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ON

Fatty Degeneration.

BY THE LATE

W. F. BARLOW, F.R.C.S.

LONDON:
JOHN CHURCHILL, PRINCES-STREET, SOHO.

1853.

TO

JAMES PAGET, ESQ., F.R.C.S., F.R.S.

AND

RICHARD QUAIN, ESQ., M.D., F.R.C.P.

WHOSE

UNVARYING KINDNESS TO THE DECEASED

ENCOURAGED THE PUBLICATION OF THE FOLLOWING PAPERS,

This Little Volume

IS DEDICATED,

WITH EVERY SENTIMENT OF RESPECT AND GRATITUDE,

BY

THE AUTHOR'S FATHER.

Writtle, Oct. 1853.

PREFACE.

THE subject-matter contained in this little volume was published by its Author—now, alas! no more—in a series of communications to the "MEDICAL TIMES AND GAZETTE." They were believed by him, and it is hoped will be also by the Profession, to merit preservation in a consecutive form; and therefore his relatives have proceeded to fulfil his wishes.

SOME GENERAL OBSERVATIONS

ON

FATTY DEGENERATION.

[*Read partly before the Medical Society of London, March* 20, 1852.]

The subject of degeneration is equal in a pathological, to that of nutrition in a physiological, point of view. If the latter shows us how we live, the former tells us why we die. But these phrases must be taken with due reserve, for our knowledge of the histories of life and death, at once so vast and complex, must, even could we pursue them with Bichât's genius, be for ever limited.

A short time ago, the topic which I shall venture to introduce this evening might have been comprised in a page, but now a large volume would fail to compass it; and I shall be only able to touch upon a few of its leading and most obvious points, as, greatly embarrassed by want of time, I coast too swiftly along its border.

One extremely common, and oftentimes fatal, form of degeneration is seen in the conversion of various tissues of the body into fat, which, although so liable to take their places, is quite incompetent to perform their parts. This change, deteriorating always, and leading frequently to gradual or sudden death, must be viewed in its widest and

fullest relations, if we would know its applications and comprehend it aright. It must be judged of as a countenance, not by one feature separately taken, but by all its features, and their blended expression. It must be studied, not as to one organ simply, but the whole body; not as to local circumstances only, but general states; not as to old age merely, but all periods of being, even that previous to birth, the time of our "first life," as Mr. Hunter called it; not as to itself alone, but its frequent, and oftentimes most perilous complication of various affections. It must be pursued microscopically as a matter of course; but he who rests satisfied with the well-marked pictures of a few spoilt fibres or damaged vessels, has not a glimpse even of the field it occupies and its immeasurable relations to decay and death.

It may at once be stated, that the subject of atrophy cannot be separated from that of fatty degeneration; the causes of the one are those of the other, and both blending inextricably, form very often descending steps of one downward course; the first does not lead of necessity to the second, but the second frequently implies the first, nay, I think *always*, for although simple defect of nourishment and true degeneration, fatty or otherwise, are clearly to be distinguished from each other, it seems impossible to conceive how any part can ever be transformed into a lower material without first suffering an impairment of nutrition. But let it be noted, that the word *atrophy*, viewed in a strict and proper sense, and, indeed, according to its plainest meaning, does not simply imply an obvious wasting of the affected tissue, but also a deficiency of perfect nourishment, whatever be its kind, and must often be used, both as a matter of truth and convenience, in reference to those first failures of assimilation, which, if they neither stop nor be remedied, must lead sooner or later to manifest changes or losses of structure. Again, it is quite manifest that real atrophy and seeming hypertrophy of a part may co-exist; there is degeneration of tissue, but increase of size, bulk therefore often, without any corresponding power; and this we see excellently exemplified by hearts, which are at once fatty and enlarged; and it is also well instanced by what Mr. Hancock pointed out to the Society the other evening, in reference to that which used to be denominated hypertrophy of

the bladder's contractile coat, this increase of size being really demonstrative of no augmentation of the muscular fibres, but often signifying the very contrary; for they have been seen by him in cases of such increase, and not faintly or a few times merely, more or less in a condition of fatty degeneration.

The right preface, then, to the rational study of fatty degeneration, is the consideration of imperfect nutrition; it then comes in legitimate order,—the order of nature, and is much simplified in consequence. In Mr. Paget's observations on atrophy, we find it treated of as a part of the subject; he speaks of it as a manifestation of atrophy, and so it is; there is no evidence of anything, if there be none of this.

It would be absurd to attempt, in such a fragment as I am offering now, an elaborate statement of all the causes (of *all*, indeed, under any circumstances) which may lead to fatty degeneration; but I will suggest for consideration some of the principal:—1st. A wrong or defective state and composition of the blood; 2nd. An insufficient supply of blood; 3rd. A deranged or obstructed influence of the nervous system; 4th. An imperfect, unhealthy, or declining state of the part to be nourished. These conditions, be it observed, are in every respect the reverse of those which Mr. Paget has specified as most important, in order to the completion of perfect nutrition.(a)

I. *A wrong or defective state and composition of the blood may be a cause of fatty degeneration.* The blood is the acknowledged life of all parts; its poverty, its diseases, its death are theirs. The great Harvey speaks of the blood being "the cause of youth and old age," and he who fairly studies this expression, shall, though he hold it too unqualified, at length perceive in it the largest meaning. When Simon informs us, that the blood of the fœtus contains more corpuscles than that of its mother; that the period of maturity is richer in these corpuscles than an earlier time; that they continue plentiful during middle age, but from thence are subject to decrease, does he not, in part, make a practical commentary on this indefinite, but suggestive phrase? (b) That the blood can give rise to fatty

(a) Lectures on Nutrition, Hypertrophy, and Atrophy, p. 8.

(b) Simon's Animal Chemistry, edition of the Sydenham Society, Vol. I., p. 237.

degeneration, in which shape age oftentimes comes prematurely, by diminishing the proper nutrition of the tissues, will appear from a multitude of familiar considerations.

Old age supplies us with by far the most abundant and general instances of this form of degeneration, a fact, which taken by itself alone, would almost prove to any one's satisfaction its dependence on a condition of atrophy or decline. Middle age may present the arcus senilis, (the discovery of the true nature whereof, by Mr. Canton, was a step in the inquiry of the first importance,) and youth even, nor do we yet know the earliest age at which it may appear; but, it is, generally speaking, seen at a later, feebler period, and constitutes one of its most characteristic signs. But to the fatty degeneration of extreme old age, which, doubtless, depends partly on the decreasing virtues of the blood itself, we can hardly affix the term abnormal or morbid; as well might we apply both or either of these epithets to the fading and falling of the leaves in autumn, which surely are not more out of the regular course of nature than were their budding and unfolding in the season of spring. Does the arcus senilis occur at this time, no one surely could speak of it as a mark of disease in the sense that he would of a variolous pustule. In the well-known representation of the seven ages, the last is surely as natural as the first. But, physically and mentally speaking, the time of old age, or rather the state proper to it, is very capricious; and how can we wonder at this circumstance, seeing with what different constitutions men are born,—what varying hereditary influences affect them,—what unlike fortunes as to rest or labour, abundance or destitution, successes or failures, to say nothing of the effects of disease and accident, tend either to spin out or contract their career.

I believe that the symptoms of the "climacteric disease," as Sir Henry Halford has described it, (a) to be, not always, but in many cases, the evidences of that form of degeneration which occupies us. It is true, that he inclines to call it "a disease rather than a mere declension of strength, and decay of natural powers," but I dare to suggest, that the contrary view will be found more correct, and, above all, by

(a) Essays and Orations, page 1.

those who most attentively consider his interesting history. Its occurrence between fifty and sixty-five years of age, a period embracing the grand climacteric, which Sir Thomas Browne discusses with all his wonted ingenuity and quaintness,(a) agrees well with the time wherein fatty degeneration invades very commonly to a serious degree. Sir Henry Halford speaks of its being complicated with other complaints; and this is exactly such a phrase as would be used by anybody about to describe the effects of fatty degeneration without clearly tracing them to their common source. He thinks it not very improbable, that it is connected with a brain wanting in energy, and a heart "irregularly supplied with nervous influence;" and these are signs of failure which, far from being incompatible with the state I would refer them to, are very often to be remarked as its attendants. "Physicians," he observes, "will not expect a cure for this malady;" neither will they for that severe and general degeneration which may occur at a time when no diet can restore the richness of the blood, no stimulants affect the vital organs as once they did, and no fortune, however prosperous or unexpected, arouse the mind from that increasing lethargy which it can no more successfully attempt to shake off than it can cure those physical changes of the brain whereupon the decline of its faculties depends.

In Dr. Marshall Hall's work on Diseases of Females will be found a chapter on "the Decline of the Vital Powers in Old Age." After reading his observations on the climacteric affection, I feel the more confirmed in these remarks. He speaks of a thinness and a paleness of the countenance, and a peculiar imbecility of its muscles; of debility of the articulation and the general movements; of headache and vertigo; of fluttering of the heart and irregularity of the pulse; of hurrying of the breathing by exertion or emotion; of quick fatigue; of wakefulness and restlessness; of a pale livid hue, and coldness of the fingers; of wasting of the muscular flesh; of the husky voice and clogged bronchia; of the distension of the bowels with flatus; of the patient being "obviously plunged into a state of dissolution by the too active operation of medicine." Let these symptoms be

(a) Of the Great Climacterical Year, that is, sixty-three.—*Vulgar Errours, Chapter XII.*

compared with those of the fatty heart, as stated by Dr. Quain;(a) and let those failures of function which degeneration produces be considered, together with the temporary disturbances which chlorosis and other affections of the blood produce; but, of course, there is all the difference between one organ failing from decay, and another, its structure remaining sound, flagging temporarily from insufficient stimulus.

But disease anticipates the ravages of time, and there is no more interesting part of our subject than that which refers to its wide relation to those various aeffctions which impair nutrition. In Dr. Ormerod's observations on the fatty heart, we find accounts of its occurring in connexion with marasmus, epistaxis, phthisis, and fever, all which affections impoverish the blood.(b) That phthisis should lead to it can give no surprise; it runs often a slow and tedious course, while an emaciation, which shows the skeleton in outline, is but too common. The observations of Louis on the softening of the tissues in cases of this affection must be well considered in reference to fatty degeneration. What he says of the fatty liver, the softened brain,(c) the atheromatous aorta, and the condition of the heart, is of great interest; but the observations should be repeated with all the help which the microscope can furnish.

It must not be thought that this question of the complication of phthisis, by degeneration, has no practical interest. The fatty heart, when once produced, is a grave addition to a complaint not needing it; and may lead even to sudden death. Not long ago I examined a man far advanced in consumption, who, having a severely degenerated heart, turned suddenly pale and fell dead upon the floor; there was no act of dying, he was instantly dead. M. Louis, in his great work on phthisis, has a chapter on " cases of unexpected death, which are not explicable by the condition of

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(a) Medico-Chirurgical Transactions, Vol. XXXIII.

(b) On one form of fatty degeneration of the heart.—*Medical Gazette*, 1849.

(c) It would be very interesting to examine the small cerebral vessels in those cases of ramollissement which complicate phthisis; it can hardly be doubted that fatty degeneration would be found sometimes. Apoplexy is a rare complication of that affection, probably because of the circulation

the organs," and describes the case of a woman who "died suddenly, to the great surprise of the occupants of the neighbouring beds." "The heart was somewhat soft;" and there is no great boldness in conjecturing that it had undergone fatty conversion. M. Louis remarks, "No doubt, in this case, the amount of disease in the lungs was considerable; but a fair portion of those organs was still permeable to the air, and respiration performed with regularity a few minutes before death. Between that time and the moment at which life suddenly ceased, no change, at least of an appreciable kind, appears to have been effected in those organs. How, then, can we explain the unexpected death? Is it justifiable to compare the viscera with the locomotive muscles, and admit that, under certain circumstances, they become suddenly incapable of performing their functions from a kind of fatigue?"(a)

M. Bizot alludes to the fatty heart as an associate of phthisis, but the cases he refers to were not examined by the microscope; it can hardly be doubted, however, that there was extreme atrophy of the organ, if not absolute degeneration. Dr. Ormerod relates four cases of phthisis in which this change had indubitably happened; in one of these, however, the patient, as should be noted, had discharges of blood from the bowels during the last three months of his life.

It would be very important to examine carefully the softened brains which occasionally occur in phthisical patients, with the view of detecting fatty degeneration of the small blood-vessels. The other day I visited a man, aged 40, who was dying of consumption; he had an arcus senilis and slight hemiplegia. His body was not permitted to be examined, and it remains uncertain whether his paralysis were due to the presence of tubercle, or fatty degeneration, or some other cause.

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being so subdued and feeble. But M. Rochoux, in his well-known work, records a remarkable instance, entitled, "Ramollissement du cerveau avec mélange d'épanchement du sang; pthisie pulmonaire." The case is rendered the more instructive from the patient being only 29 years of age. —"Recherches sur l'Apoplexie," p. 294.

(a) Dr. Walshe's Translation of Louis on Phthisis,—edition of the Sydenham Society, p. 397.

M. Louis, Dr. Latham,(a) and Dr. Stokes have observed upon the relation of the softened heart to continued fever. In some cases of its existence, an irregular, feeble pulse, and an almost inaudible systolic sound of the heart, have been noticed during lifetime. This matter is of great clinical interest. But how are we to tell whether this change of structure of the heart, supposing it to be detected after death, have preceded the fever, or occurred during its course? Much, perchance, may be learned from the history of the patient, who, ere he was fever-struck, may have long had symptoms of a fatty heart; much may be gathered from the period of the complaint whereat death surprised; much also from the age of the patient, and the absence or presence of the arcus senilis. Dr. Latham told me, that he had seen some sink at the beginning of fever, and in a manner not to be explained, unless by the degenerated condition of the heart. Dr. Ormerod mentions the case of a woman who died of fever, fatal by exhaustion; a fatty heart was detected after death; but as the patient was, previous to her illness, thin and haggard, and not less than 64 years of age, and lay no protracted time ill of her fever, it is fair to presume, that her cardiac malady had existed independently of the fatal affection, which it doubtless aggravated, and perhaps made mortal.

But all chronic or wasting diseases, whether external or internal, may lead to fatty degeneration. Among the cases referred to by Dr. Quain, is one of a child who, having been long ill, at last died of cancrum oris; another, of a young woman, who was the subject of chronic phthisis and gastric irritation; and a third was an instance of hæmaturia. Fatty degeneration, though sometimes noted especially in the heart in which organ the change has been oftenest observed, is doubtless more general than many suppose. "We never hear," says Mr. Gulliver, "of fatty degeneration of the testicles, of the kidney, and other glands, of the lungs, of the blood,

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(a) "I have been looking over M. Louis's admirable book upon fever, and find him laying great stress upon the intermitting and irregular pulse, attesting its formidable import, declaring how few who have it recover, and stating, that he has found in almost all of those who have had it, and have died, a softening of the heart's muscular structure."—Lectures on Diseases of the Heart, Vol. II., p. 163.

etc.; yet these affections are rather common in a variety of chronic diseases, especially of old people, and often in connexion with great general emaciation. In wasting of the testicle, and when the functions of that gland are impaired by lingering diseases or old age, the seminal tubes are more or less obstructed by fatty matter, which occurs in free globules, and in more equal-sized and minuter molecules, generally aggregated into comparatively large, rounded, or irregular masses, nearly opaque, and of a brown or dull yellowish colour."(a)

The microscopical researches of Mr. Bowman have lent new interest to the "fatty liver,"(b) by showing the real nature of the change. This organ degenerates from general atrophy, and so does the kidney. Renal degeneration, as Dr. Peacock shows, not rarely co-exists with phthisis;(c) nor can it be doubted that it is frequently occasioned by the latter affection, which, however, has no specific influence in causing it; whatever produces general atrophy may give rise also to failure of nutrition in the kidney, and consequent fatty degeneration. In old persons who have died apoplectic, I have noticed the granular kidney in combination with fatty degeneration of the large and small cerebral blood-vessels; forms both, of local atrophy produced by the general decline of age.

Much of early decay may be traced, doubtless, to the impairment of nutrition by slow disease; the malady vanishes, its effects never. Slow convalescence is a state which should be watched; the relapse of a malady is a frequent consequence of patients resuming their occupations too quickly; and the second attack is longer and severer often than the

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(a) In some testicles which Mr. Pardey (when house-surgeon to the Westminster Hospital) examined and showed to me, this kind of obstruction of the seminal tubes was extremely well-marked. See Gulliver on "Fatty Degeneration of the Arteries, with a Note on some other Fatty Degenerations," "Medico-Chirurgical Transactions," Vol. XXVI.

(b) *Lancet*, Vol. I., 1842.

(c) *Monthly Journal of Medical Science*, August, 1845. Dr. Handfield Jones made some interesting observations at a late meeting of the Society, (March 8, 1852,) in support of Dr. Prout's view of degeneration of the kidney, being, very frequently, quite independent of inflammation. Were I going into the general question of renal degeneration, I should, of course, refer particularly to the contributions of Dr. Johnson and Mr. Simon.

first. We must look more to the remote consequences of illness, try to prevent them more. The young as to age become old as to structure, and often from affections which impair the blood. In the plant, which seems to grow as we view it, we have evidence of a sap loaded with nutriment, abundant to overflow, and freely circulating ; but what inference draw we when the leaves turn yellow and fade away?

Close confinement has a wide relation to the question of atrophy. So have the ills of poverty, which untimely enrich pathological history. Bad food, foul air, and (far greater evil than it would seem at first) insufficient *light* even, lend death new powers. Quick starvation, as depicted by Dante, has made many shiver with horror; but *slow* starvation, silently working, but most constantly, effectually, and on an enormous scale, excites not nearly the sympathy that it should. It is this slow starvation which leads, not only to atrophy, but often to destruction of tissue; nor can we get frequently at its true history without a complex tracing of past miseries and deprivations. " Under whatever circumstances the fatty transformation occurs, it is obviously a process of degeneration, or degradation to a low scale of animal or even vegetable life." (a)

II. *An inadequate supply of appropriate blood* must be regarded as one of the principal causes of fatty degeneration. It may be either general or local. The questions of morbid change and simple deficiency of blood are, to a great extent, inseparable. Many of the cases already brought forward as illustrative of the one, imply also the other. Pure anæmia, speaking generally, can very rarely exist alone, for even that of hæmorrhage and blood-letting soon passes into spanæmia. (b) " Continuous and excessive loss of blood must necessarily produce a change in the composition of that portion which remains in the system." (c) F. Simon analysed the blood in a case of melæna:—" It

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(a) Principles of Medicine, by Dr. Williams, p. 374. Researches have borne ample testimony to the truth of the observations on "Transformation and Degeneration of Textures" contained in this work.

(b) " From αἷμα, blood, and σπανός or σπάνιος, poor; poverty of the blood." Simon's Animal Chemistry, Vol. I., p. 306.

(c) Simon, Op. cit., p. 317.

did not coagulate upon standing, and contained no fibrin. No blood corpuscles could be observed under the microscope, but merely some yellow particles floating in a clear fluid. It was very rich in fat and hæmaphæin." But its state here might have been due partly to the disease on which the loss of blood depended. As with a part, so with the body; it often doubly suffers from bad and scanty blood; and yet paleness, languor, palpitation, breathlessness, and frequent tendency to fainting, have, at times, not saved it from injurious depletion. F. Simon speaks of the difficulty of procuring blood from the spanæmic for analysis, on the ground of their being hurt by its withdrawal; but certain it is, that there are still practitioners who let not anæmia stand in the way of bloodletting.

Mr. Simon remarks, that, "in fifteen cases of idiopathic anæmia, Andral found the proportion of blood-corpuscles varying, by successive degrees, from what he considers their normal standard (127), to so low a level as 30 in a thousand; and he found (precisely as would have occurred after large hæmorrhages) that the water of the blood had increased just as the corpuscles had decreased, standing in one case as high as 886. In other particulars he considered the blood healthy; but his estimate of fibrin for healthy blood is so liberal, that probably most computators would have differed from him in respect of these cases, and would have described them as presenting an excess of that material; and the organic residue of the serum is in most cases high. It is, however, quite evident, from examination of the various analyses which have been made, that the increase of fibrin (though often observed) is not essential to constitute chlorosis; that the disease substantially consists in an atrophic condition of the blood, evinced in the non-development of its characteristic cells; and that the larger proportion of albumen generally found in connexion with this state may fairly be explained, where it exists, as an accidental result of the defective cell-growth, which has left the serum more saturated with organic blastematous material than it could have retained if the normal proportion of blood-cells had been developed out of it.

"Few of the effects of medicine are more immediate, or more remarkable, than that which results, in this disease, from the exhibition of iron. We all know, clinically, how

soon, under the influence of this remedy, our patients recover their natural complexion; and a chemical analysis of the blood explains this sufficiently. F. Simon gives a case where, after a few weeks of treatment, the proportion of blood-corpuscles rose from 32 to 95 in the thousand; Herberger, one where it rose from 38 to 98; Andral and Gavarret, one where it rose (in spite of two bleedings) from 46 to 95." (a)

In all circumstances where death happens subsequently to repeated hæmorrhages or anæmia, the heart should be most minutely examined. Four examples of fatal chlorosis have been spoken of by Dr. Marshall Hall.(b) How important to have known the state of the heart-fibres!

