

# PRESIDENTIAL ADDRESS

ON

## THE HISTORY AND WORK OF A COTTAGE HOSPITAL DURING TWENTY YEARS.

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WHEN I consented to accept the honourable position of President of this important Branch of the British Medical Association, I did not sufficiently consider the grave responsibility I was incurring in having to select a subject for my address which would possess some elements of novelty or interest. In my perplexity I remembered an old motto, "Choose the easiest." I have therefore acted upon it, and hope I may succeed in interesting you in the history and work of a cottage hospital during twenty years.

Since the first establishment of a cottage hospital at Cranleigh, Surrey, in 1859, these little institutions have sprung up all over the kingdom, evidently because they supply a want which has a real existence. Situated in villages and small towns that are beyond the convenient reach of large hospitals and county infirmaries, they form a welcome refuge for the sick and injured among the labouring poor, who find in them not only the medical and surgical care they require, but also good nursing, suitable diet, along with clean and healthy surroundings, essentials which are impossible to be obtained in their cramped and crowded houses, and for want of which the most skilful doctor often finds his advice impracticable and his remedies unsuccessful.

The increasing extension of cottage hospitals is a very important movement; there are at the present time about 400 at work, furnishing nearly 4,000 beds; if this aggregate were centralised in one place, it would exceed in accommodation eight of the largest London hospitals, but each being a detached and independent unit, it is almost unknown beyond the limited radius of its unpretending usefulness.

There are some local advantages which cottage hospitals possess, and not the least is their rural situation; the command of fresh and pure air is a factor not to be despised in medical and surgical treatment. They are popular because the patients keep in the vicinity of their friends, and can frequently see them; whilst the small cheerful rooms are more homelike than the spacious wards of a large hospital.

Eventually cottage hospitals must, to some extent, affect the county infirmaries, as they receive not only the accidents and emergencies of their neighbourhood, but have generally the first selection of curable cases, while the chronic and incurable are passed on to these most excellent and more commodious institutions.

The cottage hospital, whose history and work I purpose to describe, originated from the efforts of a few philanthropic gentlemen who had long felt the necessity of having a small hospital in Sudbury, as this town is situated sixteen miles from the county infirmary at Bury St. Edmunds, and the same distance from the one in Colchester. Their efforts met with willing response, both in help and money, so that the building was commenced in 1867, and completed the following year, at a cost of £1,500, including the purchase of the ground.

The hospital is prettily situated, and has separate grounds for the use of male and female patients. It is built in the form of two pavilion wards, one on each side of a two-storied tower. This central part contains below, two separation wards, matron's room, surgery and operating room; and above, bedrooms and kitchen. It is a great advantage in a small hospital to have the kitchen in the upper part of the building, and well away from the wards. The two pavilion wards are 30 feet long by 17 feet wide, with a span roof rising to 17 feet; the ceiling is woodwork and varnished, and the walls are cement and painted. Each of these wards, male and female, contains seven beds, with a floor-space per bed of 74 feet square, and a cubic space each of 1,200 feet. The vital importance of sound sanitary arrangements was re-

cognised from the first in the construction of the hospital. The ventilation in the large wards is naturally provided by opposite windows, three on each side with lattice openings, and on the ceiling by four ventilating shutters worked by pulleys. The water supply is derived from the town reservoir, and the service is continuous. This water is steam-pumped from a deep boring in the chalk, and like all such is both pure and hard. Adjoining each of the wards is a bath-room with hot and cold water, and also a water-closet. Originally this latter was the pail and dry earth system, and its wise adoption, I have no doubt, has prevented the sewer gas of the town from being laid on to the hospital wards. Nevertheless the dry earth closet is not perfection, if it is harmless it is not always odourless, and the constant attention required to keep it from becoming a nuisance is often too exacting for humanity. So last year I induced the Committee of Management to substitute flush water closets with open air traps. Every sanitarian has a pet trap, and the one I recommend differs from most others in being simpler. It effectually cuts off the entrance of sewer gas, while at the same time it forms the key to the whole system of house-drainage.

Our cottage hospital is named St. Leonard's, as there once existed here a lepers' hospital of that name, which was founded as a charity by Simon of Sudbury, the Archbishop of Canterbury, who was beheaded in Wat Tyler's insurrection in 1381, and whose venerable head is still to be seen in St. Gregory's church, close by. The hospital and the lepers have long since disappeared; of the income devoted to them, about £40 per annum managed to survive the good old days of municipal irresponsibility, and this was handed over to our hospital by the Charity Commissioners.

