the fresh tissue, unmistakable examples of unstripped muscular fibres were found, as well as the same polyhedral and spherical epithelium, with and without pigment, as in the more friable tumour nearer to the breast. In sections the epithelial cells were found collected in alveolar heaps, generally of great extent. The dark colour of the capsule was from infiltration of blood."

The general structure of these tumours of the irregularly-scattered sweat-glands, including their hemorrhagic capsule, appears to be the same that has been described for the puzzling class of cases known as "alveolar sarcoma of the breast," or "duct-cancer of the breast." It is noteworthy that these cases have sometimes been found to start from the areola around the nipple, a region which is known to be provided with the same kind of tubular glands as are found in the axilla. When such growths ulcerate, they resemble rodent ulcer. The so-called eczema of the nipple which has been observed in such cases would appear to be connected with the orifices of the gland, and, in its simpler forms, to be little more than the brownish secretion of the glands dried upon the skin. It seems probable that this case and Dr. Creighton's observations upon it, will be the beginning of a new classification, or of the separation of such cases from the class of mammary tumours, and their reference to the irregular deposits of sweat-glands of the axilla, and to the glands of the areola.

I may add that a tube draining away from the axilla was kept in for three days, and after its removal, union of the incision, about four inches long, was complete when the sutures were removed. The patient returned to Wales a few days after operation. I have arranged for a report as to any recurrence hereafter, but venture upon a favourable prognosis.

(To be continued.)

THE RESULT PRODUCED UPON THE MUSCLES, BONES, AND LIGAMENTS BY THE HABITUAL EXERCISE OF EXCESSIVE STRAIN.¹

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We may, I think, consider that the normal anatomy of the human skeleton has been developed to perform two distinct sets of functions, namely, to transmit weight and to sustain strain in the varying attitudes of the individual; or, in other words, that the form of the skeleton has been evolved in consequence of the habitual mechanical relationships which have existed and do exist between the organism and its surroundings. Since this relationship has not been constant in the same portion of the globe at different periods of time, nor is it constant in different portions of the globe at the same period of time, we get a considerable variation in what may be regarded as the typical anatomy of each of the several races which are scattered over the earth's surface.

Again, the reproductive function of the female entails the presence of a bulky mass which occupies her abdomen, and encroaches considerably upon the thoracic cavity for periods of several months at a time, and which causes her mechanical relationship to her surroundings to differ from that of the male, the fœtus in her abdomen being also regarded as an external relationship rather than as a portion of the mother. The form and size of the foetal head, varying as it does in the same race as well as in the several races of man, may be considered as constituting a very varied and important mechanical relationship of the individual to its surroundings during the passage of the foetal head through the true pelvis. Therefore, we find that very considerable differences exist between the male and female types in the same race, and also between the female types of the same race and of different races.

The first attempt to throw light upon this important question of the causation of the many racial differences in type was made, I believe, by Sir William Turner.² He has endeavoured to elucidate some of the mechanical factors which affect the anatomy of each race, or, in other words, to determine the peculiar relationship of the individuals of each race to its surroundings. The researches that I have made into the very remarkable and considerable alterations in character which the normal anatomy of our race undergoes when the mechanical relationship of the individual to its surroundings is altered from the normal in a definite and measurable manner, would lead me not only to support Professor Turner's views very strongly, but also to carry the same line of argument much further.

I think that much error has arisen and that little progress has been made because many observers have too often been satisfied to try to arrive at general laws from the aggregation of a large number of so-called indices, etc., instead of pursuing the more scientific course of attempting to define the factors that determine the presence of the so-called normal condition of the skeleton from a careful study of the variations in form which exist in the individuals of the same race, as well as between the individuals of different races.

I have been able to explain on the simplest mechanical principles a great number of the deviations from the normal type which are found in our own race, and, from a consideration of such, I think that we are perfectly at liberty to assume that the anatomical differences which exist in the various races of man are explicable as regards their causation upon the same basis. I

¹ Read in the Section of Anatomy and Physiology at the Annual Meeting of the British Medical Association held at Glasgow, August, 1888.