I have already mentioned, in a former contribution, the case of a boy *six* years of age only, who lay long pale and languid before dying, and in whom, after death, the most marked degeneration of the heart was found. Dr. Ormerod has detailed the history of a pale, bloodless boy, aged *eight* who had suffered from profuse epistaxis; he appeared to sink from exhaustion, and died in convulsions; the heart was found mottled by buff-coloured spots, composed of disorganised fibrils, which, in place of their proper striæ, presented "irregular rows of little granules of oily matter." A case was mentioned to me the other day, in which the arcus senilis was seen in a man aged forty, who had suffered from frequent nasal hæmorrhage, and had been bled largely likewise at different times. Without pretending to say rashly that the arcus appeared as a direct consequence of the loss sustained in this particular instance, we may suppose with reason that the degeneration of the cornea may be much promoted by repeated hæmorrhage. The conversion of this part must be caused by atrophy, before the latter can be indicated by it. The frequent and often profuse hæmoptysis which occurs in phthisis must be considered in respect of the relations of this disease to fatty degeneration of the heart and other parts. Nor must the treatment of disease be passed over in reference to the production of atrophy and

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(a) Lectures on General Pathology, by John Simon, F.R.S., p. 42. Dr. Marshall Hall, speaking of chlorosis, observes, "I have observed the blood which has flowed from the nose scarcely to tinge the sheets."

(b) Lectures on Medicine, *Lancet*, March 31, 1838.

degeneration. Laennec relates, that the heart of a woman, fifty years of age, was found after death no larger than that of a child of twelve, and looked like a withered apple. She had been treated for hypertrophy on "the plan of Valsalva." I do not say the degeneration was fatty here; but the circumstance of hypertrophied hearts being likely to become converted into fat, reads, or should read, a lesson. So long as they are simply enlarged, life, though embarrassed, may be continued long; but if degeneration be added, the danger of sudden death may become extreme, and the peril is heightened, and that measurelessly, if bloodletting be largely and incautiously adopted.

The connexion of *sanguineous* apoplexy with *anæmia* remains to be traced. It is not to be doubted that the latter, when long-continued, may lead to fatty degeneration of the cerebral blood-vessels, just as it does to that of the heart-fibres. I have seen apoplexy happen in young subjects who looked deadly pale. Not long ago I examined a chlorotic young woman, aged 26, who died with extreme suddenness. There was an immense coagulum of blood in the middle lobe of the right side of the brain, and the part surrounding it was extremely soft. The case happened before I had read Mr. Paget's contribution, and the small blood-vessels of the organ were not examined. Dr. George Burrows has frequently observed apoplexy in pale, attenuated persons, having "the very reverse of the apoplectic make."(a) Dr. George Budd has narrated some cases of apoplexy consequent on syphilis.(b) The contribution is of great interest, as supporting the doctrine that all chronic and debilitating maladies *may* so impair the nutrition of the cerebral blood-vessels as to lead to their degeneration and rupture.

It may be well believed, that the study of the whole question of degeneration will have the best influence on the treatment of disease. Certainly we have too much closed our eyes on those organic conditions, which extremely loosen the tenure of life and too much modify the result of maladies, without our aiding them by that adventurous treatment which adds largely to the perils already existing.

Bnt now let us proceed to the consideration of those *local*

(a) On Disorders of the Cerebral Circulation, p. 143.

(b) *Medical Gazette*, May 27, 1842.

obstructions to the circulation, which occasionally constitute that true, although partial anæmia, whereunto succeed atrophy and, by no means uncommonly, fatty degeneration. The coronary artery may be so obstructed as to lead to *local* fatty degeneration of the heart,—a fact already most fully and clearly illustrated by Dr. Quain.(a) Softening of the brain has often been found connected with, and rightly considered consequent upon, a narrowing of the arteries leading to the affected part; and there can be no doubt that, generally speaking, arrestations or diminutions of the current of blood, wherever they may happen, lead to atrophy and decay. Impaired nutrition of the lower extremities has been traced to congenital constriction of the aorta. The size of parts may, to a certain extent, be figured by the diameters of the vessels leading to them, although remarkable exceptions to this exist, which are readily explained by physiology.

Mr. Simon has made the observation, that partial atrophy and softening of the kidney may be traced sometimes to the blocking up or obstruction of a small artery.

In one case, he noted a vessel of this kind "blocked completely with an atheromatous and fibrinous mass, which had probably been carried into it from some larger trunk, and had thoroughly arrested the passage of blood there."(b)

The condition of the vessels in regard to the whole question of atrophy and degeneration needs a more methodical treatment than it has yet received; it can only be glanced at here. Occasionally, we find a branch of an artery so obviously occluded, and the part it supplies so exclusively degenerated, that no doubt remains about the impairing or withering influence it has exercised. But local degeneration may occur from obstructions occurring in vessels not easily traced, nay, of those which are of quite microscopic minuteness, such, for instance, as those of the brain, described and figured by Mr. Paget as degenerated in apoplexy.(c) Nor does it follow, that the small blood-vessels should be healthy, because the large ones appear quite untouched. In several cases of ramollissement of the brain, I have observed the

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(a) "Medico-Chirurgical Transactions," Vol. XXXIII.

(b) *Op. cit.*, p. 94.

(c) *Medical Gazette*, 1850; see also a subsequent communication by the writer in the same journal for 1851.

most obvious degeneration of the minute, when there was none observable in the larger vessels; but it will be often quite impossible to say how much is due to the state of the vessels, how much to the condition of the blood itself, and how much to the defective assimilation of tissues; the latter has often most undoubtedly a large share in the process of destructive conversion.

An artery is sometimes found to diminish from the disuse or paralysis of its field of distribution; and the lessening of its size may become, in some instances, a serious bar to the recovery of a part which needs all auxiliaries to the restoration of its pristine state of nutrition.

The effect of the obstruction or narrowing of vessels is much modified by various circumstances. The consequence of the diminished calibre of a vessel may be fully counteracted by the compensatory enlargement of other channels; but if there exist, as frequently happens, a diseased state of the neighbouring artery, or branches of arteries, nature may be foiled in any effort to carry on the circulation with effect.(a) Portal refers to a case of apoplexy, in connexion with which there was discovered so great an ossification of the right internal carotid that scarcely any blood could have found way through the channel; but the vertebral of the same side was three times bigger than its fellow, and had, doubtless, supplied parts which would have perished but for its enlargement. But the heart is deprived, by an anatomi-

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(a) The serpentine convolutions which arteries are wont to make when they enlarge, are admirably described by Dr. William Hunter:—"The coats of arteries are elastic, and therefore whatever distends must, at the same time, lengthen them, and thereby produce serpentine turns. I observe that this happens constantly in injecting the vessels of dead bodies; and I have often had opportunities of observing the same thing happen from the stroke of the heart in the arteries of living animals. In the snake or viper it is very apparent in an artery that runs along the outside of the lungs, which is thrown into serpentine windings every time that it is dilated by the action of the heart." He further refers to the aorta of a woman, which, "from being enlarged, had become so long that it could not run straight down the back as usual, but made gentle windings all the way." Arterial changes like these cannot, of course, happen where the vessels are made rigid by degeneration, or are so weakened at certain points that aneurism is the consequence of the blood's impulse. See "Medical Observations and Inquiries; or Mr. Erichsen's Collection of Observations on Aneurism," published by the Sydenham Society, p. 169.

cal peculiarity, of the establishment of a collateral circulation in cases of obstruction of the coronary artery,—a fact which has not escaped Dr. Quain, who cites, in his Memoir, Mr. Swan's observation that there is no communication between the branches of that vessel, and points out the necessary consequence resulting in cases of local degeneration dependent on their being blocked up or narrowed. The like peculiarity of the pulmonary circulation has been noticed by Mr. Paget in his observations on obstructions of the branches of the pulmonary artery. "From the arrangement of the pulmonary arteries, between which there is no anastomosis except in their capillaries and smaller branches, it results that, whenever the flow of blood through the capillaries of any part of a lung is prevented, there must also be a stagnation of blood in all the branches from which those capillaries are derived; and in those circumstances the blood coagulates in the vessels, and passes through various changes."(a)

But the collateral and effectual supply of the brain and other parts in cases wherein their blood-channels are diminished, is, of course, entirely contingent. If the arteries in the neighbourhood of the diseased spot happen to be healthy, the exigency of the situation may be met; but the degeneration of vessels may be so extensive, that the conservative influence of anastamosis is wanting, and the part which is supplied by the obstructed vessel perishes as a consequence. The success of the ligature of the carotid artery must be greatly modified by the general condition of the cerebral bloodvessels, both large and small. It may be impossible adequately to re-establish the circulation through fresh channels, in consequence of their diseased or degenerated state; and the brain may be so impaired in nutrition, that any impediment to its circulation may lead quickly to softening. It was stated by Mr. Hodgson, at a recent meeting of the Royal Medical and Chirurgical Society, that, in the great majority of cases wherein ramollissement had followed the tying of the carotid artery, the patients had passed the middle age of life; and one, seeing what recent researches have taught us, may be pardoned a speculation on the pro-

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(a) "Medico-Chirurgical Transactions," Vol. XXVII., p. 163.

bable condition of the bloodvessels of those persons, and their influence on the issue of their cases. The small bloodvessels of the brain, as well as the large, might have been more or less affected by degeneration. Aneurism of the larger arteries is frequently associated with other aneurisms. Degeneration of the heart and bloodvessels generally, may be looked for reasonably in aneurismal subjects. In the case of an abdominal aneurism, which I have laid before the Pathological Society, occurring in a woman twenty-nine years old, there was found a heart degenerated into fat, and a circumscribed softening in the cerebellum, the small bloodvessels in its neighbourhood presenting distinct clusters of fat granules in their coats.

In applying observations made upon the ligature of the arteries of animals to the treatment of aneurism in the human subject, it must never be forgotten that, in the case of experiment, we operate in a condition of health. If a part be degenerated, and all its vessels more or less diseased, the artery leading to it cannot, of course, be ligatured so safely as under the favourable circumstance of perfect nutrition.

That there are local causes which must greatly modify and interfere with the circulation of the blood was well known to, and insisted on by, its famous discoverer; (a) and what may be effected by these, we see well exemplified in that general degeneration of the arterial system into

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(a) I shall cite the passage to which I here refer. Let us apply what he says of obstructed circulation to cases of atrophy, degeneration, softening, and what he observes of the altered consistency of the blood to the changed condition of that fluid which we have had too ample opportunities of examining in cholera:—"Veruntamen exinde manifestum est sanguinem, in suo circuitu, non eadem velocitate et celeritate ubique transire; ut neque eadem vehementia, in omnibus locis et partibus et temporibus; sed pro ætate, sexu, temperie, habitu corporis, cæterisque rebus contingentibus, internis vel externis, naturalibus vel non naturalibus multum variari. Non enim per vias et mæandros occlusos, obstructos aut impeditos, eadem celeritate transit, qua per apertos, reseratos, et patentes; neque per corpora aut partes densas, constrictas, infarctas, uti per raras, relaxatas et deobstructas. Neque cum debiliter, lente, et molliter sit impulsus, ita expedite procurrit aut penetrat, uti cum vi aut robore impingitur, vehementia et copia cogitur. Neque crassus ipse sanguis, aut solidior, aut terrestior factus, adeo penetrativus, uti cum serosior, attenuatus, liquidior existit."—*Gulielmi Harveii Opera Omnia a Collegio Medicorum Londinensi Edita*, *p.* 128.

which fatty conversion largely enters. But study that extensive degeneration as we will, we can never behold it as it fully exists. What! though we begin with the aorta itself, and thence trace the bloodvessels to every organ, and follow them into each, so far as we are able, and scrutinize their coats with curious attention, and, with regard to the vessels of the brain, do more, and, by microscopical assistance, bring the remotest of them into clearest view, and mark their degenerations, dilatations, and the state of their surrounding tissue, selecting them from various parts of that wide-spread and intricate vascular mesh which intervenes between the great arteries and veins of the organ, and comparing them diligently as to their different appearances, we shall, notwithstanding, be obliged to leave unexplored the great mass of blood-channels, even in this structure; and what, we may ask, is the state of the small arteries and veins of the heart, the lungs, the liver, the kidneys,—what, in a word, is the minute anatomy of all the bloodvessels of every part? It is often hard, nay, impossible, to say, whether a vessel leading to a softened part have degenerated with or before it, and especially in old age and chronic maladies, in which, frequently, the blood, and its vessels, and the places it flows to, may be held to decline simultaneously. How, for example, can we sometimes say whether the arcus senilis be really an effect, or simply an association of that atheromatous condition of the ophthalmic artery which Mr. Canton has found to be connected with it? Much might be said if the corneæ and their arteries were exclusively degenerated,—more, if one arcus senilis only were found, and one ophthalmic artery only affected; but the adipose arc or circle is connected commonly with a diffuse, all-pervading evidence of decay. Yet, in cases even of the most general kind, we shall still find local modifications; here and there vessels will be perceived unusually obstructed, and, moreover, at the express points of lesions, which are far in advance of the general decay. May not the fawn-coloured patches which significantly mottle the degenerated heart, be each, in some instances, owing to obstruction of its own appropriate arterial branch or minute ramifications? May not the circumscribed diffused softenings, occasionally seen in capillary apoplexy, be centres of an extreme vascular degeneration? The true relation of a vessel to the atrophy, wasting, and death of a

part, can be known only by completely tracing it throughout its course. Anæmia of the brain may, as Rokitansky reminds us, be produced by degeneration at the aortic orifices of the cerebral blood-vessels,(a) and, though the whole length of them seem free from disease, so far as the unaided eye can reach, the microscope may find their terminal channels more or less fatty or calcareous.

It would seem, that the state of the minute circulation has not been at all sufficiently considered in reference to the softening and destruction of parts. It has been inferred, in some cases of ramollissement of the brain, that the obstruction of the artery leading immediately to the destroyed part has been the direct cause of its death; but the only support of this position is to be found in the existence of a coagulum of blood in that artery. It is my belief, that in many cases of local death, not of the brain only, but other parts, the obstruction of the artery, or branch of artery, leading directly to the mortified spot, has been the consequence, and not the cause, of the affection. That the occlusion of the ramifications of an arterial trunk may arrest the blood in its onward course, and lead to its coagulation, is too clear to be insisted on. The mortification of a limb would necessarily impede the main artery and its branches, and fill them with coagula. More limited impediments would, of course, produce more restricted effects. Mr. Paget tells us, in his observations on obstruction of the pulmonary artery, that the branches which run to an inflamed spot of lung may become filled with coagulated blood; and, in like manner, a gangrenous part may obstruct the vessels which once nourished it. These remarks refer exclusively to cases in which the large arteries are found simply blocked up, and not to those, I need hardly say, in which they have been evidently a long time narrowed, perhaps almost occluded, in consequence of degeneration.(b)

(a) Translation of "Rokitansky's Pathological Anatomy," Sydenham Society's edition, p. 385.

(b) Dr. Marshall Hall, as I learn from conversation with him, takes the view here stated, of the manner in which the larger vessels *may* become obstructed.—(See a note in his Croonian Lectures, delivered in 1851, p. 88.) In watching with Dr. Hall the circulation of the blood in the web of the frog, I have had frequent opportunities of seeing how many causes may modify its flow through arteries, veins, and capillaries. Perhaps we can

III. *The influence of the nervous system* being most closely related to nutrition itself, must be considered in reference to its failures; and it must be regarded under the separate heads of withdrawal and derangement. Parts waste in paralysis; and we may be quite certain, that, in the general impairment of functions in old age, the wasting and degeneration of various structures are often heightened by that disuse of parts which results from the growing lethargy of the mind. To what Mr. Paget and others have remarked of the local consequences of the partial withdrawal of nervous influence, I have nothing to add; but I cannot pass over, however difficult the subject may be, the question of the disturbances and losses of nutrition effected by various conditions of the mind. How hard to define the measure of their mischief, and yet how easy to perceive that it is vast! The state of the mind often injures nutrition, in an indirect manner, by withdrawing the body from those exercises and diversions which constitute main sources of its vigour; by depressing the heart's action, so that the blood is circulated with insufficient frequency and force; by modifying the respiration so extremely, that the oxygenization of the blood is less perfect than it should be; by seriously interfering with the digestive function, the disorders of which spread through the body; and oftentimes by banishing or breaking the sleep, "chief nourisher in life's feast."(a) It cannot but be concluded, from a variety of considerations, that growth, nutrition, reparation, and decay, are extremely affected by the conditions of the mind. Practically, men act as if they were so; and the great students and expounders of human nature have drawn most terrible and striking pictures of the body withering from sorrow or despair. All ages and stations testify to their truth. Youth may anticipate both the toil of mind and the cares of manhood,

"Ante annos animumque gerens curamque virilem;"

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never truly feel all the importance of a free and sufficient circulation to a part, unless we observe carefully the wonderful scene of the blood traversing the minute vessels, as shown by the microscope. The circulation, as beheld in the toad's lung, is splendid and striking beyond description.

(a) We term sleep a death, and yet it is waking that kills us and destroys those spirits that are the house of life."—*Sir Thomas Browne.*

Sydenham emphatically says:—"Etenim post venæsectionem et catharsin nihil æque naturæ vires subruit ac noctu vigilare."—*De Podagra.*

but it is on the aged, the atrophied, the partly degenerated, that the depressing passions tell most fearfully. We cannot graduate their degrees of effect as we can measure those of heat by a thermometer: but shall we doubt their existence, because we cannot weigh their consequences in an unerring balance? We must reflect delicately on the subject of life. The best thoughts on this matter are too subtle for expression. Eloquently as Bichât wrote, he left, doubtless, much unwritten which he felt was true; and many of Hunter's greatest thoughts came, probably, when he was busily dissecting, and fled with the moment. Each transient emotion which affects the breathing, or agitates the heart, alters nutrition everywhere. Vast, then, must be the sum of such influences, to say nothing of passions which rage terribly, of griefs which time cures not, throughout a life-time never safe from emotion, no, not even in sleep! Vast the effect of some master-passion, which, concealed or visible, withers the body by its ceaseless tumult, recalling, it may be, to the minds of many, that noble passage of our famous Dryden, wherein he paints—

> "A fiery soul, which, working out its way,
> Fretted the pigmy body to decay,
> And o'er informed the tenement of clay."(a)

The plant is exempted from a multitude of sources of deranged nutrition, which are quite restricted to a higher life. It may be checked in its growth, its flowering, its fructifying, by various agencies material in their kind; it may be killed by cold, or destroyed by blight, or wither from the ungenial nature of its soil,—may be exposed to the changes and tempests of the air; but it is free from all mental vicissitudes and storms. And certain we are that the existence of man is often shortened by the adversities of his fortune, or the unhappy constitution or management of his mind; nor is the general opinion held on this point to be set down coolly amongst "vulgar errors." His life is formed by the combination of processes which, times and often, mingle together, and are lost in each other, as wave in wave; they

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(a) Absalom and Achitophel. On many matters relative to the connexion between mind and body, not a few of us, conscious that we may fail in expression, turn to the great masters of our noble language, whether they have written in poetry or prose.

cannot be compared to a number of lines placed parallel, with intervening spaces, so that all may be seen with great distinctness; nor yet to a web, such as that of the spider, in which the threads, though arranged more complexly, can all be most clearly and easily traced; but they are rather to be likened to the mingling of colours, whereby effects are caused, whereunto we perceive certain tints are essential, though we fail to discover those exact proportions which are known only to the artist who has mingled them. And so in disease,—we know often the causes, or many of the causes, which are working for death, and incessantly spoiling the wonderful structures; and yet fail of assigning, with anything approaching geometrical precision, its true part to each; they all work together so simultaneously, and with such mutual aid, the body lowering the energies of the mind, and the mind impairing the strength of the body, that we can only speak of the *relative* influence of the destroying powers as of a matter of probability; but, here great judgment may be shown, and high evidence of reason and knowledge, nor must we refrain from treating of problems because they are complex, for the whole great question of life and death might well be abandoned on this very ground.

That emotion has no less direct an action in producing secretion than in causing spasm, is plain enough. Some criminals have cried that their judges may be affected, having, as many persons have, the power of "crying at will." A strong emotion raised by desire acts similarly to that which comes in spite of us, and cannot be subdued. It is not directly by the will, but through emotion, as Dr. Carpenter observes, that the lachrymal secretion is really excited; and I know from experiment that this is true.(a) In the same manner, we can act on the heart's action, not voluntarily, but by exciting some strong feeling or other of

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(a) See Dr. Carpenter's article "Secretion," in Dr. Todd's "Cyclopædia." That many diseases become extraordinarily aggravated by conditions of the mind, has been long known to our greatest observers. Sydenham, speaking of the treatment of gout, observes: "Quinimo animi tranquillitas omni ope stabilienda est," etc.—Opera Omnia. Edition of Sydenham Society, p 439. The proneness to infection produced by fear and anxiety also bears upon this question of the effects of nervous influence on nutrition.

the mind. Idiots, imbecile and weak persons, are proverbially given to tears, and they are also peculiarly prone to involuntary muscular action; and the emotion of dreams has peculiar power, not only over the secretions, but the muscles also, for the will interferes not with it. Effects of the influence of true emotion we see every day; states of the salivary, mammary, menstrual, hepatic, and renal secretions, are no equivocal witnesses of its power; and, certainly, the reparation of accidents and operations is much influenced by the mind, and, I think, directly; if the secretory processes be thus affected by it, why should not those of nutrition and repair? The effects of mental attention on the bodily organs have been treated of expressly by Dr. Holland;(a) but, with regard to some of these, it is hard to say that they are really consequences of *pure* attention. However this be, *attention* fixed on organs diseased or disturbed in function, has often the worst influence. At the time the physician would have the heart of a patient equally beating, it is frequently thrown into irregular and violent action by the mere circumstance of the *attention*, unassociated, it may be, with *conscious* emotion, being fixed upon it; and it has often struck me, that profound sleep would be the best time for ascertaining some conditions of the organ.

