ON THE
ENLARGEMENT OF THE VISCERA
WHICH OCCURS IN RICKETS.

BY

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Received June 3rd.—Read June 22nd, 1869.

It has long been known that with rickety children certain of the abdominal organs are apt to increase in bulk. Dr. Whistler, who gave in his dissertation 'De Morbo Puerili Anglorum,' published in 1645, the first account which we have of *the rickets*, as the complaint was even then popularly termed, described an enlargement of the liver and spleen as pertaining to the disease, and considered the "obstruction" in these viscera as the first departure from health. He introduced the more than sesquipedalian word *Pædosplanchnosteocace*,¹ as indicating that this disorder of childhood affected both the viscera and the bones.

Glisson, in his elaborate treatise upon *rachitis*, published five years later, refers to enlargement of the liver and mesenteric glands as belonging to the complaint, but considers that the spleen is not affected except as an accidental complication.

¹ Some interesting information concerning the bibliography of rickets is given by Dr. Gee in the 'Bartholomew's Hospital Reports,' vol. iv, p. 79.

Dr. Bright,¹ in the year 1838, described an enlargement of the spleen as occurring especially in early childhood, though he did not associate it with the rickety condition. He described this organ as becoming hard like a half-ripe apple, as having on section the lustre of damson cheese, as presenting numerous opaque whitish granules (apparently the enlarged Malpighian corpuscles), and as being swollen to such an extent as often to occupy the greater part of the abdominal cavity.

It appears, however, that little attention had of late years been directed to the state of the abdominal organs in rickets until Sir William Jenner, in his well-known lectures,² dwelt upon their changes in bulk and texture, and attributed them to an albuminoid infiltration. He pointed out that in the rickety enlargement the organs differ from the lardaceous or amyloid state in the absence of reaction with iodine, and, as regards the spleen in particular, in the absence of the sago-like transformation of the Malpighian corpuscles. He, however, made only a partial separation between the two conditions.

It seems that the alteration which the viscera undergo in rickets is still imperfectly understood, and is generally confused with the more common lardaceous or amyloid change, to which it bears a superficial resemblance while severed from it by essential differences.

I will now proceed to describe the changes which occur in the liver, spleen, and lymphatic glands in rickety children.

During the progress of rickets, if the disease be severe, and particularly if it be attended with emaciation, the liver is often found to extend below its normal situation, occasionally as low as the umbilicus, the smooth surface of the organ being very evident to the touch beneath the thin abdominal walls. The spleen under the same circumstances becomes enlarged, more frequently and to a greater extent, often acquiring seven or eight times its normal bulk and

¹ 'Guy's Hospital Reports,' vol. iii, p. 401.

² 'Medical Times,' 1860.

occupying the greater part of the left side of the belly. This organ, dragged down by its increased weight, often lies with more of its bulk below than above the navel, the upper edge of the spleen being below and nearly parallel to the lower edge of the liver. A swelling often takes place at the same time in the absorbent glands, particularly in those of the mesentery. The glands which lie near the surface of the body are often evident to the touch like shots under the skin, but the swelling is seldom such as to cause visible protuberance.

Before dealing with these changes in their clinical results their morbid anatomy may be taken into consideration.

The liver, to commence with this organ, undergoes an increase of size evenly throughout its whole bulk. It becomes less friable than in health, hard, dense and elastic. It is usually pale in colour, containing little blood. The acini, themselves of yellowish colour, are often each surrounded by a thin pinkish or grey line, so that the cut surface is covered with a fine uniform polygonal pattern, such as may be produced when from any cause there is an increase in the fibrous tissue. Sometimes in these cases it is evident to the naked eye that there is an increased quantity of loose material surrounding the smaller branches of the portal vein. The alterations which have been described are, in fact, produced by a general increase in the fibroid tissue which belongs to the organ. Within the smaller portal canals this change is very evident to microscopic examination, the fibroid sheath being, perhaps, of twice its normal thickness. The alteration described is well shown in the accompanying plate. Plate IV, fig. 1, shows the general appearance of a section of liver affected as described, showing the great increase of the portal fibrous tissue. The section of a healthy liver prepared in the same manner, and belonging to the same period of life, is annexed. The woodcuts from the same preparations (page 362) show under a higher power the proportion which in disease and in health the fibroid tissue bears to the vessels it surrounds. Accompanying the portal vessels, and extending beyond them, the fibroid tissue

stretches between the lobules, circumscribes them more or less completely, and causes the demarcation which is so often evident to the naked eye.

