in the cases now under consideration. But the occurrence of those minor pulsations is interesting, as shewing a connecting link between the cases of weakened heart, with a rapid though irregular pulse, and those where the pulse is slow and regular.

The preceding observations are published with the view of drawing the attention of the Profession to a combination of cerebral and cardiac phenomena, of which our knowledge is still imperfect.

ART. IV.—*On the Microscopical Character of Mollities Ossium.*

By JOHN DALRYMPLE, F.R.C.S., Surgeon to the Royal Ophthalmic Hospital, Moorfields, London. With Illustrations.

THE object of the following observations being to illustrate the pathology of mollities ossium, and not the particular case in which the disease occurred, I shall detail no symptoms, nor mention the various phases of the malady. The case, in itself sufficiently curious, will, in all probability, be made public by the physician who had charge of the patient; while some minute chemical observations by Dr. Bence Jones, on the condition of the urine, which formed an extraordinary feature throughout the illness, will either be published in the Transactions of the Royal Society, or be appended to the case by Dr. MacIntyre, who attended the subject of this disease.

It may, however, be interesting to state, that no suspicion of the affection of the bones existed during the life of the patient, and the mollities was only revealed by the post mortem examination. As the disease does not appear to have extended to the long bones, it is not remarkable that this should have been overlooked.

Throughout, the case presented many anomalous symptoms, and a minute detail of its history and progress cannot fail of being interesting to the Profession. In justification for publishing the microscopical appearances of the bone, prior to the history of the case appearing in print, I may be permitted

to observe, that the following remarks are simply a contribution to the minute morbid anatomy of an interesting and as yet insufficiently studied subject.

Examination of two lumbar vertebræ and a rib, affected by mollities ossium:

The disease appears to have commenced in the cancellated structure of the bone, for the external osseous laminæ are firmer and more healthy than the internal. The smooth surface of the rib, however, is raised by internal growths elevating the outer laminæ here and there, into irregularly-sized and rounded dark red projections, visible through the periosteal covering. The outer layers are still hard, requiring the exertion of some force to cut them; they are thin, however, and when sliced, expose large cancellous cavities filled by a red gelatiniform substance, threaded here and there by fine bony fibres. It is in these fibres of still existing bone, that many of the more important morbid changes may be witnessed.

The gelatiniform substance, as shewn in the accompanying wood cut, is composed of—

1st. Granular matter.

2nd. Oil globules.

3rd. Fat cells.

4th. Nucleolated nuclear cells.

5th. Caudate cells.

6th. Blood cells.

Examined by a power of about 600 linear, we find that :

1st. The granular matter appears to be the disintegration of the tissues, or of the effete cells, mixed with an infinity of oil globules of great minuteness ; partly also the granular matter which has escaped from bursten nucleated cells, since these latter are found to contain similar microscopic granules. It may be questionable whether any part of this granular matter be molecules of phosphatic earth.

2nd. Oil globules are very numerous, of various sizes, from the 8000th of an inch in diameter, to the 300th, or even larger. They are easily recognised by their dark outlines and high refractive power, and seem to be floating free amongst the various nucleated cells. They are very frequent in the specimen of diseased vertebræ, but less numerous in the rib.

3rd. Fat cells. Besides the oil globules, many dark granular cells are observed, mostly of an oval form, and somewhat irregular as to size ; they seem to consist of a fine transparent cell wall, the interior filled by round oil globules closely aggregated, and thus giving them their dark appearance. In almost all respects, they resemble the adipose cells found in colostrum, and are well represented by fig. 21, in the fifth plate of Henle's *Anatomie Générale* (French translation), specimen D. taken from the fluid of colostrum.

In some, whose shape is more irregular, the cell wall appears to have burst, and the globules are simply aggregated by a cohesive force, the globules disgregating on pressure, and constituting the free oil globules found floating in the fluid.

4th. Nucleated cells appear to form the bulk of this gelatiniform mass, and appear in great numbers, of different sizes and forms, probably modifications only, or more or less advanced stages of the same matter. The greater number are round, some are oval, others more irregular and pointed at one extremity. The round and smaller ones are about one and a half to twice larger, than the average blood cells, and, for the

most part contain a single and faint grey nucleus, with a very bright and distinct nucleolus.