Lallemand, Rostan, and other writers, count grief among the causes of ramollissement; and it is very easy to conceive a part already weak in power of assimilation, and just able to maintain its life, perishing quickly from that general weakening of the vital functions which sorrow or over-occupation may produce; or "from the disturbance of the nervous force indirectly interfering with the process of nutrition, inasmuch as this force exercises always some influence on the nutrition of each part, and is (as one may say) one among the plasturgic forces."(b)

Occupation, as well as emotion of mind, must be considered in reference to atrophy and its results. That the nutrition of the brain and other organs may be most seriously impaired by over-study is beyond question. But most employments of the mind imply emotion, though it more

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(a) "Medical Notes and Reflections."

(b) "Lectures on Inflammation," p. 55, by James Paget.

predominate in some cases than others; the school of arithmetic and the world of politics act, of course, very differently. Dr. Forbes Winslow has written a monograph on "softening of the brain arising from anxiety and undue mental exercise;" and there can be no doubt that, in many instances, threatened softening is only to be averted by an instant retreat from the toils of business, from anxiety I dare not say, for from this there is, too frequently, no refuge. But many cases of incipient ramollissement have been mistreated by everything that favours atrophy,—by low diet, blood-letting, and unsparing mercurials,—and so nature, already exhausted dangerously, has been exhausted more.(a)

The instances referred to are those happening at a late period,—instances, some of them, of pure degeneration or local death. But there is no season, save that of infancy and the dawn of childhood, which is secure from the atrophy of mental toil, the excess of which has often, no doubt, hastened death greatly. Southey, speaking of Kirke White, plainly says: "Cambridge finished him." "Peace has her victories no less than war," and, like war, she has her deaths also. Pale students pine in miserable garrets, and die of atrophy. But the saddest of all the instances of defective nourishment, and the ills it leads to, is that produced in earliest youth, or childhood even, by, what is termed courteously, "education." To hear a pale, languid, spiritless boy recite long passages from Virgil, with a tone of monotony never relieved, and an emphasis ever in the wrong place, can only give pleasure to those of his mistaken rela-

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(a) Dr. Quain observed, in the discussion which followed the reading of this paper, that "the relation of the mind to the disease of the heart in question (fatty degeneration) was one of great interest. It had happened to him to have met with several cases of degeneration of this organ in individuals who had suffered much mental anxiety. In three cases the degeneration was such as to have led to rupture of the heart; such individuals may be said literally to have died of a broken heart." Emotions may, by frequently disturbing this organ when degenerated, add greatly to the exhaustion of its action, and yet more lower its nutrition, and increased its degeneration correspondingly. Again, the heart, enfeebled by degeneration, impairs the nutrition of the body generally, and the latter re-acts upon it; and, however simple the process of decay, the complexity of its causes is often extreme.

tives or friends who seem to think that it takes not less genius to remember the Æneid than it did to compose it.

As to the mischief of attempting to "force" the intelligence, much as plants are forced often in hot-beds, I may well cite the high authority of Dr. Holland. "We find, in Quintilian, a writer ever of sound and enlightened judgment, many valuable precepts as to the cultivation of memory, and an earnest reprehension of attempts at a premature development of this or other faculties. The phrase he applies to such precocious growths, 'Inanibus aristis ante messem flavescunt,' has its exact counterpart in Lord Bacon's description of 'that over-early ripeness in years which fadeth betimes.'

"In the course of my practice I have seen some striking and melancholy instances of the exhaustion of the youthful mind by this over-exercise of its faculties. In two of these, unattended with paralytic affection, or other obvious bodily disorder than a certain sluggishness in the natural functions, the torpor of mind approached almost to imbecility. Yet here there had before been acute intellect with great sensibility; but these qualities forced by emulation into excess of exercise without due intervals of respite and with habitual deficiency of sleep."(a) Exercise is, no doubt, the power of the mind; but, when carried perpetually to the pitch of exhaustion, the brain may become damaged, perhaps irreparably, and the mediocrity of manhood forms a painful contrast with the brilliancy of youth, and the decline of the faculties comes long before its time.

IV. There is a *failure of assimilative power* in cases of fatty degeneration proved often by the obviously unhealthy or declining state of the part to be nourished. This failure, whatever may lead to it, is always the immediate and necessary precursor of degeneration. But whether a part be unable to assimilate, from the want of material, or power to appropriate it, makes clearly all the difference.

It may not be useless to pause here for a moment, to say a word or two of nutrition itself. "And what more need be adduced," observes a famous author, "to explain nutrition and the production of the different humours of the body, be-

(a) "Chapters in Mental Physiology," p. 158.

yond saying that the force with which the blood, in being rarefied, passes from the heart towards the extremities of the arteries, causes certain of its parts to remain in the members at which they arrive, and there occupy the place of some others expelled by them; and that, according to the situation, shape, or smallness of the pores with which they meet, some rather than others flow into certain parts, in the same way that some sieves are observed to act, which, by being variously perforated, serve to separate different species of grain.(a)" So wrote Descartes, who could put an assumption, no matter how extravagant, with all the clearness that he could paint a truth; but the notion here stated, unworthy of him, surely, who developed with such power the celebrated doctrine, "*je pense donc je suis*," (b) may find its rival for inaccuracy in the writings of those who, in treating of various changes of structure, have entirely excluded the tissues themselves from any share whatever in the process, either speaking of mere deposition from the blood, or following Mr. Hunter in his erroneous views of the "affections and actions" of arteries.(c)

It would be a mere useless and vain digression, to refer to the process of nutrition here, were it not that we must ever keep its mode of performance, so far as it can be arrived at, before our view in speaking of its failures. It is even now enough with some persons, to speak of one form of structure being taken away, and another left in its stead; no matter how vague their notion, provided it can be expressed concisely and with gravity. They are free altogether from that "restless spirit of research which has reached the cell, the foundation of organised structures."(d) They are incurious as to its growing by its own power, and yet obediently to the

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(a) See "Discourse on the Method of Rightly Conducting the Reason," p. 95, Edinburgh, 1850; or, "Discours de la Méthode, Œuvres," p. 36, Paris, 1851. We must no more judge of the general merits of Descartes from this passage than of those of Lord Bacon from various portions of the "Sylva Sylvarum," a Work which Lord Brougham has justly censured for its "superficial examination of facts, a hasty induction, and a proneness to fanciful theory."—"Discourse of Natural Theology," p. 148.

(b) "Pour penser il faut être."

(c) See, for example, Works, Palmer's Edition, Vol. I., pp. 216, 217; and several passages in Mr. John Bell's "Discourse on the Unlimited Growth of Tumours."

(d) Liebig, "Letters on Chemistry," p. 273.

design, and clearly for the good, of the general organism(a) —here developing into one structure, there into another, yet so that each part is perfect, and maintained in identity, save disease or decay interpose to hinder, from the first to the last. They dismiss the question of vessels being merely suppliers of nutrition, which is really an extra-vascular process, for it is more convenient to assume the contrary. They speak not of symmetrical defects or aberrations of nutrition,(b) for they have a liking for the word sympathy, whereby ignorance apologises on so many occasions, and which should be restricted entirely to mental states. They refrain from contemplating the germ-power, and the influence it exercises through all our being, preventing degeneration, causing growth, maintaining nutrition, assisting in the processes of reproduction and repair, and, in the end, by its own languishing, tending to gradual decline or death.(c) To the large and curious question of definite life, they never address themselves, even by chance, unless when imagining what is likely to be the term, either of their own being or that of some others in whom they may take interest. In brief, though it may be their special province to treat the diseases of man, they give really no more than a few stray thoughts to the great problem of how he lives, and hardly ask ever why he dies, except when mystified by a *post-mortem* inquiry. It is not to be expected of such persons, that they will be bothered by tracing the subject of degeneration through a long labyrinth of great complexity.

Would we understand the defects of nutrition, we must first learn, so far as it be possible, how it is carried on. If cell-germs, or nucleated cells, be really, as is thought, essential to the due nutrition of tissues, it might be well supposed, that some changes would occur in them which precede degeneration; and Mr. Paget has remarked a dimness of the outline of the nucleus, a loss of its colour, and, lastly, its disappearance, as forerunning the conversion of

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(a) Schwann on the "Structure and Growth of Animals and Plants," Edition of the Sydenham Society, p. 40.

(b) See contributions on the Symmetry of Disease, by Dr. William Budd and Mr. Paget. "Medico-Chirurgical Transactions," Vol XXV.

(c) Mr. Paget's Lectures on the "Processes of Repair and Reproduction," Lecture I.

the heart-fibres into fat.(a) This observation, if true of the heart, will hold good of other parts also. Nutrition, thus checked in the nuclei, may be termed crushed in the bud. The history of the growth and development of the uterine fibres, as described by Mr. Rainey, and the observations of this observer, confirmatory of those of M. Kilian, respecting the fatty degeneration they undergo previous to their disappearance, strengthen the view set forth by Mr. Paget in relation to the connexion between the vanishing of the nucleus and the destruction of the fibre. The fibres of the unimpregnated uterus are nucleated; those of the organ at the full time present no nuclei; while those which have been examined subsequent to parturition have been found, as Mr. Rainey himself showed me, degenerated into fat. Thus we see the successive stages of life, and growth, and death. And so some hearts and bladders, even as the uterus, do really become hypertrophied up to a certain time, and then, as if exhausted by their forced enlargement, degenerate and perish.(b)

There is something so amazing in the effects of the germ-force, that it is far from surprising that so many writers should have risen to eloquence in referring to it. Sir Thomas Browne devotes the sixth chapter of his "Vulgar Errours" to a refutation of the absurd popular belief, that "a bear brings forth her cubs informous or unshaped." The idea seems to have been, that she "fashioneth them after by licking them over." "Men hereby do" (says Sir Thomas) "in a high measure vilify the works of God, imputing that unto the tongue of a beast which is the strangest artifice in all the acts of nature; that is, the formation of the infant in the womb, not only in mankind, but all viviparous animals. Wherein the plastic or formative faculty from matter appearing homogeneous, and of a similar substance, createth bones, membranes, veins, and arteries; and out of these contriveth every part in number, place, and figure, according to the law of its species; which is so far from being fashioned by any outward agent, that one omitted or perverted by a slip of the inward Phidias, it is not reducible by any other whatsoever: and, therefore, 'Mire me plasmaverunt manus tuæ,' though it originally respected the generation of man, yet is it appliable unto that of other animals, who, entering into the womb in bare and simple materials, return with distinction of parts and the perfect breath of life."

(a) See Lectures on Nutrition, *Medical Gazette*; Dr. Quain, loc. cit., p. 146; and the Supplement to Professor Muller's Physiology, by Drs. Baly and Kirkes, p. 127.

(b) See Mr. Rainey, "On the Structure and Use of the Ligamentum Rotundum Uteri, with some Observations on the Change which takes place in the Structure of the Uterus during Utero-gestation." Philosophical Transactions, Part II., 1850, p. 515.

As of an individual, so of a part,—the healthier it is, the more likely is it to remain so; and the converse is certain. The parts contingent upon those which are degenerate, are far more liable to quick decay than those which form portions of well-nourished structure, for the reason, that the causes which have led to the death of the destroyed tissue, have probably begun to affect them also. The microscope shows us many stages of degeneration, but not the very earliest; the first of all is an atrophy, which would certainly have no visible influence on the spot involved. Two muscular fibres may appear alike, and present to view all their striæ; but to say that therefore they were nourished with exactly equal perfection, would be transgressing reason.

A tissue, once converted completely into fat, may be held to have perished irrecoverably. How can the sarcolemma of a fibre, once crammed with useless oil-globules, become re-filled with irritable tissue? Signs of decay they are, but never, surely, centres of reparation. Our hope, in all cases of degeneration, lies, not in the future changes of the part destroyed, but in the efforts of the bordering tissue; in other words, not in absolute death, but reparable atrophy. Time is, when degeneration of the heart is faint and partial, a slight touch merely of what we behold often in the full and fatal consummation of decay. Many fibres are sound, most to be strengthened. The cause of degeneration may be removable; perhaps it is anæmia, perhaps fever. Nothing may obstruct the blood's progress in the heart; that blood is improveable, and must be changed.

There are other cases not so hopeful: the arcus is present; the decay more general; life's forces more spent; but here much may be done often. Iron, and rest broken by only what diverts the mind and exercises the body without causing fatigue, and change of scene and pure air, and other well-known restoratives, may effect much; nay, do effect much often, arresting the atrophy which would have become degeneration, and staying the latter where it has begun.

And be it observed, that a great amount of degeneration is by no means incompatible with life's endurance; the blood-vessels of the brain may be extensively spoilt long, very long, before apoplexy appears; and existence, though it be one of peril, is protracted often, despite a marked degeneration of the heart. But the least decay is no light

matter, so quickly may it progress and kill; and we must act often on the bare suspicion of it, supposing a vital part to give even the least sign of failure. How important is any clue to a real knowledge of the incipient change! How worthy of noting the arcus senilis, as not rarely, probably, showing that identical form of destruction beginning elsewhere! In many cases, all that can be done effectually must be early done; we must not wait for recurrent and oppressive dyspnœa, for angina pectoris breaking the sleep, for attacks of syncope which are death's similitudes. We must not delay until no remedies can act, and then say coolly that degeneration is incurable. Its causes and progress, unlike that of a cancer, may often, doubtless, be more or less controlled.

Generally speaking, the most manageable cases of degeneration must be those of early life, but the rule is far from invariable. There are two results of imperfect assimilation which may affect the young as well as the old, though the latter, doubtless, the more commonly. There may be a narrowing of the coronary artery, leading to degeneration of the fibres it supplies, and there may be no hope of repair, for the plain reason, that enrich the blood as much as we will, we cannot circulate it through the decaying place. Or an artery, partly from fatty degeneration, may become disorganised at a small spot, and, with or without previous aneurism, though the general health fail not, and there be no indication of mischief anywhere, may be weakened until it burst; and so happen some apoplexies in early and middle age. Thus, *local* degenerations are often at once the most unsuspected and the worst, rupturing the hearts which, as a whole, are healthy, or destroying by the production of some limited, untimely mischief in the generally well-nourished brain. Wherever we find atrophy, it should, if possible, be stayed at once; always let it be regarded as an approach of death, no matter whether it concern a fibre, or the complex anatomy of all the frame.

It is quite necessary, so well as we are able, to consider defective assimilation, taken separately, as a cause of degeneration, fatty or not; but it is, in many cases, extremely difficult to say how much of decay is fairly attributable to meagre supply, how much to the ineffectual use of it. But that eclectic power whereby parts abstract, and that special pro-

perty by virtue whereof they perpetually renovate themselves, must always be taken into reasonable account. Could we suppose the blood of youth infused to fulness into the vessels of age, and there circulate as the old blood did, we should not go the length of concluding that the tissues would be nourished as those of the young; and this simply because the parts are unequal to the task of assimilation. And it is clear, on the other hand, that the most perfect organs would soon retrograde, if their blood were either too scanty or too poor.

Although it is very instructive, and even necessary, to consider separately the various causes which may lead to degeneration into fat, we shall, in the course of pathological investigation, have most frequently to make due allowance for the results of *combined* influences. Thus, where severe anæmia long prevails, defective assimilation may soon ensue, and aid the degeneration originally dependent, and exclusively dependent, on the altered blood; where an artery is obstructed, the blood is frequently impoverished too; and all local causes of atrophy and decay are immeasurably assisted by impairment of the state of the general health, and can only be influenced for the better by improving it. In old age, we frequently see this form of degeneration more or less general; and it may there be produced, partly by the impaired condition of the blood, partly by its sparing quantity, partly by the withdrawal of nervous influence, partly by that enfeeblement of those vital functions, the digestion, respiration, and circulation, whereunto the atrophied condition of the system tends, though, in considering this matter, we must not forget that law of our being whereby it happens that decay is certain within a tolerably definite limit of time. It is not pretended that old age always destroys by fatty degeneration, but only that it does so very frequently; and, no doubt, in a very large number of cases the degeneration present is of different kinds, though the fatty largely predominate. Mr. Canton, in examining microscopically the cornea of the aged, did not find fatty conversion in that structure only, but in various parts, especially the heart. Dr. Barnes has taken occasion to observe, that "long-continued observation and accurate analysis have established the hereditary nature of insanity and phthisis. Our acquaintance with fatty degeneration is

too recent and too little advanced to admit of any extended investigation into the transmission of this disease to successive generations." (a) Death is for ever transmitted with life; and fatty degeneration is doubtless inherited, though not as a peculiarity, as *some* diseases are, (b) for all who grow aged are extremely likely to present it in some form or other.

I have before me the notes of the examination of the body of a man who died from accident at the age of 84. I saw the blood-vessels of the brain, which were minutely examined by Dr. Charles Shearman. Both large and small were extensively degenerated. Softening or apoplexy might have been impending. The fibres of the heart, too, were extremely fatty; a fatal syncope might have occurred at any time. Renal degeneration had far advanced, moreover; he might have died from the coma of unpurified blood.(c) And we shall often remark, in examining old and shrivelled or grossly corpulent bodies, that the immediate cause of death is but the result of that condition of decay which is prevailing everywhere; and, though it may be retarded for a while, must, of necessity, progress. There are remedies for some causes of atrophy, which may be presumed to have led to more or less degeneration. There are repose for fatigue; iron for anæmia, with its many adjuncts; fresh air and change of scene, and various tonics, and generous diet for those who may be convalescent after long fevers; but what shall arrest the course of time, or what do more than render its decay more lingering than it would have been? And yet it is wonderful how circumstances are mutually adapted in old age, so as to protract it to the very utmost. The motor force much diminished, and, in some instances, dangerously languid, is economised as much as it can be; the muscles impaired greatly in irritability are maintained at rest; the

(a) "Medico-Chirurgical Transactions," Vol. XXXIV., p. 192.

(b) I refer to affections such as those mentioned by Dr. Holland, in his chapter on Hereditary Disease. "I am acquainted with a family, in which there are three examples—the father and two children—of inability to distinguish red as a colour. Another example, resembling the last, is known to me, where three brothers, and two or three children of their families, have the inability to distinguish between blue and pink."—Medical Notes and Reflections, p. 23.

(c) I shall have again to refer to this interesting case, because of its being a good type of a vast number of others of a similar kind.

heart beats, undisturbed by those passions which gave irregularity of action to its youth; the blood, diminished considerably in quantity, flows gently through the vessels of the ill-nourished, perhaps softening brain, as if considerate of the weakness of their walls; and the exertion of forces is in every way adapted to the weak condition of the dying structures; but every moment death claims something and life yields it; every moment there is risk of a sudden ending of this quiet method of passing away. I speak, of course, of extreme age, or, at any rate, of such as is plainly attended by most absolute decline; not of the old age on which Cicero dwelt with such eloquence and delight:—"Non facit ea quæ juvenes, at verò multo majora et meliora facit."(a)

In the impaired nutrition of the brain we have the solution of the mind's failures, just as in that of the heart we have the explanation often of a circulation sluggish and liable to cease. That some men, up to a very late period of life, continue to exhibit extraordinary powers, is known to all in any way acquainted with the great efforts of several of the foremost of our public men; but age too often and plainly shows us the many infirmities of our dependent nature, "fears of the brave and follies of the wise;" and Johnson wrote with no exaggeration, when he drew so darkly the drivelling of Swift, and the tears of dotage which were wept by Marlborough.(b)

Scarcely are we developed into the vigour of life, ere we begin to indicate our mortality. To live a century is to be a wonder. The uterine fibres are developed, and grow, and disappear in a set time,—presenting a most marked and striking instance of limitation of life.(c) The ovaries have a cycle of defined existence, and then wither and die; and so the whole body has its line of being, not to be exceeded save in most rare and exceptional instances. But a multitude of circumstances infringe the definite term of man. All, in

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(a) De Senectute.

(b) A very touching account has been given of the decline of Southey: "One circumstance connected with the latter years of his life deserves to be noticed as very singular. His hair, which previously was almost snowy white, grew imperceptibly darker, and I think, if anything, increased in thickness, and a disposition to curl."—Life and Correspondence of Robert Southey, Vol. VI., p. 390.

(c) See Dr. Carpenter and Mr. Paget on the Definite Life of Tissues.

plain language, have not the same chances of living long. The Registrar-General knows well enough where death is earliest and most resistless. It can only be said as a figure of poetry, "*æquo* pede pulsat." That life may be protracted, we must observe strictly those unchangeable conditions whereby only we remain its tenants. Hereditary influences and diseases kill us; early dissolutions run uniform in families. Our development is "sketched out, as it were, beforehand,"(a) and our days are numbered ere our evolution. Turn we to the pursuits which favour existence, and we shall find their influence extremely modified by the different constitutions of various individuals. Lord Bacon was most curious about longevity, but nothing more came of his treatment of the question than another demonstration of its insuperable difficulties.(b) As we descend the scale of being, the disparity of duration in each species may be considered less, and in plants it is probably least of all.(c) But we have to note that animals, imprisoned for spectacles, are doomed frequently to untimely destruction. The care of

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(a) Humboldt's Cosmos, Vol. I., 7th Edit., p. 60.

(b) He makes an allusion to the long age of many lunatics, which is not without interest. "In Hospitali Bethleem, ad suburbiam Londini, quod in sustentationem et custodiam phreneticorum institutum est, inveniuntur de tempore in tempus multi ex mente captis fuisse longævi."—Historia Vitæ et Mortis.