FIG. 1.

Portal canals in rickety liver, showing increase of fibroid tissue.

FIG. 2.

Portal canals in healthy liver, showing relation of fibroid tissue to vessels.

In some cases it appears that the cell-holding network of the acini is more closely packed than in health, as if from an excess of epithelial growth. The epithelium is sometimes fatty, sometimes almost free from oil. In this respect there is no constant change.

With the spleen the increase of bulk is usually greater than with the liver. A spleen which ought not to weigh an ounce may come to weigh half a pound. The texture and colour are changed. The soft friability of the organ is replaced by a resilient hardness, in extreme cases resembling, to use the simile of Bright, the consistence of a half-ripe apple. The colour is generally a deep red or purple, besprinkled with smooth white spots, which are enlarged Malpighian corpuscles. When the enlargement is great the section is sometimes mottled with a pale buff material, finely intermixed with the deeper colour. In some cases the colour and texture are thus altered, although the increase of bulk is trifling or absent. The amount of blood in the vessels is generally less than in health.

The microscope shows that the minute structure of the spleen is modified in the following respects.

There is an increase in the delicate reticulum in which the splenic pulp is immediately contained. This network in the healthy spleen is of extreme tenuity, the threads slender, the interspaces comparatively large. In the rickety spleen the trabeculæ are often irregularly swollen, sometimes to such an extent that where the threads are thickest they may be as wide as the spaces they enclose.

The accompanying drawings show the change which has been described. (Plate IV, fig. 3.)

The larger fibrous divisions of the spleen are often widely separated by the swelling of the tissue between them, but in other particulars they are usually unaltered. In the case of a rickety dwarf, who died at the age of twenty-six, they were found to have become thickened.

In a case where the spleen was characteristically altered in consistence, but not increased in bulk, it was found that while the reticular basis of the organ was abnormally de-

veloped, the cellular and corpuscular contents of the network had become atrophied, being replaced by shapeless masses of blood-coloured or rusty matter.

When (as in the case of Wood, below) great enlargement has occurred, there is, in addition to the change in the trabecular tissue, an abnormal development of the contents of the meshes, the corpuscles being crowded together in a manner distinctly different from what occurs in health.

The absorbent glands, particularly those of the mesentery, are often enlarged and hard. On section they are white and opaque, in consequence of an accumulation of their cellular and corpuscular contents.

The kidneys are often increased in size, smooth and pale, the convoluted tubes being more than naturally distended by epithelium. I have not been able to discover any other change in their structure.

None of the organs affected as described give any reaction with iodine.

The change which occurs in the rickety viscera are due, not to any foreign growth or deposit in their tissue, but to an irregular hypertrophy of their fibroid or epithelial elements conjoined, as there is reason to believe, with a deficiency of their earthy salts. It thus appears that the alteration in the viscera is closely analogous to that which occurs in the bones.

The following cases illustrate the preceding statements.

CASE 1.—William Wood, 7 months old, was brought to me at the Children's Hospital, suffering from rickets and abdominal enlargement. He was a twin. He had been fed entirely upon artificial food—milk and biscuit. The parents had had three other children, all of whom had died, as I was told, with abdominal enlargement and symptoms similar to those observed in the present case. The child to whom the present statement refers failed in health from the age of four months, when he began to lose flesh, to vomit frequently, and to increase in bulk about the belly, the latter symptom having been very conspicuous for the

last six weeks. He had had otorrhœa from birth. There had been no symptoms to lead to any inference of syphilis.

The child had nodulated ribs, and the external signs of rickets to an extreme degree. The chief complaint was of diarrhœa and vomiting. He was emaciated and anæmic, and had the waxy complexion of splenic disease.

The belly was greatly enlarged, owing apparently to great increase in the size of the liver and spleen. The liver extended from its normal position downwards to the level of the umbilicus, its lower edge passing in a slanting direction from the ensiform cartilage to the right iliac fossa. The spleen had fallen below its usual situation, and occupied the greater part of the left side of the abdomen between the thorax and the pelvis, while a small portion of the organ could be felt on the right of the median line. These organs were traced in outline upon the skin, presenting the configuration shown in the annexed diagram.

FIG. 3.

In spite of nourishing food, cod-liver oil, and the iodides of iron and potassium, the child gradually sank, without any material change in the symptoms, and died five days after it was brought to the hospital.