The oval cells have frequently two included nuclei, each with a bright nucleolus.

The larger and more irregular cells often contain three nucleolated nuclei, but rarely more; once or twice I have seen indications of a fourth included nucleus. In all the cells, besides the nucleus, there is some very fine granular matter, appearing as fine black points.

5th. Caudate cells are very rare; but a few are recognised as feeble attempts at progressive development. There are, however, no perfect filamentous tissue cells to be seen.

6th. Blood cells, or blood disks, normal in every respect, are very numerous, extravasated amongst the other cells, and giving the red colour to the gelatiniform mass.

This account of the soft matter found in the cancellated cavities of the diseased bone, accords very nearly with the description given by Mr. Birkett, in Mr. Solly's paper on *Mollities Ossium*(a); but the statements of Mr. Rainey and Mr. Simon differ so much from Mr. Birkett's, and from each other, in their observations on the same specimen of disease, that we are left in some doubt as to the actual appearances.

Mr. Rainey describes "a multitude of roundish bodies about the size of blood corpuscles, each of those bodies filled with a minutely granular substance" (*loco cit.*), he making no observation of nucleus or nucleolus. Again, he states, "Besides these bodies it contained also fat globules, but no regular fat vesicles;" whilst Mr. Simon "was unable to discover any new cell formation, or at any rate any mature one; cytoblasts were exceedingly plentiful, so as to suggest the probability that some such process was in progress, but nothing further, with the exception of some two or three apparently detached young fat cells."

These discrepancies, may, perhaps, be accounted for on the

(a) *Medico-Chirurgical Transactions*, vol. ix. New Series, p. 453.

supposition that these three gentlemen pursued their investigation on different portions of bone, from distinct parts of the body, and in more or less advanced stages of the disease; for while Mr. Birkett found a few caudate cells in the cranial bones, he discovered none in the vertebræ, and in the femur "nothing but fat cells and blood disks."

Be this as it may, a very important part of the investigation remains untouched, viz., the condition of the still existing bone or previously healthy tissue. It will be interesting, therefore, to determine, if possible, the point where the hard parts of the bone first begin to suffer, by what means the original textures are removed, and the new matter made to occupy the place formerly filled by the healthy bone, and its proper constituents.

It may at once be premised, that of the soft elements found in the diseased mass, the oil globules, fat cells, and blood disks (within vessels), existed in the normal condition of the bone. The two former are those found in excess, and the latter are extravasated. The nucleated cells, of whatever kind, probably are new, and, therefore, morbid. These, together with granular matter, the debris of effete cells and broken down tissue, with a fluid menstruum, constitute the gelatiniform mass, that occupies large cells or enlarged cancelli of the bone; thence certain hard parts or bony fibres have disappeared, have become softened, dissolved, and carried away, with their bone cells, proper canaliculi, and the former apparatus of growth and nutrition, Haversian canals, lining membrane, and capillary vessels.

In order to estimate the process of this destruction, it is necessary to state, that, as regards the parts submitted to my observation, viz., the lumbar vertebræ and ribs, the quantity of tissue removed has not been replaced by an equal quantity of new or morbid matter, but that a real diminution has taken place, a veritable interstitial absorption. The lumbar vertebræ scarcely exceed in thickness the intervertebral substance, and have lost nearly one-third their normal bulk.

In the second place, besides the loss of bulk, there is a great deficiency of the cohesive properties of the bone, which can now be broken or cut with facility, in some places bent without fracture, in others rendered more brittle, and easily fractured.

This, it is evident, is due to the loss of the earthy constituents of the bone; this degeneration, however, is not uniform, but more immediately in the neighbourhood of cavities containing the gelatiniform substance; since even remains of cancellated bony fibres are found passing through these morbid masses, sometimes little altered, at others softened, but not destroyed, in a state of metamorphosis rather.