(c) Mr. Hunter observes: "But there must be a period for a bee to live. . . . . I even consider that no individual insect of any species lives one month longer than the others of the same species."—On the Life of the Bee, Works, Vol. IV., p. 465. It has been asserted, that the queen-bee never dies; but a most amusing writer speaks of "being fortunate or unfortunate enough to have handled a royal carcase." It was unnecessary, certainly, to add immortality to her majesty's already many prerogatives: an observer says of her subjects: "To witness them pay homage to her as she walked round in the open air, pleased me exceedingly."—See "Honey-Bee," reprinted from the "Quarterly Review." Sir Thomas Browne has a curious chapter on the long life of the deer, in which he rightly remarks, "Where long life is natural, the marks of age are late; and when they appear, the journey unto death cannot be long. Now the age of the deer (as Aristotle long ago observed) is best conjectured by a view of the horns and teeth." —"Vulgar Errours," Chap. IX. Many circumstances, of course, interfere with our calculation of the proper age of animals. "The natural term of a hog's life," says Mr. Gilbert White, "is little known, and the reason is plain—because it is neither profitable nor convenient to keep that turbulent animal to the full extent of his time."—Natural History of Selborne, Letter LXXV.

their keepers is one thing, but the way of their nature is another.

All the various degenerations of the tissues of the aged, together with their consequences, still need explicit comment. The brain undergoes a fibrous degeneration; so does the heart; so do the voluntary muscles. Earthy degenerations, too, are common enough. "The frame of man, in its natural decay, loses the characters that once distinguished it from the dust; and, not less literally than truly, it becomes more and more 'of the earth, earthy.'"(a) Fatty degeneration, taken alone, destroys, no doubt, innumerable persons; it undermines gradually; it kills by apoplexy or rapid syncope, or it so lowers, that the least shock or inflammation may be mortal.

When we find, that scantiness or poverty of blood, chronic diseases, old age, and everything whereby the nutrition is impaired, favours the conversion of tissues into fat, we might safely conclude that atrophy, in one form or other, was its cause, without going further. But there are facts and experiments too confirmatory of this view to be passed over. And now I have arrived at a part of the subject, which Dr. Richard Quain has illustrated with no less ability than success, and I must refer to his Memoir(b) for a full statement of what I can touch upon but briefly here. It appears that the hearts of the dead can be converted into fat just as those of the living, and that the change which takes place is so similar in *appearance*, that a practised eye might be perfectly deceived. "The degeneration," says Dr. Quain, "differs from that of life in one thing only—in being universal." Now, a universal change would be incompatible with existence, and therefore could never happen during it, although it often prevails to an extent which makes us wonder how the circulation could have been carried on; many fibres, still irritable, there always must be in those who live. If any one will turn to the Memoir I am quoting, and compare *Fig.* 3, *b*. *Plate* 1 with what is represented in *Fig.*, 1, *Plate* 5, he will perceive, that to tell whether degeneration happened during life or after death, by a mere comparison of fibres affected in the extreme, and without any

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(a) "Age" by Dr. Symonds; "Todd's Cyclopædia."
(b) Loc. cit.

reference to the extent of the affection or other matters, would be plainly impossible. But under what circumstances may we expect this change to happen after death? I must illustrate one of them in Dr. Quain's own words. "A little more than two years ago, I obtained, for the purpose of examining the healthy structure of the tissue, the healthy heart of a healthy child, who had died a few hours previously from the shock of a severe burn. Having satisfied myself on the required point, I placed the specimen in weak spirit and water (one part to eight or nine), for the purpose of future examination. On looking at the specimen after a few weeks, I found it greatly changed; it had a confused, granular aspect; to such an extent, indeed, as to lead me to feel, that there must be some error in previous observations on the subject of true degeneration, as portions of a healthy heart now exhibited characters so similar. I found, however, that this change existed in all parts of a heart, which I had no doubt had been healthy, in some parts at least, when previously examined. I mentioned the observation to Dr. Williams, and was gratified at hearing from him, that the fact of this change was an illustration of an experiment which he had suggested to his clinical assistant, Mr. Edward Palmer, some time previously, viz., to try whether fatty matter was not formed after death by a molecular change in animal tissues kept excluded from the air, but exposed to moisture."(a)

Dr. Quain compares the fat so produced to the adipocire into which muscles have been long known to become changed, their moisture being maintained and air excluded.

This change, although not seen until lately in its true and wide pathological meaning, has been very long known and observed.(b) But the conversion of muscles into this fatty

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(a) "The same idea has been entertained and clearly expressed by Dr. Hodgkin, in the Seventh Report of the British Association, and will also be found in his 'Lectures on the Morbid Anatomy of the Serous and Mucous Membranes,' Vol. II., Part 1, 1840, p. 539. The fact of finding a fatty liver in a preparation which did not seem to be such when taken from the body, contributed to the formation of this view."

(b) Mr. Quekett refers to the conversion of muscles into adipocire in his recently published lectures on Histology, p. 201; and Professor Liebig especially alludes to it. "When," he says, "the cemetery of the Innocents at Paris was removed from the interior of the town to the outside of the

substance, is only one instance of the many chemical changes which the loss of life exposes to. In gangrene, as in death of the body generally, new combinations form; but, so long as due nutrition lasts, all changes are prevented but those proper to and preservative of life. Not that there is no death within the body,—not that we keep the same parts always, but that renewal ever balances decay, until that period of our being when death, in a strict sense, may be said to begin; for we must not regard the act of dying as consisting of the sinking and struggles of the few last moments, but as one stretching over, save some rapid diseases interfere to prevent it, a long space of time, and, for the most part, silently proceeding.

When we view the changes of the fatty heart as produced by Dr. Quain, we note an effect caused to a certainty by our command of favouring circumstances. There are no circulation, no nervous influence, no process of assimilation to antagonise. All the fibres are exposed to one influence, and all are destroyed. In life it is different; the forces of life and death strive always, and very often with a varying success. The change is not always, therefore, uninterruptedly progressive. The fibres, too, often are differently situated; some are better supplied with blood than others; some yet assimilate and long resist; while others about them yield to decay. The alteration is, therefore, partial. Occasionally the colour of the heart shows this;—there are spots of redness which were seats of life; fawn-coloured spots, too,—soft, fragile, granular on being broken, and not looking in the least like fibre, which, in truth, they are not, and of which death had taken possession. Again, there may be a variety of changes to be seen, even in the sarcolemma of a single fibre; here striæ are becoming faint, there fat granules show the consummation of destruction. And yet, in the living as in the dead, the molecular changes may be regarded as the same, and essentially the same in cause; and we know some circumstances producing them in the

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barriers, the buried corpses, which had accumulated to a depth of sixty feet, were found to a great extent apparently converted into fat." * * * "This human fat was employed to the extent of many tons by the soap-boilers and tallow-chandlers of Paris, for the manufacture of soap and candles."—Op. Cit., p. 214.

former, even to a certainty; others which favour them with great probability. When a muscle, to repeat what I have said before, is preserved after death in a state of moisture, and kept from air, adipocire usurps the place of its fibres. Now, this is very nearly the virtual condition of some muscles in life-time. They are preserved moist, and from the influence of the atmosphere, unless we speak of such indirect influence as this may exert on them through the circulation; the blood still reaches them, but it may be either in spoiled quality or languid stream; the nervous influence is withdrawn or deranged, and the fibres, their assimilation being at an end, degenerate and die. This is the case with the heart often, which cannot be rested, even for a moment, so imperative, so all-essential is its action; and yet it must work on, no longer recruited, as once it was, and threatening always to cease suddenly. If the physician does not watch with interest the changes depicted in this small field, how is it to be expected, that he will adequately study them on a larger scale, that he will seek after them with microscopic eye, and yet with a mind that would, wherever possible, make every use of minute appearances, provided always they be understood completely, in illustration of a grand and comprehensive law?

Mr. Hunter, in his very important paper on "the Digestion of the Stomach after Death," the title whereof is extremely characteristic of his peculiar and often most happy language, speaks of the resistance which is made by life to chemical processes (partly it might be said, I think not improperly, through chemical processes of its own) in that terse and emphatic manner, wherein his earnestness, not less than his extraordinary originality of thought so frequently appears. "Were not the living principle capable of preserving animal substances from being acted on by the process of digestion, the stomach itself would be digested." But he would seem to have gone too far when he observed, that "the diseases of an animal body (mortification excepted) are always connected with the living principle, and are not in the least similar to the changes which take place in the dead body." Now, the experiments of Dr. Quain, together with the whole tenor of his observations on degeneration, show that this passage is too unqualified, if the word "disease" can be truly applied to fatty conversion or

change; but I doubt whether Mr. Hunter would have himself so used it in reference to our subject. Most likely, judging from his general most philosophical mode of treating topics, that he would have spoken of it as a premature or normal decay, as Mr. Paget has already done. However this may be, it cannot be doubted, that Dr. Quain has shown clearly and fully the truth of a remark which the great physiologist previously makes:—"An animal body undergoes changes after death, but it has never been sufficiently considered what those changes are, or how soon they may take place."(a)

The lower the organisation of a part, or supposing it be highly organised, the weaker it be from the effects of atrophy, the more likely it is to degenerate, for the nearer its state is to that of death. "When," as Dr. Quain observes, "the vital power which belongs to these higher products of animal organisation is weakened or destroyed, they yield to the physical and chemical influences which surround them, and, by an inherent principle, descend into a class which is shared by them in common with plants and minerals." The same author cites the following facts, in order to show, that parts within the body, before death, may become converted into fat in the same manner wherein parts do afterwards. A formation of fatty matter in the blood has been noticed at the expense of the albumen. Fat has been seen in "softened tubercle, pus, atheroma, and gangrene of the lungs, as being derived from the debris of animal matter, as in the conversion of flesh into adipocerous matter." Fat has been found in "masses of fibrin, non-vascular tumours, the walls of arteries, in situations in which its presence could not be deemed the result of a deposition from the blood." Certain parts of a medullary cancer of the

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(a) Works of John Hunter, Vol. IV., p. 117. But Mr. Hunter's observation hold good generally; and it may be said of all his views of life, that they should be earnestly studied. Plain language has been expected from him where the subject admitted of nothing explicit. Just was his censure of the "mechanical" philosophers. By nothing physical or chemical can we fully explain the phenomena of life, though physics and chemistry, undoubtedly, teach us much about them. See Dr. Pereira's edition of Professor Matteucci's Lectures, p. 11. "No chemist on earth can make out of the earth a piece of sugar, but a vegetable can do it."—Hunter's Works, p. 217.

liver were found to consist almost entirely of oil globules. "Infinitely more numerous fatty globules" were noticed in "the central softened portion of a large mass of tubercle from the kidney, than in those parts where the softening had not commenced." The fibrin effused from inflammation of the membranes of the spinal chord has become changed into fat, and so have adhesions from chronic peritonitis. The same conversion has happened to fibrin from hæmorrhage. The fatty change has been shown by the microscope to be similar to that observed in degenerated muscular fibre. (a)

It would not be difficult to add to these instances. Lehmann speaks of "pathological depositions of fat,"(b) but in many cases wherein fat is found, it could not have been "deposited," using the word as ordinarily employed.

Dr. Barnes gives an example of fibrin in the placenta undergoing fatty degeneration.(c) Dr. Johnson has more recently remarked, that "it is by no means improbable that the fatty matter which is found in the arterial canals (speaking of affections of the kidney) may result from a molecular change in some constituents of the stagnant blood contained in the vessels."(d)

Facts of this kind must be borne in mind in studying the conversion of the tissues into fat. Taking death as a central point wherein this process may be observed, nay commanded, we may perceive non-vascular products, tissues of low and feeble vitality, parts more highly organised, but reduced in nutrition, some less, some more, all ranging around it, and concurrently testifying, though very often under most varying circumstances, and with unequal force,

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(a) These interesting examples of conversion have been drawn from observations made severally by Dr. Babington, Dr. Williams, M. Rokitansky, Mr. Paget, Dr. R. Quain, Dr. Copland, and Dr. Archibald Hall. See a more precise account of them in Dr. Quain's Memoir, "Medico-Chirurgical Transactions," Vol. XXXIII., p. 144.

(b) Physiological Chemistry, translated by Dr. Day, Vol. I., p. 252.

(c) Loc. Cit., p. 201.

Dr. Tyler Smith showed me a well-marked instance of conversion of placental fibrin into fat.

(d) Gulstonian Lectures, Lecture II.—*Med. Times and Gazette*, April 24.

See also Mr. Simon on the "Ulterior Changes of Fibrin."—Op. Cit., p. 102.

to the one inference, that as death itself produces a state in every sense favouring the conversion in question, so atrophy in the living, that frequent origin of local destruction, leads to a change which is *virtually* the same.

PART II.

It would be hard to name any subject which has made quicker or surer advances than that of fatty degeneration. It must soon occupy a place most conspicuous in medical lectures. There must be less dread of the evils of plethora, more fear of the languor and failure of nutrition. Fatty degeneration, *as affecting the vascular system*, forms a large chapter of our subject,—arteries, veins, and the intermediate vessels, are all prone to be affected by it. Not only has this form of decay been observed in the *small* blood-channels of the brain, the structure of which is so highly favourable to the examination of them, but also, and since my last communication to this Society,(a) in those of the placenta and lung, as has been shown in the contributions of Dr. Barnes(b) and Dr. Dittrich.(c)

Dr. Barnes's paper is entitled, "On Fatty Degeneration of the Placenta, and the Influence of this Disease in producing Abortion, Death of the Fœtus, Hæmorrhage, and Premature Labour;" and he states enough to show the great pathological import of what may be termed a new branch of the subject. It is not, as may be seen, extra-uterine life alone which is perilled and destroyed often by fatty degeneration; intra-uterine existence may become lost

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(a) "Case of Softening of the Brain; with Observations on Fatty Degeneration, in its Relation to Softening and Apoplexy." *Medical Gazette*. 1851. But first see the contribution of Mr. Paget, *Medical Gazette*, 1850.

(b) "Medico-Chirurgical Transactions," Vol. XXXIV.

(c) "Ueber den Laennec' schen Lungen-Infarctus und sein Verhältniss, zur Erkrankung der Lungenarterie, von Dr. F. Dittrich, Erlangen," 1850.

through it, to an extent which, in the present state of the inquiry, we cannot calculate : but it may be presumed a large one, if only for the reason, that, where fatty degeneration has been found at all, it can for the most part be commonly discovered.

The changes which may take place in the placenta and its vessels have been well described by Dr. Hassall: "In the placenta affected with fatty degeneration, certain of the lobes, in place of presenting the red spongy texture of healthy tissue, exhibit a fatty appearance, and are of a yellow colour, glistening, firm, and ex-sanguine, while the remaining lobes present their ordinary characters, at least to the unaided eye." If I mistake not, I have seen formerly not a few such placentæ, without being aware of their true condition; and there can be no doubt, I think, that the change often happens, though not to the extent which leads to abortion or premature labour, or even interferes, to any serious degree, with the nutrition of the fœtus. Dr. Hassall thus describes the minute alterations which he has been enabled to detect in a degenerated placenta :—

"1st. We observe that the villi are thickly studded with innumerable spherules of oil.

"2nd. The chorion is much altered; it is thickened and destitute of nuclei.

"3rd. The walls of the vessels no longer contain nuclei; these having, in all probability, become degenerated into spherules of oil.

"4th. The spherules of oil are contained some in the chorion, some in the walls of the blood-vessels, and many in the intervals or spaces between these.

"5th. The cavities of the vessels are almost invariably free from fatty deposition.

"6th. The vessels are destitute of blood."

It may be well to compare this account with that previously published by Professor Kilian of the like condition of placenta :—"He had the opportunity of minutely examining that of an eight-months' child, which had died a fortnight before birth. It was found to be pale and easily torn the uterine surface being of a bright yellowish white colour for two or three lines in depth, and of a brittle, friable texture, as compared with the red portion of the placenta, from which it was separated by no exact line of demarcation.

Examined with the microscope, the extreme ends of the vessels of this portion were found to form little knobbed swellings, composed of fat globules, strongly reflecting the light. From these ends of the vessels, filled with fat droplets, closely packed together, the blood-corpuscles of the placental vessels were quite absent; but, in proportion as the vessels were traced back from their terminations, the fat globules were progressively replaced by blood globules; the walls of their vessels, which, at their terminations, were also loaded with fat, recovering their natural appearance." Professor Kilian observes, with truth, that the limitation of the fat globules, and the normal state of a large portion of the placenta, show that the change was not a *post-mortem* effect, and makes the suggestion, that "a sluggish, feeble circulation, through the remote ends of the vessels, and a resulting defective nutrition of the vessels themselves, (perhaps aided by the influence of opiates or other means of weakening the heart's impulse,) may be the earliest stage of this retrogressive metamorphosis, leading to fatty formation in the cells of the vessels."(a)

Dr. Barnes, speaking of the reasons of this placental change, observes, that "pregnancy itself appears to predispose to the formation of fat;" but there is evidently a real degeneration, not dependent, I should suppose, on any of the incidents proper to gestation, but rather on some accidental circumstances which influence the blood, or interfere with the circulation and nutrition of the placenta. It would be interesting to know whether the placentæ of phthisical or weakly females are not more especially obnoxious to this decay. Dr. Barnes cites an instructive case, communicated to him by Mr. Bartlett, of a lady pregnant three months and a-half, who was much shaken, first by riding over a rough road in a dog-cart, and afterwards by making a false step in getting out of it. The death of the fœtus seems to have followed, but she went her full time, when she was delivered of an embryo of the fourth month. "The placenta was an inch in thickness, nodulated in parts, universally firm in texture, and of a yellowish white colour, and had undergone general granular metamorphosis."

It is unnecessary to say, that general fatty conversion of the placenta implies the total destruction of the organ. The

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* See British and Foreign Medico-Chirurgical Review, Jan. 1851, p. 272.

part, as in this case, may be preserved from putrefaction and retained in utero; but so soon as it is destroyed, the quicker it is cast away the better. It is interesting to note, that the placenta is prone to the same degeneration as the uterine fibres. When we observe the change beginning at the ninth month, we must remember that the organ has already lived its destined term, and that the time for its decay has come. All things correspond; the child is not ready to be born before the uterus which contains and will expel it, and the temporary lung whereby it has respired have reached their full maturity.

That placental apoplexy may occur from degeneration of the small blood-vessels cannot be doubted.(a) It is probable that all the effusions *called* apoplectic may be frequently connected with disease of the vessels. Blood is poured occasionally into the heart's substance, into the tissue of the voluntary muscles, and into the walls of the uterus. These may be dependent on actual degeneration, or mere atrophy of the walls of the blood-channels, the escape of blood being probably favoured by the softened condition of the parts around them. And the ecchymosis which occasionally happens in aged people from a mere touch almost, implies most likely, in many instances, the same state of blood channels. In some forms of hæmorrhage, the condition of the blood itself is, as we know, undoubtedly at fault, as scurvy and purpura show well enough.

But let us pass on to *pulmonary apoplexy*, which is described as effusion of blood into the cells or tissue of the lungs.(b) The forms which it may assume are various: it may occur in small or large patches, or even occupy a whole lung; it may be attended by laceration of the organ, and the hæmorrhage may find way into the pleura; it may be followed, even as apoplexy of the brain, by the conservative formation of a cyst. The various changes in the effusion and implicated tissue have been minutely described. Two cases have been referred to by Hasse, in which the blood proceeded from burst aneurisms of the aorta and subclavian artery; but these are peculiar, and throw little light on the general subject. The shapes of the affection, and many of

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(a) Dr. Barnes refers to this point.

(b) Hasse alludes to "loss of consciousness," in connexion with it, but this, clearly, is accidental only.

its complications, have been explained far better than its causes. The most satisfactory reason assigned for its occurrence is the obstruction to the pulmonary circulation, which is attendant on extreme auriculo-ventricular contraction of the left side of the heart; yet it is doubtful whether even this would have caused it, at least in *many* instances, but for atrophy or degeneration of the vessels. There is room, then, evidently, for fresh research; and the observations of Dr. Dittrich—for an abstract of which I am indebted to Dr. Kirkes—have great interest. They tend to the inference, that fatty degeneration of the small blood-vessels of the lungs is a common cause of sanguineous effusion into their structure.

Dr. Dittrich says, "that in a large majority of cases of pulmonary apoplexy (infarctus) the proximate cause of the hæmorrhage is a diseased state of the branches of the pulmonary artery.

"This disease consists—

"1st. In a greater or less dilatation or widening of the canals of the vessels, the widening being sometimes very great (enormen).

"2nd. In a fatty metamorphosis of the walls, both of the larger, and especially the smaller and smallest vessels.

"3rd. In a kind of slow inflammatory process, attended with the deposit of a coagulable material, which is in part converted into a tissue similar to that of the arterial walls, in part degenerates into fat.

"He then enters into considerations, to show that the disease occurs especially in those cases in which the pulmonary vessels from any cause become considerably or permanently dilated: as, for example, when they are submitted to undue distension from constriction of the mitral orifice, especially when this is followed by hypertrophy of the right ventricle; and again when the small vessels become dilated, in common with the bronchial tubes, as a result of atrophy of the pulmonary tissue. He tries to show that, in all cases, the widening of the canals of the vessels precedes the deposition of the new material within their coats,—the object of such deposition being to strengthen the walls thus weakened by dilatation." The latter notion is very curious.