At the post-mortem examination the swelling of the belly proved to be due, as anticipated, to enlargement of the liver and spleen, which occupied the position assigned to them during life.

The liver, which, under the circumstances in which the examination was made, could not be weighed, was much increased in size. It was smooth externally, firm in texture, and of a pale fawn colour. The acini were preternaturally distinct, each being surrounded by a pale pinkish-grey line, so that the section was covered with a honey-comb pattern of adjacent hexagons. Subsequent examination showed that this appearance was produced by an increase of the fibroid tissue which normally surrounds the portal vessels and makes its appearance at intervals between the lobules. Though the colour of the liver was suggestive of fatty change, the epithelium, which was finely granular and opaque, was unusually free from oil-globules.

The spleen weighed seven and three-quarter ounces, probably at least seven times its normal weight. It was firm and consistent, having much the feel of the lardaceous spleen, which, however, it did not in other respects resemble. On section it appeared to consist of a fine intermixture of a red and a pale buff material, the lighter disposed in small specks imbedded in the red. Under the microscope it was found that the larger fibrous divisions of the spleen were much further apart than in health, owing to a great increase of the splenic structure between them.

The increase of this tissue was in great part owing to a swelling of the delicate translucent network in which the cells and corpuscles are immediately contained. The swollen trabeculæ lay in large and irregular breadth, covering a considerable proportion of the section, instead of existing, as in health, in the form of slender threads, which, from

their tenuity, lie almost concealed by the cellular and corpuscular elements they enclose. The accompanying drawing shows the change described (see Plate IV, fig. 3).

Besides the increase of the trabecular tissue there was an absolute increase in the cells and corpuscles of the pulp. These were closely packed in the cavities of the swollen matrix, and were often in such close apposition that by mutual pressure many of the larger cells had been rendered polygonal.

The kidneys were perfectly natural.

The lumbar glands and all the absorbent glands within the abdominal cavity were swollen, and congested to a purple colour.

The pericardium was occupied by firm thin adhesions. The lungs were congested, particularly at their bases.

The organs which have been mentioned, as well as the stomach and bowels, were tested with iodine without the display of any "amyloid" reaction.

There was no tubercle in the body.

CASE 2.—Ellen Smith died under my care at the Children's Hospital at the age of four years. Since she was a year old she had had swelling of several of the joints and of the hands. When in the hospital she was evidently rickety, the cachexia being strongly developed, while the change in the shape of the skeleton was comparatively slight. The child was emaciated and anæmic, the complexion earthy, the teeth decayed.

She was pigeon-breasted, and the ribs were swollen at their cartilaginous ends, though not so much as is sometimes seen. The wrists, knees, and ankles were swollen, though the shafts of the bones remained straight. A remarkable point in the case was the manner in which the symptoms simulated those of osteo-arthritis.

There was a peculiar swelling of the fingers, apparently due to enlargement in the substance, or in the immediate neighbourhood of the first phalangeal joints.

Almost all the limbs and joints were at times the seat of

severe aching pain, which varied with every change of weather, and were aggravated by the least movement.

The abdomen was prominent; the spleen was enlarged, being evident to the touch for a distance of two and a quarter inches below the ribs. The liver was also enlarged, reaching below the ribs for an inch and a half.

FIG. 4.

Her life was brought to a close by a febrile attack, which began with slight inflammation of the tonsils, was attended with severe diarrhoea, and showed, at last, the symptoms of pneumonia.

At the post-mortem examination the bones proved to be extremely rickety; their articular ends were large and soft, and their cancellous tissue contained a deposit of red glutinous matter. The insides of the joints were natural.

The swelling of the fingers was due to an increase of the

cancellous tissue of the first and second phalanges, like that which was found in the ends of the larger bones.

The pleuræ and pericardium were occupied by old adhesions. These were small recent vegetations upon both mitral and tricuspid valves. The lungs were congested and in patches gave evidence of lobular pneumonia.

The liver was attached to the diaphragm, the spleen to the diaphragm and abdominal wall, by old adhesions.

The liver weighed eighteen and a half ounces. It was resistant and tough; generally of a pale fawn colour. The acini were indistinct in outline. The section was traversed by vessels which to the naked eye had an exaggerated appearance, which the microscope showed to be portal veins surrounded by an excess of fibroid tissue. The epithelium, which was very closely packed, was slightly fatty.