² Report on the Human Crania and other Bones of the Skeleton Collected during the Voyage of H.M.S. *Challenger*, and other papers in the *Journal of Anatomy and Physiology*.

believe that it is by working in this direction that progress is to be made, and that it is by a careful study of the factors that determine every deviation from the normal type presented by the subject which bears an abnormal relationship to its surroundings, that we will be in a position to ascertain the mode of development of every detail in the anatomy of the organism which bears to its surroundings what we may regard as a normal relationship; or, in other words, a non-specialised relationship, and to verify absolutely the problem of evolution.

Fortunately, in the present condition of society, we have an almost innumerable number of experiments upon the normal subject made for us, and, from a study of these, we ought to be able to obtain a vast amount of information, and to make generalisations of great importance. The natural experiments to which I refer are the changes in the anatomy of the individual which are produced by the pursuit of some laborious occupation. There are very many trades in which the labourer is engaged habitually in performing a definite series or sequence of movements, each event of the sequence leaving a permanent and unmistakable impress upon the anatomy of the organism, the bones being altered in form very materially, the muscles in structure, and the articulations in their character and anatomical details. I allude to such workmen as ships-trimmers, coalheavers, shoemakers, porters of various kinds, milkmen, washerwomen, etc.

I do not think that anything can be more full of interest, or possibly more productive of good results, than the careful study of these changes. In discussing the variations presented by the skeleton, we are but too ready to shelve their causation if it is not at once obvious, and to fancy that we are explaining the mode of their production satisfactorily by asserting that they are retrocessions to lower types, examples of deficient or abnormal development, or the product of some disease.

While writing this, I have before me a very interesting paper³ on Variations of the Human Shoulder Girdle, by Professor Thomas Dwight, whose work is familiar to all of us. In that paper he has collected the varying indices of the scapula in many races of man and quadrumana. In discussing the lower angle of the scapula, he states that its form depends in part, though not wholly, upon the development of the surface to which the teres major is attached. He goes on to mention the usual slight projection from the axillary margin of this bone, which is occasionally very largely developed. He says that this process bears no direct ratio to the size of the teres major, and that the third trochanter on the femur is an analogous case, the occurrence of which, in his opinion, is quite uninfluenced by muscular development; also, that its existence in man is probably, as in the case of the third trochanter, the appearance of a peculiarity of a lower form. This quotation from Professor Dwight's paper brings me to the subject of mine, namely, the Result Produced by the Habitual Exercise of Considerable Strain upon Bones, Muscles, and Ligaments. In reference to the two conditions to which he calls attention, namely, the projection from the axillary border of the scapula and the third trochanter, my experience would lead me to conclude that the explanation which he gives of their presence is false, and that instead they have been developed as the result of excessive strain sustained habitually by the lower portion of the subscapularis, and by the psoas muscles respectively, bone extending along the tendinous attachments of these muscles, and in the direction in which traction is habitually exerted. I have never yet examined throughout the body which presented these or similar prominences in the attachments of muscles and ligaments without being able to satisfy myself completely that they are dependent for their presence upon the habitual transmission of excessive strain through these structures.

I need hardly remind you that in the normal subject, with advancing age, the abductor and extensor muscles cease to exert their functions fully before the flexors and adductors, and that, in consequence, the processes of bone upon which the former exerted strain during active adult life, and which were dependent upon the exercise of that habitual strain for their existence and continuance as prominences, disappear when that strain is no longer exerted. I would instance the atrophy of the tuberosities of the humerus, which takes place in feeble old age in association with the ascent of the head of the humerus from its normal position in relation to the glenoid cavity.

Before proceeding further, I would point out that the process

³ *American Naturalist*, July, 1887.

⁴ The Causation and Pathology of the so-called Disease Rheumatoid Arthritis and of Senile Changes. *Trans. Path. Soc., Guy's Hospital Reports*, etc.