It may happen, undoubtedly, that obstruction to the circulation through any set of vessels may, by producing

congestion merely, become a cause of their atrophy and degeneration; for distension of them, especially if it be violent and constant, implies that tense condition of their walls which is certainly unfavourable to their due nutrition. Still we know of many cases of atrophy, degeneration, and dilatation of large, and even of small, blood-vessels which can by no means be imputed to any impediment to the flow of blood through them; and it seems most reasonable to believe, that the degeneration described by Dr. Dittrich is often primary, and the dilatation secondary. Admitting the existence of the first, it is very easy to account for the occurrence of the second; the liability of a vessel to aneurismal bulging, provided the change have not so far proceeded as to lead to its rupture, being in direct proportion to the weakness of its walls. That the small blood-vessels of the brain, in numerous instances, become aneurismal, to a greater or less extent, and in various degrees and places, from the mere atrophy and degeneration of old age, is beyond reasonable question; though it may be readily granted that any affection of the heart which offers impediment to the venous circulation of this organ would favour the change, and expedite the ruptures which sometimes result from it. Further inquiry may, perhaps, show us cases of pulmonary hæmorrhage occurring from vascular degeneration, in which the left side of the heart, or the whole of the organ, is free from disease, and in which no ground can be given for supposing that the bulgings in the vessels were due to their being abnormally distended. It is a question of great moment to inquire into the history of this change in the lungs. What are its relations to age, to atrophy of the blood, and tissues generally,—to cardiac and other diseases? How often does it occur in connexion with a like alteration in the blood-vessels of the brain? What is the concurrent condition of the branches of the pulmonary and bronchial arteries, so far as they can be traced? What of the pulmonary membrane, which is liable, and not in old age merely, to fatty degeneration, as Mr. Rainey shows?(a) There is vast scope for observation.

I observed, in my paper on Cerebral Softening and

(a) Mr. Rainey showed me a good instance of it in a young subject who died, having emphysema of the lungs.

Apoplexy, that "softenings of the heart and brain are most probably attended in many instances by the same state of their minute vessels. It is not likely, as Mr. Paget has observed, that the small vessels of the brain should be peculiarly affected with degeneration. It may be rather assumed that the change more or less affects those of other parts."

I have just referred to the state of those vessels in certain conditions of the placenta and lung, but am not aware that any observation has been published on the *like change occurring in the heart*,—an organ whose visible arteries degenerate and whose texture softens in so remarkable a way. There is, doubtless, difficulty in disentangling and cleaning the small vessels, and bringing them into view; but Dr. Charles Shearman had the goodness to show me one of $\frac{1}{1\,1\,1\,4}$ inch in diameter in a marked instance of degeneration of the heart, which had undergone the same change as the fibres. He has kindly given me the notes of the case, from which I shall extract freely, for not only does it demonstrate this new fact, but illustrates also that important association of fatty degeneration of the fibres of the heart and small blood-vessels of the brain to which I have already drawn attention. Henceforth, as I remarked, "it will be of particular interest to compare the condition of the cerebral vessels and cardiac fibres in cases of apoplexy and sudden arrestation of the action of the heart."

Robert Jakeman, aged 84, was admitted into the Westminster Hospital, July 11, 1851, for an injury of the ribs, of which he died. He never rallied altogether from the shock of the accident, which, in my belief, was rendered fatal by the heart-degeneration.

A general and microscopic examination of parts was carefully made by Dr. Charles Shearman, which I had the opportunity of observing. The large vessels of the brain were more or less degenerated, but especially the internal carotid arteries, which were quite rigid from changes almost symmetrically involving them. The cerebrum and cerebellum were both of softer consistence than usual, and in one or two spots particularly; and some "slight extravasations were noticed on the walls of the third ventricle."

"One of the small branches of the vessels in the fissure of Sylvius was traced into the substance of the anterior lobe

of the right side, where the brain, though not so much softened, was not so firm as it should be. Some small vessels were separated from the brain, and carefully washed from all adhering cerebral matter by syringing them with distilled water, and then narrowly examined. In vessels of the diameter $\frac{1}{600}$th of an inch, the transverse and also longitudinal muscular fibres were well seen; nevertheless, there was some deposit in the coat, the nature of which was not determined. In those of $\frac{1}{1200}$th of an inch, no fibres were seen; the nuclei were somewhat obscured by a deposit of yellowish-brown granular matter, not uniformly distributed, but collected in masses, and more abundant at the point of a branch being given off by the vessel, or at a decussation of it. By acetic acid diluted, the nuclei became more marked, and the general tissue of the vessel clearer; but the granular matter was better exhibited through the action of this re-agent; by digestion in warm ether a great part of the granular matter was removed. In vessels of the diameter of $\frac{1}{1500}$th of an inch, the deposit was nearly of equal amount; in those of $\frac{1}{2400}$th of an inch there was little or none of it. The granules which formed this deposit were very small, varying from the least visible size to the $\frac{1}{10000}$th of an inch, but chiefly about the $\frac{1}{20000}$th of an inch."

There was no appearance in the lungs which could in the least explain the reason of death.

"*Heart.*—It was larger than usual, but its weight was not taken. The right auricle was capacious, and contained a firm, parti-coloured clot of blood; the substance and lining membrane of the auricle looked healthy. The walls of the right ventricle were thin, rather pale, and not flabby; the tricuspid valve was a little thickened at the free edge. There was a slight atheromatous deposit in the pulmonary artery, immediately above the valves, which were healthy. Left auricle: The lining membrane was thickened, opaque, and of a slightly slate tint. The mitral valves closed imperfectly against water thrown into the left ventricle. The walls of the left ventricle were rather thin and pale, and felt soft and greasy. There was some atheromatous deposit on the carneæ columnæ, and thickening of the mitral valve at its edge, and slightly elsewhere. The aortic valves, rigid and rough throughout, allowed a very rapid filtration of water through them. The aorta presented atheromatous

matter in the sinuses of Valsalva, and immediately above them, but not to any great extent.

"*Kidneys.*—Both were granular, and contained some cysts, also the cicatrices of old ones; and, what was important, the blood-vessels of the kidney stood out from the surface, on a section being made, as if more or less rigid. An attempt was made to separate the vessels from the substance of the kidney, but they were too brittle.

"Nothing particular was observed in the liver.

"Under the microscope, the heart-fibres looked decidedly fatty, and there was, in consequence, considerable difficulty in dissecting them. The fatty granules were seen in groups, and were larger than usual. I was able to separate a small vessel, and, on examination by the microscope, found it present most distinct groups of granules, lying in the substance of the coats of the vessel, their appearance being precisely like that of the vessels of the brain; the diameter of the vessel was $\frac{1}{1714}$ inch.

"The arcus senilis was extremely well marked in both eyes."

This is not the only case of death after accident which seemed to be attributable, in great measure, to the state of the heart at the time it occurred. The condition of the small vessels, which, though one only was examined, may be believed reasonably to have existed here, is probably common enough, though not readily discovered where the organ is much softened, and may occasionally be related to the atrophy which has existed, as cause to effect, for the change of the vessels may possibly lead to a narrowing of their channels, and so prevent the free and perfect distribution of blood, or it may so affect the capillary walls that those operations between the blood and the tissues, in absence whereof the latter must certainly lose their integrity, cannot be maintained. Again, this state may lead us to suspect that there may be occlusion in some minor branches of the coronary arteries, which we have not detected, and perhaps cannot trace. But of one thing there can be no doubt; it is related to those effusions of blood which occur in the flabby and easily lacerable portions of the organ, just as the like condition is very frequently related to the hæmorrhage which takes place often in the softened brain.

We have seen how degeneration of the small blood-vessels

has been found in the brain, the placenta, the lung, and, lastly, in the heart. Probably the small vessels are mostly implicated wherever tissues undergo this change. Dr. Quain showed me a well-marked instance of the fatty degeneration of some small blood-vessels in a cerebral tumour which itself was in parts becoming changed into fat. It had the look of an old apoplectic effusion, but the microscope showed that it possessed the characteristics of a malignant structure. In the last course of lectures given by Mr. Paget before the College of Surgeons, he spoke of the softening, wasting, fatty, and calcareous degenerations of cancers. Their vessels undergo, it may be well supposed, the like changes; and, perhaps, arguing from what we know of healthy tissues, abnormal structures may occasionally degenerate from atrophy and degeneration first attacking the arteries which supply them. Occupied naturally with the growth of tumours, which sometimes amazes by its celerity; the prodigious size they occasionally attain to; the havoc which they make; the suffering which, under many circumstances, they occasion; and oftentimes the utter impossibility of arresting them, we have too little contemplated their usual course, average existence, and the way they die. Persons do occasionally outlive a cancer; its own powers of life being shorter and weaker than the general forces of existence.

I must be permitted to dwell upon the fatty degeneration of the small blood-vessels of the brain, although it be not long since, following Mr. Paget, I have touched upon that subject. That degeneration, although it be very common, cannot certainly be detected in all cases of apoplexy. I should most calculate on finding it in those persons destroyed by cerebral hæmorrhage, who have lived beyond the maturity of life, who present the arcus fully marked, or have a fatty heart, or fatty degeneration more or less general, the large vessels of the brain being found atheromatous, and a marked degree of softening surrounding the clot.

It is needless here to repeat the two instances that I have narrated before, but I shall venture to sketch an example which has come under my notice since they happened, on account of its presenting a history and features which will soon be called quite familiar.

A woman, 74 years of age, considered by her neighbours in tolerable health, but thin from general atrophy, com-

plained on the 18th of July, 1851, of a severe but transient pain in the head. The next morning, early, nothing seeming to ail her, she was busy as usual; but between twelve and one o'clock she was found senseless on the floor of her room, with no movement visible but that of breathing; and she remained much in the same state through the rest of the day and the night which followed. On the 20th I saw her first. Then she lay with a pale, cadaverous face, contracted pupils, most obscure general sensation, a pulse of 100, and moderate force, while her respirations, 44 in the minute, were alarmingly heavy. The *right* side was never stirred; the left was almost in continual action,—not the action of spasm, but that clearly of the will, notwithstanding the mind would, in absence of it, have seemed altogether incapable of willing. By pricking sharply the right arm and leg, I could readily excite a most marked retraction of either; no feeling seemed to attend it, and it could easily be occasioned, time after time, by the like stimulus, applied carefully with the same force. But no such movements could be occasioned in the left and unparalysed leg, over which the will, that effective antagonist of spasmodic action, yet preserved some measure of control. No rigidity of muscle was anywhere observed.

The sequel of the case was that common in such instances. On the 21st the pulse and breathing were more hurried; the reflex movements of the paralytic parts were not excited without difficulty, and were very feeble; the pupils could scarcely be excited to act; the whole frame wore the look of sinking, and death came on in the evening of that day.

The body was not examined until rather more than forty-eight hours after death, and this delay, probably, somewhat modified the general appearance and consistence of the brain. Rigidity had quite subsided. A spot of subcutaneous effusion of blood, produced most probably by pressure, was observed on the right arm.

The outer surface of the cranium was made very irregular by most prominent ridges, in the lines of the squamous and lambdoid sutures. The brain, though generally flaccid, admitted of the comparative softness of parts being tested; the vessels on its surface were full. There was an arching or bulging of the corpus callosum, such as I have frequently noticed on occasions in which the

lateral ventricles have been distended with fluid. The *left* of these cavities was completely filled with blood, for the most part coagulated; its outer and inferior boundaries were extremely softened, and quite broken up; shreds of cerebral matter, coloured with blood, lay about, and were partly mingled with the effusion; the upper portion of the corpus striatum was soft, flocculent, and looked as though blood, at innumerable points, had escaped from its vessels. Of the thalamus opticus there was not a remnant. The partition of the ventricles was slightly destroyed; the right ventricle contained only a little fluid blood; its walls generally were not softer than the rest of the brain, and had yielded only at the spot in the septum. The effusion, which might have amounted to three ounces or more, exclusively occupied the *left* ventricle and the space gained by the destruction of its walls; and it will be clear, therefore, that the disposition of the hæmorrhage accounted, as is customary, for that of the paralysis.

The large arteries at the base of the brain presented manifest signs of atheromatous degeneration, but it was at no point unusually striking, and the basilar artery was tolerably free from evidence of change. There was a distinct and firmly-attached tumour of fat, of about the size of a damson-stone, immediately behind the optic commissure.(a)

The lungs were healthy; not so the heart, which was shapeless, flabby, readily lacerable, and loaded with fat, which here and there seemed entirely to occupy the whole of the wall of the ventricle; long streaks of fat, with intervening fibres, much encroached upon, were seen plainly in many places beneath the pericardium. A few vegetations were seen on the edges of the tricuspid valve. The aorta was slightly atheromatous at its origin. The pulmonary artery seemed quite normal.

The spleen was very small and shrivelled, and coated with a firm, yellowish material.

(a) "In a case by Drelincurtius there was a steatomatous tumour the size of a fist between the brain and cerebellum. In this case there were both blindness and deafness, and it was fatal suddenly by an apoplectic attack. In another, by the same writer, the pineal gland was enlarged to the size of an egg, and was of an earthy or stony structure."—Abercrombie on the Brain, etc., Fourth Edition, p 439.

The kidneys were in a state of confirmed degeneration.

I had the advantage of Dr. Quain's assistance in microscopically examining the minute cerebral blood-vessels and fibres of the heart. The first small vessels which were looked at were those chosen from around a little clot which lay in the mass of softened brain that surrounded the apoplectic effusion. There could be no mistake about the extreme and general fatty degeneration which they had undergone. It was remarked in vessels of varying diameters, including those of quite capillary size. A great deal of fat was found on and around the fibres of the heart, which were seen in some places in a state of true and manifest fatty degeneration.

Such is the form of apoplexy whereof doubtless many of the aged die, and which is now impending over numbers. Atrophy affects the brain, the heart, and the kidney together, and there is risk not only of death by syncope, but of three kinds of fatal coma, between which it is most essential to distinguish,—the cerebral, cardiac, and renal.

The softening of the brain, which is so common around an apoplectic clot, was well seen in this instance. There is nothing more important for the student to remark and understand. I have seen persons content themselves with observing the magnitude of an effusion, quite careless of the condition of adjoining brain. They look to the effect only, not the cause. I have marked others who have considered the softening as the result of effusion, reversing Nature's order. Hæmorrhage into the brain is one of the issues of ramollissement,—one of the very commonest.(a) This is no new notion, although recent researches, as must be fully granted, have done so very much to confirm its correctness. M. Rochoux was so convinced of its truth, that he speaks distinctly of "ramollissement *hémorrhagipare*." And, in another place, he defines, with his usual clearness, the true nature of apoplexy as it ordinarily occurs:—"Pour l'apoplexie, elle consiste en un vice de nutrition, d'où part cette alteration, cette diminution de la cohésion normale du tissu

(a) Dr. Rowland, in his recent work on softening (p. 92), gives a case of apoplexy in which the brain in contact with the clot, and for an inch and a half beyond it, was of a pulpy softness. In this example, symptoms of ramollissement preceded the apoplexy.

encéphalique, laquelle, etant parvenue à un certain degré, se termine par une déchirure immédiatement suivie d'hémorrhagie, de compression, et de tous les désordres locaux qui ont pour effet de produire les symptômes apoplectiques." (a) What could we say more truly now?—how better phrase it? Still, thanks to our inquirers, we have made progress. Proofs of the reason of this statement have been accumulated. The real nature of the change of the blood-vessels, both great and small, which has so important, and often so essential, a relation to softening of the brain and its issue, apoplexy, has been clearly demonstrated. We have seen, moreover, that there is no peculiarity about it; that it is even to be expected as the consequence of the atrophy of age or some other cause; that it is precisely like that which affects the heart; that, very frequently, it is only a little part of the voluminous evidence of general decay. We have simplified our knowledge by enlarging it; and further extension only can give it what it needs, yet more simplicity.

Softening of the brain leads to different degrees and forms of effusion. Sometimes there is a large clot in the centre of the softened part; sometimes the extravasation bursts through into the lateral ventricles, or, far more rarely, into the arachnoid sac; sometimes there are many small centres of effusion; or the blood may be interspersed in minute dots, constituting what is called capillary apoplexy, and where this happens, we may be quite certain that the hæmorrhage is from a multitude of little vessels. Bichât, in explanation of cerebral h morrhage, referred to the fragility of the capillaries of the brain. They have "no investment of areolar tissue, and may be termed *naked.*" (b) They require the support of the bed they permeate; should the structure soften through which they run, but, above all, should they be degenerated and aneurismal also, what easier

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(a) Sur l'apoplexie, pp. 150, 413.

(b) "Although areolar tissue is the ordinary nidus in which the capillaries, as well as the vascular trunks, run in the various organs and tissues of the body, still there are certain situations in which the capillaries are wholly destitute of this means of support; to these the term *naked* has been applied by Professor Bowman. He first detected naked capillaries in the Malpighian bodies of the kidneys; as the capillaries of the brain have no investment of areolar tissue, these also may be termed naked."—Lectures on Histology, by John Quekett, p. 134.

than to conceive their bursting readily?—what easier than to imagine, in certain states of them, the danger of an obstructed cerebral circulation, the fatal issue of laughing, or coughing, or declaiming violently, or even of a prolonged expiration?

PART III.

Nothing could have been more common than expressions respecting "determination of blood to the head," "dangerous fulness of the vessels of the head," and "increased vascular action within the brain itself," by way of explaining the occurrence of apoplexy.(a) But how is it that children escape as they do? How frequently do they become convulsed with violence, either from teething or some other cause! Surely, if mere congestion of the cerebral blood-vessels would lead to apoplexy, nothing could be better adapted to occasion it than a paroxysm of hooping-cough, in which the eyes start and redden, and the face becomes tumid and purple, and the veins of the neck swell immensely, and all things denote how obstructed is the return of the blood in its course from the head to the heart. If mere distension of vessels sufficed to occasion the apoplectic effusion, epilepsy would commonly pass either into fatal coma or instant death; the efforts which are now compatible with safety would be loaded with peril; no child could cry until it gained its point, no actor "make a passionate speech." It is true that we read of apoplexy frequently occurring during sleep, when the cerebral circulation is more or less embarrassed; and we feel no surprise at the cases cited by Dr. Watson in his Lectures(b), of a

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(a) No writer has carried this sort of language to a greater length than Dr. Cheyne, whose work on apoplexy is, notwithstanding, full of interest and instruction. That the structure of the vessels must be at fault is a truth fully recognised by other writers—Dr. Abercrombie, Dr. Watson and Dr. Copland, for instance.

(b) Third Edition, Vol. II, p. 525.

clergyman during the delivery of a sermon, of a literary man while speaking in a public assembly, and of an officer while giving the word of command being struck with the complaint; nor do we wonder at Lord Chatham's seizure, as we find it described by our brilliant essayist and historian.(a) In such instances, it is likely that the vessels of the brain burst during distension; but in every probability their degenerated condition disabled them from resisting it. Men go on for a while with cerebral hæmorrhage impending over them; a little more atrophy and degeneration of blood-channels and a little more softening of the brain around, suffice to produce it, and perhaps even in a moment of calm.

Professor Rokitansky, in reference to disease of the vessels, remarks, that it "appears to some extent necessary as a cause of apoplexy, for it is often observed that the deepest congestions, whatever their nature, but especially those intense mechanical ones which give rise to cyanosis, do not produce apoplexy." Again, he says:—"There is no single cause that will account for the frequent repetition of attacks of apoplexy in many individuals, and its simultaneous appearance at several different spots in the brain but the presence of disease of the vessels. This also partially explains its happening symmetrically in corresponding portions of the brain at the same, or nearly the same period."(b) But

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(a) "Critical and Historical Essays." London: 1851, p. 769. It is difficult, and especially when we look to the subject of it and the attendant circumstances, to imagine a more interesting account of an apoplectic seizure. I extract a passage:—"When the Duke of Richmond had spoken, Chatham rose. For some time his voice was inaudible. At length his tones became distinct, and his action animated. Here and there his hearers caught a thought or an expression which reminded them of William Pitt. But it was clear that he was not himself. He lost the thread of his discourse, hesitated, repeated the same words several times, and was so confused, that, in speaking of the Act of Settlement, he could not recall the name of the Electress Sophia. The House listened in solemn silence, and with the aspect of profound respect and compassion. The stillness was so deep, that the dropping of a handkerchief would have been heard. The Duke of Richmond replied with great tenderness and courtesy, but while he spoke the old man was observed to be restless and irritable. The Duke sat down, Chatham stood up again, pressed his hand on his breast, and sank down in an apoplectic fit."

(b) Rokitansky's "Pathological Anatomy," Vol. III. Edition of Sydenham Society, p. 400.

microscopical demonstration was highly needed to put certainty in place of probability,—to show in what manner the minute vessels are changed,—how thickly they are studded with fatty granules, or calcareous particles, or a mingling of both,—how they bulge at points, or are actually sacculated,—and how, in a word, they are so weakened and spoiled as amply to account for those effusions of blood which the unaided eye can find no lesion whatever to explain.

It is not to be imagined that in all cases of apoplexy such changes will be discovered, either in the large or small vessels, as will satisfactorily account for the disease. Dr. Ormerod informs me, that in a child aged nine, who died of apoplexy of the pons Varolii, he found the neighbouring capillaries quite healthy. Cerebral hæmorrhage, in early life, being often referrible to quite local changes, is apt to leave fainter traces of its causes than that which happens at a later period. Often the rupture will escape notice from want of care, often in spite of it. It may happen, too, in many instances of cerebral hæmorrhage, that all the small vessels implicated may be torn up, and mingled with and lost in the clot; and it is not too hastily to be concluded that there was no degeneration, simply because it could not be detected.