The mesenteric glands were much enlarged. In section they were hard, close, and firm, the larger being opaque like the cortex of a kidney affected by scarlatinal inflammation; their appearance being suggestive of epithelial accumulation. On section it appeared that the increase of bulk was due to a great increase in the cells and nuclei belonging to the gland, more particularly of the former, which pervaded the whole tissue with an abnormal uniformity. No change was found in the fibrous stroma.

The kidneys were pale and smooth. The pair weighed four ounces. Small ulcers were found in Peyer's patches at the lower end of the ilium.

None of the organs gave any iodine reaction.

The spleen weighed eight and a half ounces, and measured five and a half inches by three and a half. It was rigid and hard, crushing under the fingers with a grinding sound. The colour was deep red, which was closely besprinkled with white Malpighian corpuscles. The section under the microscope was unusually dense, chiefly owing to a great increase and close arrangement of the cells and corpuscles.

The reticulum of the spleen was somewhat exaggerated, but had undergone no marked alteration.

A portion of the spleen was incinerated for the purpose of ascertaining the proportionate amount of its earthy and alkaline components. It was found that, as in rickety bones, there was a deficiency of the earthy part. The results obtained are placed in apposition, for the sake of comparison, with a similar analysis of the ash of a healthy child's spleen; and one also of a lardaceous spleen obtained from a child who had died of phthisis with large vomicæ. The diminution of the earthy salts in the rickety spleen is sufficiently evident.

Mineral constituents of 100 parts of fresh spleen.¹

	Earthy salts.	Alkaline salts.	Composition of alkaline salts.				
			Potash.	Soda.	Phosphoric acid.	Sulphuric acid.	Chlorine.
Rickety spleen (Ellen Smith).....	·094	·989	·283	·196	·055	·025	—
Healthy spleen	·274	1·054	·322	·115	·118	·215	·096
Lardaceous spleen	·258	·658	·218	·115	·07	·049	·105

Passing to the clinical part of the question, while it is not necessary that I should repeat much which is well

I may state that in three healthy spleens the alkaline salts in 100 parts were found to vary from 1·054 to 1·092, the earthy salts from ·121 to ·274. From this it would seem that while in the healthy and the rickety organ the amount of alkaline salts is nearly the same, the earthy salts exist in health in a decidedly larger proportion than was found in the rickety spleen which was examined. I regret that I am not able to give further observations as to the mineral constituents of the viscera in rickets; future opportunities may supply the deficiency. Cases of considerable splenic enlargement from rickets occur so seldom in post-mortem examination that a considerable time may pass before another analysis can be made. The difference between the rickety and the lardaceous spleen is very striking, one being deficient in the earthy, the other in the alkaline, constituents.

known as regards the history and results of rickets, there are several points to which I must draw attention.

The condition of the viscera which has been described is, as far as my observation has gone, peculiar to childhood, belonging especially to the first four years. It usually occurs in connection with the well-known signs of rickets as they affect the bones. I have never seen it well-marked except in such conjunction, though sometimes the visceral appear to precede the osseous changes; and it not seldom happens that the visceral change may be extreme when the modification of the skeleton is but slight.

The rickety state of the viscera, like the alteration in the texture of the bones, is transient in its nature. Under favorable circumstances the affected organs have a strong tendency to recovery, and even when swollen to the utmost will occasionally return to their natural dimensions.

The change in the abdominal viscera appears to interfere comparatively little with their functions. The swelling of the spleen, indeed, when considerable, often is accompanied by a tint of skin suggestive of leucocythæmia; but the excess of white corpuscles in the blood, as shown by microscopic examination, is comparatively slight.

The change in the liver is unaccompanied either by ascites or jaundice, and though the kidneys may be considerably enlarged, the urine remains free from albumen.

When the visceral change has taken place to a considerable extent the child is generally emaciated and anæmic, having either the earthy complexion of rickets or somewhat of the waxy look of splenic disease.

Such a child is especially liable to be attacked by the diarrhœa, bronchitis, or pneumonia, to which rickety children are prone, and these affections constitute the chief danger to which it is exposed.

The following case illustrates the symptoms and the favorable issue of the disorder which has been described.

CASE 3.—Frederick Grant, fifteen months old, came under my care at the Children's Hospital, in June, 1868.