The external tables of the bone resist longer than other parts, and a whole bone may be so soft, *generally*, as to bear to be bent without breaking, although the external laminæ are still so hard as to be cut with difficulty, even with a strong knife.

The disease, therefore, probably, commences in the cancelli and medullary canals, and proceeds from the Haversian canals to the bone cells and canaliculi. It is to these latter points that attention must be directed.

If a minute fragment of bone be selected from the edge of one of these cavities, which contain the soft red matter, we shall often find edges thin enough for microscopic observation, without further interference than simply washing it clean from the nucleated cells and blood disks that surround and adhere to it. If it be then examined with a power of about 600 linear, certain changes of importance will become visible. The edges of the bone, at the very margin of the cavities alluded to, are reduced to the greatest possible tenuity, and appear to be embedded in a mass of nucleated cells, which adhere with great tenacity to the bone. When these are washed away, the bone itself seems composed of polyhedral cells, resembling some forms of vegetable tissue, but these cells are indistinctly visible, appear below the surface, and out of focus. When the eye is brought to look upon the superficies, the proper bone cells (bone corpuscles of some authors) become apparent. Instead, however, of the usual

elongated, narrow oval cell, with more or less extended dendritic canaliculi radiating from their parietes, they are found considerably enlarged, or irregularly round, and the canaliculi proportionately shortened, in so much that the diminished length of the canaliculi seems to depend upon the enlargement of the cells whence they originate, or into which they pass.

At first sight the bone cells appear more numerous than is natural, but this is due to the approximation of the cells to each other, by reason of their mutual enlargement.

In those instances where the bone cells have undergone only early changes, although the enlargement and alteration of figure be still perceptible, the canaliculi are less disturbed, and in some aspects appear as if truncated, and crop out of the surface, resembling the tubular structure of ivory, when cut transversely to the direction of the tubes.

Away from the edges, or as we approach more solid portions of bone, presumably less implicated in the disease, the bone cells are found more of their natural size, more of their normal figure; the canaliculi longer and more arborescent,—in fact, less interfered with by diseased action, as is shewn in the accompanying cut.

It is difficult in such an investigation to say whether these enlarged bone cells are occupied or not by any of the nucleated cells, for as the gelatiniform matter surrounds on all sides the portions of bone, and as it is composed of myriads of cells,

blood cells, oil globules, and granular matter, it is obviously impossible to gain a view of the bone cells without a careful washing of the specimen in many waters.

The cellular *appearance* of the bone before spoken of, seems to be due to portions of the structure immediately surrounding the bone cells being more transparent than elsewhere, as if indeed the denser part of the tissue immediately around a system of these bodies had been absorbed, and so enabled the transmitted light to shine through more easily. Although this is a point not very clearly determinable, especially as this appearance is more readily recognised when the instrument is not in its true focus, yet it favours the belief that absorption is set up in the immediate neighbourhood of the bone cells, and encourages the view that the enlargement of these cells is due to progressive absorption from their inner walls, and thus that their natural function of growth and support is in this instance perverted.

It is true, however, notwithstanding what has been assumed above, that we as yet want definite knowledge of the functions of the bone cells, and their canaliculi, in the normal state; it is probable, however, that they are subservient to the purposes of growth and nutrition. In a transverse section of a long bone, they are found arranged with a good deal of regularity in the concentric osseous laminæ which surround each system of Haversian canals. These latter conduct the capillary plexus of blood-vessels; the plasma, or that fluid which contains the proper elements of nutrition, is eliminated without doubt from these blood-vessels. May not, then, the canaliculi, as a system of capillary tubes, convey the fluid to the bone cells, as organs of appropriation, and may not, also, effete parts, the displacement of old, as well as the replacement of new molecules, go on by these channels?

The observations made in the specimen of mollities ossium lend some colour to this view. In the neighbourhood of the diseased cavities from whence bone earth has already been re-

moved, we find the bone cells all enlarged, and altered in figure, interstitial absorption going on from surfaces, viz., from the inner walls of the bone cells themselves. Thus gradually enlarging, they at last run one into the other, and constitute the hollows, now filled with the reproductive nucleated cells, and the debris of old tissue.