In examining ruptured vessels of minute size, we must (as Abercrombie and Rokitansky observe) remember how many are *secondarily* torn by the effusion of blood. How readily they must be ruptured in some cases is quite clear to any one who has ever been at the pains of disentangling and preparing them for the microscope in instances where they have been chosen from portions of brain in a state of ramollissement.

It should be inquired whether the fatty degeneration of the small vessels is so apt to be symmetrical as that of the large ones. With this view, blood-channels might be selected from spots as nearly correspondent as possible, and accurately compared.

Where a clot of blood is effused, it will be well to examine other parts of the brain, to determine where the degeneration is most marked, and to see, also, if another attack might not shortly have happened, had a recovery from the past one taken place.

It will be of interest, also, to scrutinize the vessels around

the cysts which are remnants of former apoplexies, and especially those around abscesses of the brain.

It will often be found, no doubt, that the degeneration is very extensive in apoplectic subjects extremely old, and in others, also, whose brains present marked general indications of atrophy and degeneration. In Mr. Dunn's case of apoplexy of the cerebellum, there was not only a pulpy mass around the clot, but the convolutions of the brain were shrunken and less firm than normal, whilst the optic nerves, both in their course and at their origin, gave signs of atrophy, and the "whole arterial system of the brain was more or less in an unhealthy state." This is the sort of instance in which extensive fatty or calcareous degeneration of the minute blood-channels may be looked for confidently.(a)

Fatty degeneration of the small blood-vessels has been seen both in the cerebrum and cerebellum, but not yet, so far as I know, in those of the spinal marrow. However, effusions of blood into this organ have been found surrounded by softening of its tissues, and it can hardly be doubted that it will sooner or later give evidence of the like change. May not some cases of paraplegia depend on fatty degeneration of the cord, and some examples, too, of partial paralysis? It should certainly be sought for in all instances of ramollissement of the organ, and the rather as doubt is often thrown on the true nature of cases of this kind, the change being referred very commonly to *post-mortem* effects. Some examples of amaurosis and deafness are probably dependent on fatty degeneration of the optic and auditory nerves, either in their course or at their origin.(b)

It may be well to refer to an instance or two of cerebral softening, unattended by apoplexy, in which fatty degeneration of the small blood-vessels has been found.

In the case of a man, aged 37, who died after suffering acute pain and being convulsed on the right side of the body, there was found a circumscribed softening in the posterior cerebral lobe, a little above and outside the left lateral ventricle. The part affected was extremely tumefied, and

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(a) See Medico-Chirurgical Transactions, Vol. XXXII., p. 110.

(b) I have mentioned, in a former contribution, a case of blindness, in which the optic nerves were examined by the late Mr. Dalrymple and Mr. Holthouse, and found in a state of fatty degeneration.

must, doubtless, have produced pressure of the brain. In some places it looked pink, in others red, in others violet, in many there was a blending of colours. Innumerable small vessels were seen ramifying through it here and there. The minute blood-vessels were examined by Dr. Charles Shearman and myself, and found studded with fat-granules, which in many spots were extremely thick; small dilatations were observed also. From the rapid course and the symptoms which marked the affection, the age of the patient, and the appearance which the brain presented, all taken together, I can hardly doubt that this was a case of softening from inflammation. It is quite *possible*, however, that the affected part might have been, previous to its attack, in a condition of low and impaired nutrition, and of fatty degeneration also.(a)

In a case of red and white softening of the right hemisphere of the brain, minutely detailed by Dr. Sibson, "the minute arteries running through the posterior convolution affected with red softening were observed many of them to have their walls studded with minute fatty granules."(b)

The frequency with which inflammatory softening and fatty degeneration are observed together, is, of course, an important question. Dr. Ormerod obliged me with a note of the case of a man about thirty-five years of age, who died of red softening, attributed to "repeated sub-acute inflammation of the left optic thalamus and corpus striatum."

"The arteries of the base of the brain, both large and small, seemed quite healthy to the eye and microscope. The capillaries of the white undamaged portion of the brain were quite normal; those in the yellowish still consistent parts were many of them opaque and thickened in points, but they were pervious and of a uniform calibre. In the softened part they were shrunk, contained no blood, and were only to be followed through the mass by their opaque, granular coats." Whatever was the exact change here, it is regarded by Dr. Ormerod as an effect of inflammation. In this point of view the case is interesting, if only to show

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(a) I am indebted to Mr. Tebay for the opportunity of examining this specimen of red softening.

(b) Report of Pathological Society of London, 1851-52, p. 242.

that the changes in the vessels were such as must have greatly disturbed nutrition and accounted for the softening which prevailed. Fat granules in a part are no proof of the absence of inflammation(a), considered by themselves, but may even occur because of it. The presence or absence of inflammation must be determined by the condition of the part *viewed as a whole*, together with all the symptoms and circumstances of the case.

The relation of fatty degeneration to inflammation, acute and chronic, is one of the most interesting, yet difficult points for future inquiry. Fatty degeneration may precede either acute or chronic inflammation, and when the effects of these latter come to be examined, it may be impossible to assign what degree of mischief may be due to the inflammation and what to the process of decay preceding it; or it may happen, contrarily, that inflammation may so derange the nutrition of a part, that from the time of its occurrence fatty degeneration shall commence and make progress.

In speaking, too, of the dilatation of vessels, we must remember, also, that inflammation produces it as well as atrophy and degeneration, but often, it must be presumed, through these, for inflammation interferes with the conditions which are essential to preserve nutrition.

Sometimes, it may be, that vessels once dilated from inflammation never recover, and afterwards pass either into fatty or calcareous degeneration. In this case dilatation would precede degeneration and so make exception to a general rule.

As changes of the blood-vessels, in consequence of inflammation, have so important a bearing on our subject, I shall take advantage of some remarks of Mr. Paget, which I will not injure by any alteration. "With the enlargement of the blood-vessels a change of shape is commonly associated. Being usually elongated, as well as dilated, they are thrown into curves and made more or less wavy or tortuous. Thus we may see the larger vessels in an inflamed conjunctiva, or, more plainly, the sub-peritoneal arteries in cases of peritonitis; so, too, they are represented in the in-

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(a) Inflammation and fatty degeneration are often, no doubt, simply co-incident. Great error of interpretation may happen here.

flamed rabbit's ear.(a) A more remarkable change of shape of the small vessels of inflamed parts is that in which they become aneurismal or varicose. The first observations of this state were published, I believe, by Kölliker and Hasse, in an account of a case of inflammatory red softening of the brain, in which many of what, at first sight, appeared to be points of extravasated blood, proved to be dilatations of capillary vessels filled with blood. After this they found the same changes, but in a much less degree, in some cases of inflammation artificially excited in the brains of rabbits and pigeons.(b) Many, as well as myself, have since made similar observations, most of which, however, seem to show that the peculiar dilatation has its seat in the small arteries, not in the capillaries of the inflamed part. The diagrams illustrate some of the dilatations observed in vessels of the brain by Kölliker and Hasse, and of those seen by Bruch(c) in the peritoneum of a dog after a wound in the abdomen; one from a specimen of diseased ovary, described by Professor Harting, and given to me by Dr. Van Leeuwen; and some from a case of inflammation, or extreme congestion of vessels in a fringe of false membrane on a pericardium. The several figures represent various forms and amounts of partial dilatation. Some are like gradual fusiform dilatations of the whole circumference of the vessels; some like shorter and nearly spherical dilatations of it; some like round, or oval or elongated pouches, dilated from one side of the wall; in short, all the varieties of form which we have long recognised in the aneurisms and aneurismal dilatations of the great arteries may be found in miniature in the small vessels of such inflamed parts."(d)

The force of the obstructed blood-current, associated occasionally with the impaired nutrition of the vessels, explains sufficiently these changes.

There are circumstances, no doubt, in which these altera-

(a) Sometimes such tortuosity makes the vessels appear varicose, as in a case by Reichert, in Müller's Archiv., 1847.

(b) See, regarding all the cases, Kölliker s paper in his "Zeitschr. fur wissensch. Zoologie, B. I., s 262, *et seq.*

(c) Henle and Pfeufer's "Zeitschrift," Bd. V., s. 65, und taf. i.

(d) Lectures on Inflammation, p. 5.

tions are permanent; and it is easy to conceive how pneumonia or cerebral inflammation, to all appearance recovered from, shall produce changes in vessels whereunto subsequent degeneration shall add largely; nay, which may one day be discovered even and altogether imputed to the latter. How closely does one subject bear upon another! One main reason why medicine has not more advanced lies in the fact, that subjects have been so violently separated, so exclusively considered, so treated of as though they could neither receive nor give light, but stood altogether alone.

The conclusion, that vessels may really degenerate during the inflammatory process, derives support from various facts which have been observed. Mr. Paget thinks that he has seen "fatty degeneration of the muscular fibres in inflammation of the heart,(a) especially in a recent case, in which the heart was punctured with a needle, and the patient died four days afterwards. The portion of the heart near the needle was more degenerate than the rest of its substance." By producing acute inflammation of the cornea in animals, Dr. Strube has occasioned fatty degeneration of it, and he has observed the same change as a consequence of those chronic inflammations which make it nebulous or utterly opaque.(b) Inflammation occurring in the previously quite healthy parts of *young* subjects, and attended by well-marked symptoms and *unequivocal* products, are those, of course, which may be expected to furnish most information respecting its production of vascular or other degeneration. In the great majority of cases in which fatty degeneration of the small vessels has been hitherto observed, it was due, most probably, to simple atrophy; and where this will satisfactorily account for it, nothing can justify our having recourse to the supposition of a more complex cause. And here I may add, that I have known degenerations of the larger vessels attributed to inflammation by observers, who have been doubly wrong: first, they have referred the change to a process of the existence whereof they had no proof whatever; and, secondly,

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(a) *Ibid*, p. 42.

(b) Der Normale Bau der Cornea und die Pathologischen Abweichungen in Demselben. Würzburg, 1851. I have to thank Mr. Paget for referring me to this Essay, and acquainting me with some of the principal matter in it

supposing them to have proved its existence, they clearly perceived not that it could only have acted in causing such effects by lowering and impairing the functions of nutrition. I refer, it must be said, to true degeneration, and not to any deposit upon a texture preserved in integrity.

The liability to fatty degeneration in general is proportionate to the age of the patient. Late life abounds in it; and the comparative rarity of this affection at an earlier time is obvious enough. Examples of it in the young are of the greatest interest, and most illustrate its special causes. The earliest age at which it may attack the cerebral bloodvessels is a very important point of inquiry.(a) Dr. Snow Beck has opportunely given me the note of a case in which degeneration of these channels happened in a young male child aged *one year and seven months*. "He was a stout, healthy child when attacked with convulsions, and died after two day's illness. The large arteries in the Sylvian fissure contained much deposit in their inner coats, which, from the manner in which it was collected into groups, the perfect transparency, the strong refraction of the light, I considered to be fatty deposit; but as this was not tested either by ether or dilute hydrochloric acid, I am unable to speak positively on the subject This small deposit was traced into the smaller arteries, where it was less in quantity, and even to the minute vessels, which measured but $\frac{1}{2500}$th of an inch in diameter, outside measurement."

The degeneration was most probably fatty, but, supposing it were calcareous, the interest of the case is in nowise diminished.

A well-marked instance of fatty degeneration of the small bloodvessels of the brain, occurring at an early period of life, has been recorded by Mr. Paget. The subject was a young woman (E. Rose), aged *twenty-one* only. All the brain appeared quite healthy, "except the left corpus striatum of which nearly the whole was reduced to a soft, pulpy substance, with mingled shades of pink, greyish, and pale yellow, and with small spots of blood here and there scattered through it." There was "striking" fatty degeneration best marked in vessels from 1-150th to 1-400th of

(a) M. Durand-Fardel has given an Appendix on Softening of the Brain in Children, which shows how seldom this affection has been noticed in them, and how much it needs further inquiry.—*Traité du Ramollissement, etc.*, p. 513.

an inch in diameter. The softening in this case may be supposed to have been augmented during the illness of the patient. After an attack of hemiplegia, she lay ill for above a month, and died "*in extreme emaciation.*"(a)

At present, there is a great want of cases of apoplexy and softening in early life, which have been well examined. There are many instances of the former on record, some of which happened in young children, but the exact condition of the vessels in them is a point untouched; the most essential matter has, as too often happens, been quite passed over. This should not be in future; we must know the link whereby cases occurring at unlike ages, and under different circumstances, are really associated. As atrophy is peculiar to no age, so neither is degeneration. Through atrophy, death may anticipate development; through it also, time, speaking pathologically, becomes "the great innovator."(b)

There is a question of peculiar interest to examine in relation to degeneration of the small cerebral bloodvessels. We know that epilepsy and other forms of convulsion less likely to so terminate do not end frequently in apoplexy. But occasionally it happens, that the epileptic dies from cerebral hæmorrhage; and, if it be that *coma* is a frequent issue of his paroxysms, or very likely if even it be not so, the danger of his situation may not at first be seen. Nothing certainly more fearful could happen to a man on the verge of apoplexy than an epileptic convulsion; nothing could be a severer test of the firmness of the cerebral vessels. No doubt puerperal fits, the most terrific that can be seen, would end often in fatal hæmorrhage, did they not mostly happen at a

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(a) "Groups of dark, blood-red crystals, of apparently prismatic form, were numerous in the softened substance of the brain."

(b) I cite the following Table, in which Dr. Rowland, (on "Ramollissement of the Brain," p. 46,) has added 97 cases to 153 already detailed by Andral, in order to give some idea of the relative frequency of cerebral softening at different ages. It would be interesting to add to this list any cases which may have been noticed at an earlier age than that of 15.

	Andral.	Others.	Total.
15 to 20	10	6	16
20 to 30	18	14	32
30 to 40	11	8	19
40 to 50	19	13	42
50 to 60	27	12	39
60 to 70	34	27	61
70 to 80	34	16	50
Above 80	0	1	1
	153	97	260

time when the vessels and surrounding tissue are as yet strange to decay. But I suspect that where the brain is in a state of softening ("ramollissement hémorrhagipare"), effusion far more commonly takes place than is supposed as the direct consequence of convulsion, the indirect of degeneration. I well remember an instance in which softening, convulsion, and apoplexy must have successively ensued. Paroxysmal apoplexy, as Dr. Marshall Hall describes it, may be soon changed for, or pass into, organic, when the vessels are atrophied and ready to give way. In cases of hanging, cerebral hæmorrhage, contrary to rule, has happened sometimes. Was the congestion intenser than usual in these cases, or was the state of the vessels such as to convert their distension into rupture?

Cerebral softening would, I think, far oftener end in hæmorrhage, did the blood still circulate with any great degree of force and freedom through the affected part. In some cases, the very cause of the softening seems very much to preclude the risk of hæmorrhage, at least serious hæmorrhage. Where, for instance, it follows the tying of the carotid artery; or is really dependent on obvious narrowing of some branch of a cerebral artery; or on some pressure being made upon it from without; or on its being blocked up by a piece of fibrin detached from the heart and then carried into its channel in the way described by Dr. Kirkes;(a) there would not seem, considering that the part is absolutely perishing from loss of blood, much probability of its vessels being so filled with it that they should be distended and burst from its pressure. Again, in some of those cases of very old age, in which ramollissement persists without apoplexy; we must remember that, if the vessels be weak to the utmost, the blood is often extremely sparing and circulates through them very feebly. Undoubtedly, the most favourable case of all for hæmorrhage is that in which the vessels are much weakened and degenerated, while the blood is propelled, perhaps in more than usual quantity, violently

(a) "On Some of the Principal Effects resulting from the Detachment of Fibrinous Deposits from the Interior of the Heart, and their Mixture with the Circulating Blood."—"Medico-Chirurgical Transactions," Vol. XXXV., p. 281. In this communication will be found observations both of originality and importance. A new cause of softening is pointed out, or, more properly, a cause newly discovered; and the association of heart and head affection, by a most simple yet hitherto unsuspected mode which is here insisted on, is of singular interest.

through them, or, what is more dangerous, has its flow obstructed.

In examining the changes of the minute arteries, it will be found occasionally that the degeneration is not purely fatty, but composed partly, or mostly, or even altogether, of earthy particles. An instance of apoplexy, with right hemiplegia, has been detailed by Dr. Jenner :—"The deposit was in some cases limited to the middle coat, and in several the calcareous matter existed in the form of minute granules, giving only a clouded appearance to the coat. Hydrochloric acid dissolved the calcareous matter, giving off bubbles of gas, probably carbonic acid. The coats of the arteries, after the action of the acid, looked perfectly healthy. The walls of a few of the capillaries were studded with fat."(a)

A case has subsequently been laid before the Pathological Society by Mr. Rainey, in which there was degeneration of the vessels of the cerebellum, exclusively of an earthy character. I had the opportunity of examining a specimen, and also a beautiful drawing of them by Dr. Bristowe. The particles in the vessels might easily have been supposed fatty ; they looked extremely like the fatty particles which were seen in case of softening of the corpus striatum in sequel of symptoms of paralysis and epilepsy, and which have been admirably figured and engraved.(b)

Of course, in considering fatty degeneration, one is not bound to treat of every other product and evidence of atrophy and decay ; but calcareous and fatty degeneration so often occur together, and are apparently so frequently traceable to the same causes, that some observations, at any rate, must be added, in reference to their mutual relations.

In the atheromatous degeneration of the larger arteries, it

(a) "Crimson or Hæmatoid Crystals, and Calcification of the Minute Arteries of the Cerebrum."—Report of the Pathological Society, 1851-52. The rhomboidal crystals were first figured by Sir Everard Home, but first fully described in detail by Virchow. Taken from a clot of blood they may, as Dr. Jenner states, serve to determine the date of its effusion. "Independent of the interest which their appearance might excite, they are probably of some practical importance, for it would seem that, whether really, as Virchow states, a crystalline form of hæmatosin, or not, they are never found unless preceded by stasis of blood, and that several days, perhaps weeks, are required for their formation. The earliest period at which Virchow knew them to be found was seventeen days."

(b) See case by Dr. Langmore and Dr. R. Quain, Report of Pathological Society, 1851-52, p. 246.

has been sometime known that earthy and fatty matter were intermixed. It has been shown more recently, and first by Dr. Jenner, that the same thing happens in the smaller vessels.

In old age, no doubt, it frequently occurs that in one part mere withering, in another fatty, in a third calcareous, degeneration is the more prevalent.(a)

In the same spot, we may note atrophy here leading to fatty, there to calcareous degeneration; but why to one in this point and the other in that, is, so far as I know, not yet to be explained. Thus, in a case of partial atrophy and degeneration of the placenta, laid recently before the Pathological Society by Dr. Handfield Jones, "the villi of the fœtal part were very distinct, and were in part simply atrophied, in part loaded with oil, or with oil and calcareous matter."(b)

Fibrous tumours may pass either into fat or earth, or both; so may fibrinous degenerations. Crystals of cholesterine, according to Lebert, have been detected in tuberculous matter.

Inflammation, too, disturbing and weakening nutrition, may, even in parts especially prone to fatty degeneration, lead to that which is calcareous. Whether it ever does so in the cornea I am unable to state, yet this is an interesting matter for inquiry.

Pericarditis has been known to lead not only to atrophy of the heart, but to cholesterine appearing in place of its fibres. Such a case has been described by that distinguished pathologist M. Lebert. It is essential to note, that it was only the portion of the heart which lay beneath the adherent pericardium that was thus

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(a) It is well known that earthy degeneration, as affecting the aged, has been laid the greatest stress upon by writers. Dr. Symonds has forcibly remarked on it in his article "Age" (Dr. Todd's Cyclopædia). Of course let all kinds of degeneration be considered, and each, if possible, traced backwards to its cause and forwards to its consequence. Fatty degeneration may appear to some to be receiving undue attention now; but some amends must be made for our having so long acted as though it had no existence; and every day almost pays fresh tribute to its importance, and a new seat or effect of it is still being frequently pointed out.

(b) I have had the opportunity of examining this mixed form of change in several mature placentæ. through the kindness of Dr. Druitt, who has made an elaborate inquiry into both fatty and calcareous placental degeneration. As it has been communicated to the Royal Medical and Chirurgical Society, I am not able to state the information he has given me. In the degenerated deciduous membrane of one placenta I observed crystals of cholesterine.

affected. "Il parait donc que dans cette partie malade du cœur, le tissu musculaire a presque entièrement disparu et a été remplacé par du tissu fibreux, par des matières minérales amorphes et par des cristaux cholestériques." "Ces plaques offrent, du reste, la même composition que nous avons signalé bon nombre de fois dans les plaques qu'on appelle ossification des artères. Il est probable qu'ici l'adhérence partielle du péricarde a eu pour suite l'oblitération d'une partie des vaisseaux nourriciers du cœur, et de là atrophie et dégénération." (a) Here we see that no *perversion* of assimilation, no *special* cause of deposition, is referred to; all is ascribed to atrophy, even as wasting always is, and as fatty degeneration always should be.

The varieties of degeneration which have been seen in the small arteries are—

1. The fatty. 2. The calcareous. 3. The fatty and calcareous mixed. 4. The pigmental.(b)

It may be added, that M. Lebert has once noticed tubercle in a small artery of the brain.(c)

Atrophy appears a simple expression; but how various its causes, how multiform its issues are! What more different than common white softening of the brain, wherein the organ becomes liquid almost, and the morbid toughness of it which prevails in that fibrous degeneration of its tissue, in which the nerves partake,—yet both are caused by failure of nutrition! With regard to these two effects of decay, I may remark, in passing, that their symptoms are often so similar, that it is impossible to say during life which is present; they occur at the same age, and are commonly attended by the like gradual weakening of the intellect. Nor does the arcus senilis, or fatty heart, untie the difficulty of distinguishing between them. The association of fibrous and fatty degeneration is so common, that one may prevail in the brain and another in the cornea.(d)

Features of a similar cast and expression attach to all

(a) "Atrophie Partielle du Cœur, et Transformation Cholestérique à la suite d'une Péricardite." Physiologie Pathologique, par H. Lebert, à Paris, 1845. Vol. I., pp. 167, 168.