He was the second child of apparently healthy parents, the first being in good health. He had formerly been able to walk, but had failed in health after an attack of whooping-cough. He now could neither walk, nor sit upright, nor even hold up his head, but lay helpless, as his mother expressed it, "all of a heap" in her arms. His joints were enlarged, the anterior ends of the ribs presenting globular swellings. The chest was laterally compressed and the anterior fontanelle was widely open. He had the peculiar waxy pallor suggestive of splenic disease. The belly was prominent, and both the spleen and the liver were much enlarged, their outlines being easily traced through the thin integuments. The spleen had fallen below its normal situation, and lay in great part below the umbilicus, barely touching the lateral edge of the thorax above, while it stretched downwards to the outer end of the groin, and crossed the median line, so that the extremity of the organ lay a little to the right of the navel. The liver was felt bulging downwards nearly as low as the umbilicus, in such a position that its lower edge was nearly parallel to, and a little above, the upper edge of the spleen. The position of the viscera is shown in the accompanying diagram. The urine was free from albumen and from excess of phosphates.

The child was still at the breast. It was ordered to be weaned at once, and had cod-liver oil, with quinine and perchloride of iron.

A considerable quantity of blood was now passed from the bowels with diarrhœa, an occurrence which was immediately followed by a marked diminution in the bulk of the liver. The child did not at first improve, but became more anæmic and waxy in aspect. It had frequent diarrhœa, and further suffered from an attack of bronchial catarrh. It was found, however, that cod-liver oil, in an emulsion with lime water, was retained, and by the help of wine and raw meat he began to amend.

When seven months had elapsed there was a marked improvement in every respect. The child was plump, much

FIG. 5.

heavier, and had a more healthy tint of skin. The bowels were regular; the appetite good; and the child could now use its limbs freely, though still unable to stand. The spleen and liver had much diminished in size, the spleen measuring only two and three-quarter inches from above downwards, the liver projecting only two inches below the thorax.

The cod-liver oil was now taken, unmixed, without trouble, and the improvement continued steadily. After about ten months the child had lost nearly all trace of the visceral enlargement, and was proportionately improved in other respects.

The spleen was entirely out of reach. The most careful examination failed to detect any sign of enlargement in this organ. The liver had diminished in bulk, insomuch that it could be felt only for an inch below the edge of the thorax, and this only with some difficulty. The general health of

the child had improved in like measure. The appetite was good. He was now rosy in complexion, and had the tint and plumpness of perfect health. He could stand alone and walk for a few steps.

There still remained some evidence of rickets, as evinced by the backwardness in walking, and by want of closure of the anterior fontanelle. In other respects the child seemed in perfect health.

That recovery may occur when the visceral enlargement is extreme, and the circumstances of the case are apparently desperate, the following statement will show.

CASE 4.—In the early part of 1861, a child, eighteen months old, named Frances Lewis, the sixth of an otherwise healthy family, was brought to me at the Children's Hospital. She had been falling off in health and flesh ever since she was a month old, and had never walked. She was weaned at nine months. When seen she was in a state of helpless prostration and looked as if she could not live many days. She was extremely emaciated, weighing only fourteen pounds. She was perfectly pallid, and had in a marked degree the waxy complexion characteristic of leucocythæmia. The joints, which were of rickety conformation, were remarkably flexible, so that the limbs could be moved in any direction almost regardless of their ligamentous attachments.

The belly was prominent; the abdominal muscles were loose and thin, allowing the outline of an enormous spleen to be traced with facility. The tumour which represented this organ was dull on percussion and lay close under the abdominal muscles. It occupied the whole of the left side of the abdomen, from beneath the ribs to within from half an inch to an inch of the fold of the groin. Near the hip the tumour approached the groin more closely than towards the median line. The position of the lower edge of the spleen was marked on the skin with nitrate of silver, so that any variations which might occur in the bulk of the organ might be ascertained.

Cod-liver oil, iron, quinine, and nourishing food were

ordered, while the ointment of iodide of potassium was rubbed daily over the enlargement.

At the end of a month she had improved in appearance, gained a pound and a half in weight, and the edge of the spleen had moved up about an inch. The same process of amelioration continued, the gradual diminution of the spleen being shown by the elevation of its lower edge, until at the end of six months this organ was almost out of reach of the fingers, being felt with some difficulty close under the ribs. The child now looked plump and well; it could stand alone, and bore but little resemblance to its former self. She was seen from time to time until nearly three years old, the same treatment being continued. She became fat and rosy. The spleen shrank to nearly its normal dimensions, so that it could hardly be felt in the hypochondrium. She remained backward in walking, but in other respects appeared to be in perfect health.