While this destructive process goes on, we have evidence of undue turgescence of the vascular system. I am not aware whether any injection, or at least any *microscopically successful* injection, has ever been made of bone in this disease, but its greatly increased redness, even the extravasation of the so numerous blood disks, are proofs of the fact. Blood long effused undergoes many changes, microscopically considered; the cells become shrivelled, irregular, crenated, &c.; here, however, the disks are, for the most part, wholly normal.

Presuming, therefore, either a high degree of vascular congestion or of vascular activity to be present, the proper functions are perverted. Original structure is removed, soft as well as hard elements are carried out of the part by its own vascular system, and out of the body by the excretory glands, the still healthy kidneys. The particular case now under observation evidenced the most extraordinary morbid excretion furnished by perfectly healthy excretory organs, the depuration of a vitiated blood. But while this waste or disintegration of the bone is going on, while the local circulation appears to be active, and the supply of blood increased, the lost parts are not replaced by new matter of a like kind; in place of a molecule of bone restored for one removed, we find cytoblasts, a nucleolated nuclear cell, each probably, as in malignant disease (with some special differences), capable of furnishing its like.

These facts admitted, were we to examine no further, *mollities ossium* would be reduced to the category of malignant diseases, a simple fungoid condition of the bone,—to which, indeed, it bears some superficial resemblance.

In true malignant disease of bone, original structures are

destroyed, and replaced by new and soft matters, but the mass ever increases, new cells go on producing still newer ones, until sometimes the tumour attains enormous bulk. In the true osteo-sarcoma, new bone is, however, formed, not much differing in its essential characters from healthy bone, while in the disease under consideration no new bone is ever formed, and the real bulk of parts is diminished.

It seems probable, therefore, that in mollities ossium the nucleated cells have a limited duration of life; some feeble attempts at progressive development are seen in the caudate cells, but after a certain reproductive process the majority die, or become disintegrated, are resolved into granular matter and oil globules, dissolve, and are carried out of the system by the circulation of the kidneys.

Such cells will therefore take a position a little above pus formations; pus cells are nucleated, do not probably reproduce themselves, have a short time of existence, die, become disintegrated, fall into granular matter, oil, and liquor puris, and are, as we know, often absorbed. In mollities, the nucleated cells do probably reproduce their like; the original cell bursting, and giving out its nucleus, or nuclei; these latter pursue a similar course, then become disintegrated and fall to pieces. This explanation will account both for the very different shapes, sizes, and numbers of these cells and their included nuclei; while their shorter period of life, or ready disintegration, separates them from those higher forms of malignant disease, where the mass increases the more rapidly as it approaches its conclusion, or advances in a sort of arithmetical progression, until the patient is exhausted by the demand made upon the system for ever-increasing growth.

[In order to render the foregoing remarks as clear as possible, the accompanying wood engravings have been made from very accurate drawings by Mr. Dalrymple. In these, *a* represents a blood disk, as means of comparison

for size; *b*, different forms of nucleated cells; *c*, caudate cells; *d*, fat cells; *e*, oil globules; *f*, natural aspect of a bone cell; *g*, enlarged and morbid bone cell.]

ART. V.—*Remarks upon Cerebro-spinal Arachnitis, as it has lately appeared in the Irish Workhouses and some of the Dublin Hospitals.* By ROBERT MAYNE, M. B., Physician to the South Dublin Union Workhouse, and Lecturer on Anatomy and Physiology at the Richmond Hospital School of Medicine.

THE disease which forms the subject of the following pages consists essentially in acute inflammation of the membranes which invest the brain and spinal marrow; and from the post mortem appearances presented by the fatal cases which have fallen under my observation, the arachnoid seems to be its especial seat.

This disease, so far as I have been able to ascertain, has but recently made its appearance in Ireland; and to my friend, Dr. Darby of Bray, his professional brethren are indebted for the first notice of its ravages. During the months of January, February, and March, of the present year, several cases occurred in the Rathdown Union workhouse, to which he is physician,