(b) Mr. Paget's Lectures on Inflammation, p. 33.

(c) *Op. cit.*, Vol. I., p. 464.

(d) I have described an excellent example of this latter effect of atrophy in the *Lancet* for January 27, 1849. Cruveilhier has strikingly figured it: but the best account of the change is that given by Dr. Sims in Vol. XIX. of the "Medico-Chirurgical Transactions."

forms of degeneration. The latter lie often, as Dr. Symonds has expressed it, "on the very outskirts of the region of vitality," frequently, indeed, beyond it utterly. Death seizes particle by particle, becoming, so to speak, insidiously and imperceptibly possessed of its property, however it be called sudden at the last.

Surely it would be difficult to find a better word than that of *degeneration* (a) for the signification of those changes, whereby, passing from the complex to the simple, the structures suffer their decline and fall. Whether degeneration be fatty or earthy, premature or retarded, associated with hardening or softening, it results simply from a withdrawal of force, and presents the same marked antithesis to all that we understand and would express by development, growth, or nutrition. We can change, after death, fibre into fat, but nothing here is organised anew; disorganization, on the contrary, has been effected.

We may think with profit of Mr. Hunter's words:—"Fat is no part of an animal." . . . "An animal is the same without it as with it;" and couple with them Mr. Paget's commentary. In all cases of conversion of structures, it never appears but at a loss, and is literally no part of an animal—no *essential* part. So far from supporting life in any way, it is nothing but a mark of death. We measure by its quantity the dangers that once threatened, and refer to it when questioned as to sudden dissolution. And so, from a point of view which Mr. Hunter took not, and, with the information open to him, could not take, we may, adapting ourselves to the advancement of knowledge, use language, even stronger than he employed, as truly descriptive of that inferior material which commonly encroaches just in proportion as life is weakened, and is one of the best possible evidences of decline and proofs of fatal atrophy.

(a) In a general sense, Dr. Johnson's definition of the term ("a falling from a more excellent state to one of less worth") seems to answer every purpose. The precise meaning which should attach to it as a pathological expression has been clearly and fully set forth. See Mr. Paget on Inflammation, p. 33, Lecture IV.

PART IV.

Taking the manifest order of anatomy, I should have shown *the relation between degeneration of the larger arteries and sanguineous apoplexy*, before insisting on the changes of the smaller ones in reference thereto; but I have proceeded from branch to trunk, from my mind being fixed on the more usual forms of cerebral hæmorrhage, it being rare to *find* a rupture of any considerable vessel, either without or within the brain, in explanation of the cause of the effusion. But, before directly adverting to those states of the great cerebral arteries which give rise to aneurism or rupture, it will be necessary to make a few observations on the "atheroma" of arteries in general.

With the obvious exception of the arcus senilis, which, from being observed so readily during life, and especially where the irides are darkly coloured, is by far the most frequently noticed form of degeneration, the atheromatous destruction of arteries is the most generally discovered form of decay. Yet, as Hasse takes good occasion to observe, "its pathological import has been but little attended to," for, although it has been associated by so many observers with the obstruction, yielding, and bursting of vessels, its relation to the condition of the smaller blood-channels and tissues around, its wide bearing on definite existence, and the question of general and local death, nay, even its nature, have been loosely explored.

Recent inquiry is, however, apologising for defects of the past, and this degeneration is taking due rank in pathology. Its appearances, as noted by the eye alone, need hardly occupy us; and we may pass on to some points which the microscope has shown in respect of its minute or real anatomy.

Atheroma is a word of complex signification; it is used often to denote a confused mingling of unlike changes, and employed yet more commonly where the precise kinds and degrees of alteration entirely pass by without examination. It has been resorted to by writers where the vessels ramifying in the brain have ruptured, where the heart, with its coronary artery narrowed, has burst, where one or more aneurisms, internal or external, have been discovered, and with not less gravity than could have been assumed by a perfect knowledge of the states it signified. We are indebted to Mr. Gulliver for showing that fatty degeneration is a large part, often, of that which, as a whole, may be called atheromatous.(a) He has discovered in atheromatous matter oil-globules of varying size, number, and form of distribution, earthy concretions, and crystals of cholesterine; and margarine and oleine have been extracted from it by Dr. Davy and himself.(b) So many observers have been able to confirm the correctness of the figures given by this inquirer of the atheromatous material, that it is needless to say that I have seen what were faithful repetitions of the appearances. It must be observed, that atheromatous degeneration varies extremely, according to its stage, and according, also, to the various results of arterial atrophy in different persons. Sometimes fat globules largely predominate, at others calcareous particles. The coronary artery of a woman who died having three aneurisms, seemed affected, all but exclusively, by fatty degeneration.(c) But in speaking of

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(a) On Fatty Degeneration of Arteries, "Medico-Chirurgical Transactions," Vol. XXVI

(b) Rokitansky, who makes a similar statement, speaks of "molecules exhibiting various degrees of consistence, from coarseness to extreme fineness, and consisting of albumen and calcareous salts."—"Pathological Anatomy," Vol. IV., p. 265. Mr. Gulliver observes, at the end of his contribution:—"Several months after the foregoing paper was read before the Society, I had an opportunity, for the first time, of consulting the excellent work on pathological anatomy by Dr. Hasse, from which the following passage has been obligingly translated for me by my friend Dr. Willis:—'Bizot often observed in it (atheromatous matter) shining bodies like gold-dust (gold-pulver); and Cruveilhier saw aggregations which resembled in all respects the plates of cholesterine of many gall-stones. These masses have been examined by Gluge, microscopically, and found to consist of aggregations of fat globules.' I have neither seen M. Gluge's work, nor the observations above referred to of M. Cruveilhier"

(c) The subject of this case was a patient in the Westminster Hospital, under the care of Mr. Phillips. Dr. Basham showed me the specimen. Hasse states that he has found atheromatous masses, "on several occasions, to consist of fat globules merely."

degeneration of vessels as seen only by the naked eye, it is always better to call it atheromatous, for this epithet pledges to nothing exact, and may be used whether there be fatty or earthy particles, or an abundance of both, mingled with cholesterine and albuminous molecules.

The peculiar depositions *upon* the inner coat of an artery, which Hasse describes under the designation of semi-cartilaginous patches, the fibrinous or other matter which may be found lying *between* the coats themselves, and the atrophy and destruction of the vascular structures, must be regarded separately. Whatever the character of the change may be in various cases, atheroma itself is always connected with a state of atrophy. It is often associated with a pretty general decay of organs; and, like fatty degeneration of the heart, it may be produced through the spanæmia and mal-assimilation so apt to be dependent on chronic and exhausting maladies. The author of the unrivalled work on phthisis mentions, that "organic lesions" of the aorta happened in a "sixth part of his cases, in subjects varying in age from thirty-five to seventy-five years."(a) But it will very often be impossible to distinguish between the atheromatous degeneration of lingering complaints, and the normal decay which is proper to old age. It is in the young and the middle-aged only, that we must attempt wholly to connect the change in question with that failing nutrition which exhausting maladies are wont to entail. Often, no doubt, it is the double issue both of time and disease, as in the case of tubercle in association with old age.

Degeneration of arteries may end either in the occlusion or dilatation, the softening or hardening, of a vessel; it is of every extent(b) and degree; it may affect a trunk exclusively of the branches, or the converse, but very frequently, as may be well shown by the blood-vessels of the brain, it more or less involves the artery taken in its entire course. Common in the old, and very often to be called normal, there are not wanting instances of its happening even in the very young; some to the point are cited by Hasse, who speaks of ossification

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(a) Dr. Walshe's Translation of Louis on Phthisis, p. 53.

(b) "In the pathological museum of the Leipsic Hospital, there is an aorta, exhibiting a continuous series of ulcers through its entire length."—Hasse's "Pathological Anatomy," p. 78.

of arteries, more or less extensive, occurring at the ages of fifteen months, and of three, eight, eighteen, and twenty-four years.(a) The kind of degeneration, both in large and small blood-vessels, may perhaps be determined in some degree by the tendency of the constitution itself. What is the influence of gout, for example, in reference to this matter? It must be observed, too, that all arteries are not equally given to decay. The pulmonary artery, as pathological beginners know, is oftentimes quite healthy, when the aorta(b) from its origin to beyond its arch, is here thin and shrivelled, there ulcerated, and studded with atheroma at almost every point. Symmetrical degeneration is, as M. Bizot points out, extremely common; and the fact, interesting of itself, becomes of great moment when taken as illustrative of that general law, whereon Dr. W. Budd and Mr. Paget have so fully insisted.

It would be superfluous to enter at any length into the obvious relation between failure of nutrition and every form of arterial degeneration. Where atheroma is, atrophy has been. Fatty, calcareous, and mixed degeneration, must be connected with the conditions of the surrounding tissues and body generally. Mr. Gulliver (c) and Dr. Davy (d) both insist on there being "almost always atrophy and discoloration of those parts of the middle coat of the artery which happen to be near to the accumulated fatty matter." Hasse speaks of there being found in the atrophic fibres phosphate and carbonate of lime.(e) Rokitansky compares

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(a) Mr. Hodgson observes, in his work on the "Diseases of the Arteries and Veins," p. 23, that "calcareous matter is sometimes deposited in the arteries of very young subjects. My friend, Mr. George Young, possesses a temporal artery which he removed from an infant fifteen months old, in which the coats of the vessel are converted into a complete tube of calcareous matter. Portal observed a similar occurrence, 'Cours d'Anatomie Médicale,' Tom. III., p. 133. See also Scarpa on 'Aneurism,' Wishart's translation, p. 89." As to many important points respecting arterial degeneration, the reader must not fail to consult "Recherches su le Cœur et le Système Artériel chez l'Homme," par J. Bizot, (de Genève.) See "Mémoires de la Société Médicale d'Observation," Tome Premier, Paris 1837, p. 262.

(b) The relative frequency of aneurism in these two vessels will of course be thought of in connexion with this point.

(c) *Loc. cit.*, p. 89.

(d) "Researches, Physiological and Anatomical," Lond. 1839, pp. 327 and 436.

(e) "Pathology," p. 81.

the fatty degeneration of the fibrous coat to "the so-called fatty metamorphosis of the muscular tissue." In considering the changes of this particular structure, we must keep in view how readily fibrin is converted into fat, and the strong disposition of fibrous tumours, their force of growth failing, to calcareous decay.(a) Calcareous granules, in scales and groups of elliptic form, have been seen by M. Bizot upon the lining membrane of certain arteries. Some granules in large arteries may probably, like those pointed out by Dr. Jenner in small vessels, be occasionally difficult, perchance impossible, to distinguish from minute oil globules. True ossification of arteries does not exist; let this process be distinguished from the calcification of tissues falling to decay.(b)

Atheromatous degeneration must be fully considered.

1st. In relation to the arteries themselves:—

a. Their atrophy and change of structure.

b. Their narrowing and obstruction.

c. Their dilatation and aneurism.

d. Their ulceration, as it is termed improperly.(c)

e. Their rupture.

2nd. In relation to the due nutrition of the parts which they supply.

3rd. In relation to definite life, whether looking to the body or particular tissues.

4th. In relation to the symmetrical failures of the nutritive process.

5th. In relation to the question of diagnosis, (d) for this may be aided by an obvious aneurism, or an artery, as the radial, clearly ascertained to be degenerate by the touch.

6th. In relation to the whole complex question of decay.

Although, as a rule, dilatation of the arteries is consequent on some obvious change in their coats, it may be supposed, that, in some instances, simple atrophy may so attenuate and weaken the walls as to disable them from resisting the pressure of the blood. An example of many co-existing aneurisms is on record, in which no change of structure was visible. "M. Jules Cloquet gives a remarkable instance

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(a) *Op. cit.*, Vol. IV., p. 269.

(b) "Lecture on Fibrous Tumours," by Mr. Paget.

(c) Rokitansky's Pathology, Vol. IV., p. 266.

(d) I refer especially to suspected degeneration of the heart or brain.

of disposition to true aneurism in a subject aged fifty. Numerous sacculi were found in all the second-sized arteries. The aorta and primary branches had fewer. *There was no alteration of tissue;* but the sacculi were thinner, as if produced by simple dilatation." (a) Supposing that no microscopical examination were made in this case, it is impossible to say positively that the tissues were unchanged; but, at any rate, it is not a little curious that such a number of aneurisms should have been unaccompanied by apparent change. Dr. Baillie remarks, that "the arteries near an aneurism are diseased to a greater or less extent in different persons; but he does not recollect a single instance in which they were totally free from disease." (b) I have myself seen a considerable number of aneurisms examined, and my experience agrees with the far larger and important one of this accurate pathologist. Dr. Baillie attributes the rarity of aneurism of the pulmonary artery to its having no arch and the easy passage which the blood has through it; but here certainly its comparative immunity from atheromatous change must also be taken into full account.

Looking to the extreme commonness of atheroma of the larger arteries, we shall be surprised that aneurism is not more frequent. At the base of the brain we see daily the most extensive degeneration, and yet aneurism of the arteries situated there, and effusion resulting from their rupture, cannot be called frequent by any means. Many cases have, indeed, been narrated, but let us note through what a space of time they range, and how various their narrators are. The number of apoplexies wherein the great arteries have been proved to be the causes of the hæmorrhage, are as nothing compared with those in which small or very minute branches have been affected; and infinitely the most common seats of aneurism are presented by the small blood-vessels.

But no cases of cerebral hæmorrhage more suddenly kill than those depending on the large vessels; they must generally, of course, be far more swiftly fatal than instances wherein the small ones are involved. Mr. Copeman has collected some interesting examples of hæmorrhage from the great cerebral arteries:—

(a) Mayo's Outlines of Pathology, p. 463.

(b) Morbid Anatomy, eighth edition, p. 16.

1. A case of a man, aged 35, in which a branch of the right middle cerebral artery presented an aneurismal tumour the size of a swan-shot, from the rupture of which death happened in about thirty minutes after the seizure.

2. A case from a small aneurism of the left vertebral artery. Both vertebral arteries were in a diseased state, being in some places cartilaginous, though the individual was only 24 years of age.

3. A case from the bursting of an aneurism of the basilar artery; the coats of the vessel were cartilaginous.

4. A case from ruptured aneurism of the same artery. The patient, a young woman, was only 21.

5. A case from ulceration and rupture of the same artery. The margin of the opening was thick, and of a dull yellow colour. There was no appearance of aneurismal sac. The subject, an attorney's clerk, was 30 years of age.

6. A case from a small ruptured aneurism of the middle cerebral artery.

7. A case, in a youth of 19, from an aneurism of a branch of the middle cerebral artery. It was the size of a pea.

8. A case from rupture where the vena magna Galeni comes to its termination.(a)

M. Serres has described a case from rupture of an aneurism of the basilar artery as big as a hen's egg. Generally aneurism precedes rupture, but, as one of the above instances might be cited to show, not always. Others might be added. Sir Astley Cooper tied the left carotid of a man in 1808. In 1821 his patient died of apoplexy, caused by the bursting of the left middle cerebral artery, which was found larger than that of the right side, and denser and whiter than usual.(b) Sir Charles Bell was called upon to give evidence at the Old Bailey, respecting a woman who died of rupture of the left anterior cerebral artery, after being struck by her husband in a quarrel.(c) This case is of great interest in a medico-legal point of view. A man, aggravated by his wife, who had sold for gin "the bed he was to lie upon and the tools of his trade," struck her in a quarrel, and, "the contention continuing," struck her again. He was tried for her murder, but was acquitted on

(a) "Copeman on Apoplexy," pp. 34, 39, 40, 49, 53, 107, 108.

(b) Guy's Hospital Reports, Jan. 1836, p. 57.

(c) See "Cheyne on Apoplexy," p. 216, *et seq.*

the evidence of Sir Charles Bell, who said that there were states in which external injury or shock might be unusually liable to produce rupture, and that intoxication might predispose to it. I remember being present at the examination of a case of sanguineous apoplexy, which occurred to a woman after a blow upon the forehead by her husband, which left an ecchymosis. The question was, had he killed her? She was in a passion at the time she was struck, and there was associated with the apoplexy a contraction of the right auriculo-ventricular opening of the heart, the auricle being dilated from the impediment offered to the return of blood. Under the circumstances, such evidence was given that the case went no further than the coroner's inquest. It is important, in cases of this kind, to search well for evidences of disease in the large vessels of the brain, and to note accurately whether there be softening about the effusion, and to what extent, and to mark also the state of the small vessels near. Traces of former effusions should also be sought for, and the heart observed, not merely as to its cavities, valves, and vessels, but the minute condition of its fibres.

Cerebral aneurism, like every other, must be viewed closely in relation to fatty degeneration; not that it is contended to arise *exclusively* from that species of decay, which, however, may be held most commonly to aid more or less in its production. Where mixed forms of degeneration occur, we are compelled often, in alluding to *one* of them, to treat of their joint consequences. But, *practically* speaking, it is not so much the exact species of degeneration to which we shall find it so essential to attend, as to the grave destruction of tissue which results. Aneurisms, I apprehend, would be more common in the old, but for the quantity and force of the blood-current diminishing; and, on the other hand, limited degeneration may be perilous in the young, from the full and oftentimes tumultuous circulation which may be prevalent. While lingering disorders dispose to degeneration, they can only be said to lead to aneurism in an indirect and modified sense; but in this way most surely, for parts of arteries, defective in assimilation, will languish and decay, though only at a little spot or two, where anæmia or exhaustion are much protracted; and then it may happen, on the constitution recovering, in a general sense, and the circulation regaining its wonted power, that the affected

spot, equal enough to resist the weak current, gradually gives way before the strong. On going into the history of cases, we feel often that what we most seek is most perfectly hidden. Commonly, for example, we want to know the exact changes left by some fever or exhausting disease, but can reach nothing certain.

Dr. Brinton has drawn up a valuable table of fifty-two cases of intracranial aneurisms.(a) According to his summary, the average time of their occurrence is the fortieth year.(b) The terminations of the cases should be well observed. Asked how these aneurisms may end, we might reply—

1. Death may result from rupture, which was the end of half the instances collected by Dr. Brinton.

2. The aneurismal artery may have its ramifications so degenerated that fatal softening or apoplexy may be the consequence.

3. The aneurism may destroy by direct pressure on the medulla oblongata.

4. It may prove fatal by indirect compression of the same, occasioned, in some cases, by sudden effusion into the lateral ventricles.(c)

(a) See end of Report of the Pathological Society, 1851-52.

(b) A case from Dr. Crisp's work is cited which happened at the age of *fourteen*.

(c) Death seems to have happened from rapid ventricular effusion in the remarkable case of aneurism of the anterior cerebral artery, the size of a hen's egg, detailed by Dr. Hamilton Roe. (Report of Pathological Society, 1850-51, p. 46.) The patient was a young woman of 21, and had long been affected by cerebral symptoms, of which drowsiness, no doubt from gradual pressure on the brain, was one. I watched this patient from time to time, and was one day suddenly called to her, and found her dying. The face was suffused and purple; there was no respiratory movement, not even the slightest; and the sudden application of cold to the face had no effect whatever; but the pulse was still beating, and so kept until the asphyxia was complete. A very large quantity of fluid was discovered in the lateral ventricles, and its pressure, added to that previously maintained by the large aneurism, most probably caused the swift dissolution. No convulsion ever happened in this case, a circumstance to be explained by the locality of the aneurism. Dr. Baillie, observed, that tumours in this spot were apt to produce various impairments of vision, and that they commonly gave rise to convulsion if they made pressure on the medulla oblongata. Compare this latter remark with the results obtained by M. Flourens in his experiments: "Les hémispheres cérébraux ne sont point susceptible d'exciter immediatement des contractions musculaires."—*Systeme Nerveux, p.* 18, *et seq.*

5. It may give rise to mortal epileptic convulsions.

6. Or the patient may die of some cerebral disease in nowise connected with the aneurism; or of heart affection; of renal diseases, or some acute malady; or fever, or of some form of degeneration kindred with that which caused the aneurism. Aneurism, of course, gives no immunity from any other complaint; and so we find it by accident in the bodies of those who have died from affections of another sort.

Deficiencies will be found in many cases of cerebral aneurism which should be supplied by future records. Like apoplexy, it may happen from local decay, or from such as are associated with the most general evidences of decline in both vessels and tissues. The cases should, of course, be classified and kept distinct. Hitherto cerebral aneurism has been viewed too much in isolation. The change producing it is often general, the arteries being almost everywhere speckled with more or less thickly-grouped patches of decay, and time alone is wanting to the development of other aneurismal sacs. It should always be inquired, what is the state of the branches of the artery which is the seat of the disease? what of the neighbouring arteries and arteries in general? what is the condition of the heart and kidneys? and so forth. Is the arcus senilis ever associated with the aneurisms happening in early life?

It was held by Morgagni, that aneurismal dilatations gave rise to apoplexy. This view of the disease, to borrow Dr. Cheyne's language,(a) he has endeavoured thus to illustrate:—"Two aneurismal tumours preceded the attack of apoplexy, which in twelve hours was fatal to the celebrated Bernardin Ramazzini. These aneurisms were not larger than a bean; and, what is not a little curious, they occupied a similar situation on the back of each hand, in the angle between the forefinger and thumb.(b) Morgagni tells us

(a) *Op. cit.*, p. 32.