It will be observed that the treatment adopted in the preceding cases was that ordinarily required in rickets. I formerly thought that outward applications assisted to reduce the bulk of the spleen, but later experience has led me to rely rather upon internal than external remedies. The diet should be nutritious, and carefully adjusted, consisting of milk, beef-tea, meat, and wine, according to the age and condition of the patient, while medicinally cod-liver oil is a prime necessity, and iron and quinine seldom fail to be beneficial. The importance of fresh air is well known in cases of rickets; but this remedy, unfortunately, is not always at the command of the physician.

The preceding details lead to the following conclusions:—

The state of the viscera which has been described as rickety, belongs especially to childhood, and is generally associated with the external signs of rickets. It takes place simultaneously in several organs, and is analogous to the alteration which, under similar circumstances, occurs in the bones.

The change in the viscera is due, not to the presence of any formation foreign to their structure, but to an irregularity of growth, which alters the natural proportions of their tissues. The epithelial and corpuscular element is generally increased, while in the liver the capsule of Glisson, and in the spleen the trabecular tissue is abnormally developed.

The more observable functions of the several organs are but little affected, neither jaundice, ascites, nor albuminuria resulting.

Under favorable circumstances the viscera recover their natural condition, the disease yielding, sometimes readily, to treatment.

The disease which has been described is distinct from the lardaceous or amyloid change on the one hand, and on the other, from that enlargement of the spleen and absorbent glands, which has been associated with the name of Dr. Hodgkin.

Rickety differ from lardaceous organs in the absence of the peculiar bacony translucency, in the absence of iodine reaction, and in the exemption of their blood-vessels from evident alteration.

In the lardaceous there is a deficiency of the alkaline constituents, in the rickety, probably, of the earthy.

The lardaceous change depends usually upon chronic suppuration or exhausting disease, the rickety has no such antecedents. The lardaceous change is rare in early childhood, to which period the rickety disorder especially belongs.

The lardaceous disease, unlike the rickety, generally gives rise to albuminuria, dropsy, and other derangements of function, and in its relation to treatment is eminently intractable.

The enlargement of the absorbent glands and spleen, to which Dr. Hodgkin drew attention,¹ is separated from the rickety change by important differences.

¹ 'Medico-Chirurgical Transactions,' 1832. See also a paper by Dr. Wilks in the 'Guy's Hospital Reports' for 1865.

In the disease described by Hodgkin the glands, swollen by a new growth of fibro-nucleated tissue as well as by an increase in their secreting or corpuscular element, sometimes cause conspicuous lobulated tumours on the surface of the body, a degree of enlargement, which, as far as I am aware, is never attained as the result simply of rickets.

A more important difference is the production, in Hodgkin's disease, of a fibro-nucleated or cellular deposit, distinct from the tissue in which it lies, resembling, to the naked eye, lumps of suet, tallow, or crude tubercle, occurring chiefly in the spleen, but also the liver, kidneys, lungs, and absorbent glands.

Hodgkin's disease is attended with grave symptoms of anæmia, prostration, and anasarca, and appears to have little tendency to recovery.

DESCRIPTION OF PLATE IV.

FIG. 1.—A section of a rickety liver magnified 20 diameters, showing the increase of fibroid tissue in the portal canals, lying somewhat irregularly between the lobules.

The specimen was obtained from the liver of a boy two years old, who died under my care at the Children's Hospital of pneumonia. He was the subject of extreme rickets. The liver weighed $14\frac{1}{2}$ ounces, the body 15 lbs. The liver was firm and elastic, having the characters described in the paper. The excess of interlobular fibroid tissue was evident to the naked eye. The bones, the spleen, and the kidney were all characteristically affected.

FIG. 2.—The section of a healthy liver obtained from the body of a child free from rickets. The portal fibrous tissue is seen in normal amount.

The section is subjoined for comparison with Fig. 1; it was prepared in the same manner, and is magnified to the same extent.

FIG. 3.—The section of a rickety spleen magnified 400 times, showing the irregular swelling of the reticulum described in the paper.

The specimen was obtained from the body of W. Wood (see p. 366).

FIG. 4.—A section of a healthy spleen obtained from the body of a child free from rickets. This is given for comparison with Fig. 3. It was made in the same way, and is magnified to the same extent. The reticulum here has its natural appearance of a regular network, with slender threads and comparatively large interspaces.

Fig: 1.

x 20.

Fig: 2.

x 20.

Fig: 3.

x 400.

Fig: 4.

x 400.