(b) "Dr. Baillie records an instance where both the internal carotids, on the side of the sella turcica, were distended into little aneurisms, one of the aneurisms being about the size of a cherry, the other somewhat smaller, and similar examples are related by other writers. I have seen two such myself, a beautiful preparation of one of them is preserved in the museum of the College of Physicians." (Dr. Watson's Lecture, Third Edition, Vol. I. p. 515.) Dr. Baillie observes, after mentioning the case which Dr. Watson cites—"It is remarkable, that in the only two instances which have come to my knowledge of aneurisms being formed in the arteries or

that the old man used to show him these tumours, which came on in the last years of his life, and would often describe what he had suffered before their appearance, from a violent palpitation of the heart, and from an intense hemicrania which followed it. At last, after the palpitation and hemicrania had left him, a loss of sight, first of one eye and then of the other, preceded the apoplexy." The palpitation of the heart, the aneurism of the hands, the gradual loss of vision, and, finally, the apoplexy may be concluded most reasonably to be due, all of them, if not to one form of degeneration wholly, at least to mixed forms of it, caused in common by the same prevailing and increasing atrophy. The arguments of Dr. Cheyne are opposed to the view taken by Morgagni; but, had he seen what may be beheld with the microscrope almost daily now, he would never have spoken of the improbability of aneurism extending beyond the great arterial trunks. It is to be believed that many effusions of blood into the brain depend directly on the simultaneous rupture of numerous aneurisms of the small blood-vessels.(a) Instances of apoplexy occur which cannot be explained either by any visible rupture of the large, or by the condition of the minute, vessels. In some of these cases, some branch of intermediate size has probably given way.(b)

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the head and brain, there has been an aneurism in both arteries in the same situation and at the same time. I once met with an aneurism in each of the carotid arteries, at the origin of the internal carotids." (Morbid Anatomy, Eighth Edition, p. 273.) Mr. Hodgson refers to a case recorded by Sir Gilbert Blane of "two aneurisms of the internal carotid arteries, about five-eighths of an inch in diameter, filling up the hollow on each side the sella turcica;" and to a preparation in Mr. Heaviside's Museum, "of two flask-like dilatations of both vertebral arteries immediately before their junction to form the basilary." (Op. cit., pp. 76, 78.) A very interesting illustration of the symmetrical disposition of tubercle in the choroid plexus is given in Dr. Baillie's representations of diseased parts, Tenth Fasciculus, Plate VII.

(a) I have observed in very minute blood-vessels, with the microscope, what I have never seen in a large, namely, a chain of aneurismal dilatations running along its coats. In a former part of this paper (see *Medical Times and Gazette*, December 18, 1852, p. 617) I have spoken of the possibility of vessels, once dilated by inflammation, passing either into fatty or calcareous degeneration. The language is not sufficiently explicit. I had intended only to put the supposition, that they might *occasionally* do so.

(b) A case of apoplexy would not have been introduced in this place, were it not clear that cerebral apoplexy cannot properly be separated from cerebral aneurism in our consideration of these matters, whether we regard the large or small bloodvessels of the brain.

A short time ago, Mr. Hunt gave me the opportunity of examining the brain of a young woman who died rapidly of apoplexy. She was only 21. Her complexion was sallow. Within a few days of her attack, she had been quite well; but then had pain in her head, and was changed in her temper, seeming "morose and dissatisfied." One morning she was seized with what appeared to be an hysterical attack. There were some movements described as convulsive. Insensibility followed, and she sank rapidly, and died about ten o'clock in the evening.

There was a clot of blood in the middle lobe of the brain, close to its inferior surface, and covered only by a very thin layer of cerebral substance. The brain around it was very slightly softened. A branch of the middle cerebral artery, running in the direction of the effusion, was atheromatous, and presented an aneurism, the size of a small pea; but no rupture could be detected, either in this or any other vessel. The cerebral vessels looked generally healthy; the brain, as a whole, was of the most normal appearance and consistence; but yet the liability to apoplexy had not been quite local, for there was a small effusion into the fourth, and in one of the lateral ventricles.

It was, of course, desirable that the small cerebral bloodvessels should be minutely examined. I tried, together with Dr. Basham, to find some traces of degeneration in them, but could only discover a few granules, which resisted the influence of hydrochloric acid, and were undoubtedly fatty.

I sent, also, parts of the brain adjoining the coagulum to Mr. Paget, Dr. Quain, and Dr. Charles Shearman, who favoured me with the following reports.

Mr. Paget says:—"In the piece of brain which you sent me, I found none but small bloodvessels,—capillaries, and those of one or two sizes larger. Nearly all these appeared healthy; only a few showed slight signs of degeneration. I have an impression, that, in other cases of apoplexy in unusually young persons, I have seen the degeneration of the arteries very local. One may suspect, in these cases, that there may have been a single defective spot in a large vessel, rather than a general or extensive state of degeneration."

Dr. Quain remarks:—"I have examined with great care the specimen you last sent me, but I cannot find any marked degeneration in the small bloodvessels. There unquestion-

ably is some; there are highly refractive particles studding the walls of several of the smaller bloodvessels. The change may possibly have affected the branches of some one particular vessel, of which, perhaps, I have not got a particle. The case is most interesting."

Dr. C. Shearman observes:—"The bloodvessels, generally, are very full of blood; long single rows of blood-corpuscles are seen in some of the smaller. I cannot find any aggregations of fatty granules. In the small vessels, of about the diameter of $\frac{1}{1300}$th of an inch, the fat-granules are scattered about in small quantity, but certainly not to an extent sufficient to render the walls brittle or liable to bulge. By acetic acid, some other fat-granules become visible; but these lie outside the vessel."

Abundance of cases will be found in which cerebral hæmorrhage is seen associated with largely pervading degeneration, either of a fatty or earthy kind. This instance deserves comment on a different score. It is remarkable for the limited traces left by it of a defective nutrition. But though remarkable, it is an example, I doubt not, far from singular. The vessels of the brain, just like those of the heart, are liable to very local decay. Why so? Is it that the blood has not reached fully the affected spot? Or that the spot itself has been defective in assimilating power? Perhaps we do not sufficiently allow for the latter condition in many instances, for it is beyond question, that there are parts within us weaker than the rest, and prone especially to morbid influences and premature decay. They do not flourish as the rest do, even under precisely the same circumstances. And so it would appear that the guide of philosophers had no little occasion for remarking:—"And as to the diversity of parts, there is no doubt but the facture or framing of the inward parts is as full of difference as the outward; and in that is the cause continent of many diseases, which, not being observed, they quarrel many times with the humours which are not in fault, the fault being in the very frame and mechanic of the part, etc."(a) No physician, probably, could have gone much further at the time of this passage being written, for then the laws of nutrition were but little known. That we must look, not to the blood only, but to the

(a) Lord Bacon's "Advancement of Learning."

assimilating processes of the parts it supplies, for the explanation of various defects of nutrition, and more especially to those which are extremely bounded, may be seen clearly, to proceed no further, from the ofttimes precisely symmetrical disposition of the palpable results of disease and decay. Much, most undoubtedly, lies in "that process, in the exercise of which fellow-parts separate from the blood and appropriate matters of identical composition, and maintain through life their original likeness in form, composition, and structure."(a) As correspondent parts are alike in living, so also in dying they are still alike; that strength which once was both simultaneously and equally furnished, becomes withdrawn in the same manner. But one occasional, obvious reason, whatever may lead to it, of unsymmetrical decay, is no doubt some disparity in the assimilating power of corresponding parts; and hence we find sometimes, though M. Bizot's deduction may be confirmed so often, that an artery is atheromatous at a particular spot, whereof the fellow place in the opposite vessel foreshadows decline not ever so slightly; nay, more, that one spot is perhaps almost the only part in which nutrition can be demonstrated to have fallen short.

When under the microscope there lie spread before us a number of fibres of most various aspects, some showing hardly a remnant of muscularity, others having striæ scanty and faint, a third set appearing with perfect structure, we are driven to conclude, supposing (which, we may grant, must sometimes happen) them to have been perfectly equal recipients of the blood, that they must have most differently availed themselves of the supply afforded, and have offered most dissimilar resistance to destruction. But here we see no more than we may every day discover in the whole body, or any organ of it. Inequality of nutrition is no ground for surprise. Rather would it be strange if every fibre of one muscle, every duct of one gland, if all portions of every tissue had precisely the same original structure and power, and were exposed to exactly the like influences, and similarly answered to them throughout all the term and changes of life. Were this so, indeed, all parts of each tissue would

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(a) Dr. William Budd on the "Symmetry of Disease," "Medico-Chirurgical Transactions," Vol. XXV., p. 100.

of necessity perish exactly together; one hair would not turn grey before the others, and the irritability of a single muscular fibre might be held as a proof of the soundness of the rest.

In mentioning the remarkable case of Ramazzini, who had symmetrical aneurisms, I have added a note which might, perchance, lead to the supposition, that such aneurisms are more common than they really are; and, arguing from the remarkable symmetry which has been proved to exist in arterial degeneration, they might be naturally supposed to be very frequent; but M. Bizot found only 6 out of 138 subjects, affected with aneurism of the extremities, who presented a symmetrical position of it. (a) Moreover, in 551 cases placed together in a table by Dr. Crisp, I find fellow arteries described as aneurismal fifteen times only, and out of these the popliteal are mentioned eleven; nor would I have it inferred, that the double aneurisms were strictly symmetrical. One of the cases recorded is a popliteal aneurism, in which another aneurism of the same kind was cured by pressure fifteen months before. (b)

In conducting the inquiry, it is plainly of great importance to be satisfied, not only, when an artery becomes aneurismal, that it is free from aneurism on the spot opposite to that affected, but also that the vessel is *healthy* there; for there may be, as M. Bizot takes occasion to observe, corresponding degenerations, though differently advanced. (c) *Time* is to be distinguished from *seat* of occurrence. Cataracts are, of necessity, always symmetrical when fully formed; but one takes the lead of the other, often thus furnishing an instance of resemblance as to seat, but of more or less difference as to time of decay.

Even now the history of aneurism is incomplete. What are its associations? Of what die those who have been cured of the affection by the ligature or compression? How often springs it from local defect or accident? how often from part either of extended or general atrophy?

(a) Loc. cit., p. 440.

(b) Diseases of the Blood-vessels, p. 235.

(c) Mr. Phillips laid recently before the Royal Medico Chirurgical Society a case of double (not symmetrical) popliteal aneurism occurring in a woman. I had the opportunity of observing it, the patient being treated in the Westminster Hospital.

Dr. Bellingham and Dr. R. Quain have both referred to its association with fatty degeneration of the heart. I have laid a case where this occurred before the Pathological Society; (a) the subject was 29 years of age; there were found, also, slight fatty degeneration of the small blood-vessels of the cerebellum and granular atrophied kidneys.

Both in a surgical and medical point of view, the association of aneurism and fatty degeneration of the heart is of great practical consequence. If an artery be tied where the heart is ill-nourished, partly degenerated, and feeble to the utmost, is it not likely, even setting all other considerations aside, that the circulation may be consequently so feeble as to prevent the wished-for, necessary changes? (b) Symptoms have been charged to the progress of aneurism on certain occasions, which were due more probably to the state of the heart connected with it. Lancisi refers to difficulty of breathing, on exertion, as a sign of "aneurism of the pulmonary veins," and quotes Peter Poterius to show, that those who are affected with it are apt to die suddenly. But this author excelled in imaginary diagnosis, and was clearly equal to the (I say, not unscrupulous,) invention of causes. (c) Setting both this, and many other writers, aside,

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(a) Report, 1851-52, p. 310.

(b) I have referred, in the first part of this essay, to degeneration of the blood-vessels as one cause of the failure of operations for aneurism in aged persons. Very early age does not give good reason to apprehend a bad issue, but late life often does. Mr. Haynes Walton tied successfully the common carotid of a child only four months old, who had an aneurism by anastomosis within the orbit, and the operation succeeded perfectly. "Our anatomical injections," says Mr. John Bell, "are successful only in very young subjects; while, in older subjects, the arteries burst, because they have lost their strength, or tear, under the necessary ligatures, because they have lost their pliancy. The anatomist knows, by the first touch of the femoral artery, for example, whether his subject will bear to be injected; and the surgeon, in like manner, often foresees, by the first touch of his finger, those burstings of the artery and secondary hæmorrhages, of which so many have died."—"Principles of Surgery," London, 1826. Vol. I., p. 316. Mr. Bell makes reference to the case of Petit, who, having amputated a thigh, could neither affect the femoral artery by tourniquet nor ligature.

(c) "Treats of the diagnosis of spasm of the longitudinal fibres of an artery." . . . . "The diagnosis and treatment of false aneurisms depending on spasm of the circularly-spiral fibres of arteries are explained." —"Observations on Aneurism," printed for the Sydenham Society, pp. 51, 52.

however, it is plain, from the detail of recent cases, that symptoms may occur in the course of aneurisms which are probably due either to atrophy or degeneration of the heart.(a) I may refer especially to the attacks of syncope, which frequently occur, and these certainly are not due always to changes happening in the arterial tumours. In some cases of aortic aneurism, there are palpitation, faintness, breathlessness on exertion, all relieved somewhat by the recumbent posture; all, commonly, to be more satisfactorily accounted for by the state of the heart than that of the aneurism. A man, who was a patient of Mr. Holt's, died lately in the Westminster Hospital with a huge aortic aneurism, which caused an immense bulging of the chest. So pale he was, that syncope could hardly make him paler. Not rarely his breathing laboured, his pulse fell, and he seemed as though dying. The swift march of the aneurism, together with the immense quantity of blood which, after death, was found to have been deposited within it, sufficiently explained the marked anæmia. I examined the heart microscopically. Fibres were chosen from both auricles and ventricles. There was incipient fatty degeneration everywhere, and in some places it was very marked. Moreover, fat was noted in abundance between the fibres. But it must be left for future research to demonstrate how very closely we should observe the heart in various instances of aneurismal tumours, and not at once, and too positively, refer for explanation to certain assumed changes in the latter when passing attacks of faintishness occur; or, as in other cases, where an ashy paleness overspreads the features, as with death's own hue, and the heart pauses or falters frightfully, and the breathing is transacted in long, distant sighs, and the mind seems as though departing from the body, and drops of sweat lie crowded on the brow.

For those who are contented with resting on effects, without looking to causes, the association of aneurism with the subject of degeneration, both fatty and calcareous, has but

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(a) A case is related by Mr. Hodgson (*Op. Cit.* 48) in which much heart-disease co-existed with marked dilatation of the aorta. The subject of it was subject to syncope, had a small, frequent, intermitting pulse, and died suddenly. "The semilunar valves were thickened, and separated from each other." "The right ventricle of the heart was very much enlarged and flabby."

little interest. But aneurism, as a general rule, is not less dependent on imperfect nutrition, though far, oftentimes, from being *entirely* so, than suppuration is on a process of inflammation. And as, in treating of inflammatory action, we must speak of abscess, so, in discoursing of atrophy and its issues, must we consider aneurism. In the course of this change we are too apt to think only of the operation for its cure; or where, unhappily, no ligature can be resorted to, nor compression used, to confine ourselves to the helpless watching of its progress. It is, be it observed, far more terrific in a medical than a surgical light; large arterial trunks have been secured with a boldness to be justified only by confidence in nature, whose great resources are the best aid of art; but what is to be done for cerebral, thoracic, abdominal aneurism?

Let this affection, like every other, be, wherever possible, viewed carefully in its every relation. Of what significance is a slight spot of atheroma, when regarded in true connexion with it! In the varied processes of the human body, be they of health or sickness, there is no such matter as an accident, no such thing as a trifle. The fall of an eyelash typifies death; the least speck of arterial atrophy or degeneration is in accordance with a law not less fixed than that whereby man, regarded as a complex whole, becomes "developed into dissolution." Let us not forget conclusions in phenomena, nor think that *mere* observation will avail. If we view principles, without reference to facts, we shall soon be advancing beyond our depth; but if we view facts without reference to principles, we shall be as young children seeking pebbles on the shore.

CONCLUSION.

THERE are times in which we most gladly quit the contemplation of decay, to refresh ourselves with opposite subjects. We turn from the spectacle of withering age to that early period of human existence wherein progress of body and expan ion of mind seem, as it were, to contend for mastery, and power nerves each fibre of the frame and beauty decorates it with luxuriant graces; or still wishing to occupy our thoughts intently, we leave with delight the pages of Rokitansky, that voluminous historian of varied destruction, to dwell on the contributions of Schleiden and Schwann, those philosophical expounders of the laws of growth of plants and animals.

But perhaps my readers are already tired with my dwelling so long on a process of destruction; yet I would ask them before concluding, to take a calm, wide, just survey of the importance of those recent investigations which have thrown such a great and lasting light on this common, and oftentimes premature and insidious, form of decay.

They show us how long we have been wandering in confusion; how long we have been calling and treating, or rather mis-calling and mis-treating as *separate diseases*, what were only forms of one common degeneration. What a medley of instances has observation collected which, linked by no reason, illustrated no law, though they testified to an industry that, undiscouraged by failure, still groped in darkness! Who a short time ago would have dared to assert, unless from some morbid desire to be ridiculed, hæmorrhage of the brain, the heart, the lung, and the

placenta was often the result of fatty degeneration similarly affecting those parts and leading to their rupture? Who could have asserted that "mollities ossium," atheroma of arteries, and the arcus senilis, heretofore grand and unmeaning appellations, were only specimens of the same devastation? Who have affirmed that ramolissement of the brain and softening of the heart were (I say not invariably) examples of it too? Who could have spoken of degeneration of the liver and kidney as conditions associated with, and dependent on general atrophy? Who could have traced gradual to the same cause as sudden death as now we can? Surely there has been, to speak most modestly, a great and evident advancement in pathology.

Formerly when I turned to works of authority for some intelligible information on the true nature of softening of the brain, I found myself in a sea of confusion. I could little comprehend why it should be denominated a *special* affection, or why it should be referred often and unhesitatingly to inflammatory action, or why it should be remarked in such frequent connection with sanguineous effusion. I found that some observers,—as Rostan and Abercrombie,—wrote clearly enough on certain cases; but their views failed lamentably to reconcile what appeared such unlike instances, and fell immeasurably short of the truth as we are enabled to see it now. As for many observations made upon the subject, they have left it far darker than they chanced to find it; they tend to no simple and enlarged deduction; they are without clearness, for they want truth. The great majority of cases of cerebral softening are certainly due to mere failure of nutrition, often implicating many parts together, of the decay whereof an index is frequently written legibly on the clear cornea. Cases which at first sight appear anomalous, are not really so; no age excludes atrophy and fatty or other degeneration. In an idle admiration of rare instances, men are apt to forget those every-day examples which are in crowds about them, as though familiarity with a phenomenon were equivalent to understanding it: but there is no greater, plainer error; nor have we, most of us, a more pressing need than that of thoroughly questioning ourselves as to how much real knowledge, as opposed to mere conceit or fallacy, is laid up in our memories.

One would think, to see how some persons confuse themselves

with vain differences and distinctions, that they were actually interested in finding them; but true advantage and means of progress lie, on the contrary, in simplification, in ascending from facts to laws, in seeing in opposite classes of phenomena the various yet not opposing expressions of distinct principles. We have had enough of detached sentences in pathology, of mere scattered syllables and bits of syllables, and we require discourses of concurrent passages, flowing from principles and pointing to ends. We have our field-days for science. A tribute is to be paid to Harvey or Hunter, and we become inductive philosophers *for the day.* But an *habitual* mode of thinking, speaking, acting, proving how earnestly we have studied those great and immortal interpreters of Nature, would, though a silent, be the highest veneration we could pay to memories quite above our praise. How do we need that spirit of philosophy which animated them! They knew (what some men will never learn), that the great *student* is the only *teacher.* Some writers appear to proceed on no plan but that of showing how much they need one. In a science like ours, so full of difficulty, and demanding not only careful observation, but so large an exercise of the reasoning power, we require contributions which are consistent throughout. It might at least be expected of every author that he should not be perpetually contradicting himself, nor invent fresh causes at every turn. The student, bewildered by the various directions which a writer will point out, resembles a traveller, who, having lost his way, is told by some person with whom he may chance to meet that he may go to the right or to the left, straight forwards or turn back. Men who are familiar with the author's subject, may be able to separate the corn from the chaff,—but the student is in search of, and requires a guide. He is baffled by the variegated, incongruous story. He sees glimpses of truth in the chaos before him, but finds it not less difficult to distinguish the right doctrine from the mass of error which surrounds it, than to extract a Diana or a Minerva from a block of marble not yet rough-hewn.* But if he will study the great subject of Fatty Degeneration, he will have no difficulty in *discovering* for himself

* This expression is borrowed from an admirable passage of Descartes. See Œuvres. Paris, 1851. Page 12, Discours de la Méthode.

the close and speaking relationship of facts which seem to have none at first sight; and how uniformly one part of the long history is supported by the rest of it. Let him only fasten his attention on the subject, and he will want no guide; he will perceive the researches of different inquirers agreeing as productions of a single mind. They have all the consistency, all the simplicity, all the weight of truth; and to English pathologists are disproportionally due the credit of inquiries which will most certainly advance not only the science, but the practice of medicine; teach us, times and often, both what to do and what most to refrain from doing; and add largely to the proofs, that "knowledge *is* power."

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