St. Leonard's Hospital was established for the relief of poor persons suffering from accidents or curable diseases; chronic and incurable cases are not eligible as patients, though occasionally they may be received, if likely to be temporarily benefited by a few weeks' residence. Infectious diseases are entirely excluded, and an out-patient department has been purposely avoided. The hospital has accommodation for twenty beds, but keeps only sixteen ready for use, which are equally divided between the sexes; the average number kept occupied during each year being eight. The highest number of patients admitted in any one year was 145 in 1883, and the lowest number, 103 in 1873. The average for the last twenty years is 127. The average duration of each patient's stay in hospital was 24 days, average cost £3 12s. per patient.

The financial position of the hospital has always been satisfactory. Its income and its expenditure annually average £460. The income is derived from four sources.

1. Annual subscriptions, which amount to £200. This is the sheet anchor of support, and if any necessity arose, I have no doubt this sum would be largely increased.

2. Parish offertories, amounting to £100. These are the collections made at harvest thanksgiving services in the churches of the town and the surrounding twenty-six parishes. The labouring classes in these parishes take this opportunity of contributing to the support of the hospital in which either they or their friends have derived benefit.

3. Payment by patients amount to £50. No patient is admitted free, the lowest charge is 2s. a week, which, if neither the patient nor friends can pay, is paid by the Board of Guardians. The majority of the patients belong to the 2s. class; others are charged in proportion to their means.

4. Endowments, which bring in about £110. These are derived from the lepers' charity, the rent of a cottage on the ground, and the interest on investments. The capital which now belongs to the hospital amounts to £1,700, and as it is entirely derived from legacies, it is an excellent testimony to the fact that the work of this little institution has been appreciated.

The success of any hospital depends very much upon its officials. At St. Leonard's the chief official body is the Committee of Management, who are gentlemen selected by the subscribers, twelve in number, one-third of whom retire every year. The Committee have always taken a hearty interest in every department of the hospital, and the institution owes much to the secretary, the Rev. T. L. Green, the rector of the parish, who was one of its original founders, and has continued ever since to guide its successful career. There are two medical officers appointed to the care of patients, who are subject to annual election. They are Mr. J. C. Lynch, who has been attached to the hospital since its foundation, and myself, who was appointed four years later. We take alternate weeks for admitting patients, whom we retain until their

discharge, and we invariably assist each other in difficult cases and operations. We have the benefit of a consulting physician and surgeon; up to last year these were Dr. Ogle and Mr. Timothy Holmes, of St. George's Hospital, who have on several occasions received patients from us for further treatment or operation. I must especially mention the kindness of Mr. Holmes, who has four or five times come down from London to assist us by his skill and advice. Since the retirement of Dr. Ogle and Mr. Holmes from St. George's Hospital, Professor Humphry and Professor Latham, of Cambridge, have kindly undertaken the office of consultants.

The resident staff consist of only three persons, a matron, an under-nurse, who also has to act as housemaid, and a cook. In every hospital very much of the smooth and easy working of the machinery depends on the matron. This, however, is less the rule in a large hospital, where there is much subdivision of labour, than in the small hospital, where the duties are concentrated in one person. The matron, therefore, of a cottage hospital must be a person possessing many and varied qualifications. She must be a good nurse, strict and kind with patients, and able to act promptly and wisely in emergencies; she must be an experienced dresser, attending the doctors on their visits, anticipating their wants, and taking charge of the patients in their absence; she will prepare beforehand what is requisite for operations, and will assist at them; she will have learnt to dispense the medicines prescribed by the doctors, to take care of the surgical instruments and appliances, and to know their names and uses. She must be a good housekeeper, and careful in superintendence of the dietary stores, and furniture. The cleanliness, neat appearance, and sanitary condition of the hospital depend on her; she has to keep the monthly accounts of expenditure, and of the payments made by patients. Besides all this, she will be ready to interview visitors of all ranks who are interested in patients, and will be able to furnish them, if necessary, with a clinical history and prognosis of any case. Failure in any of these qualifications renders a matron unfit for the charge of a cottage hospital, though she might be able to fulfil perfectly well the duties of a large one. In the selection of a matron I consider it a mistake to choose an elaborately trained and experienced person, as she is not likely to possess that elastic adaptability so necessary to a cottage hospital, where she still has a good many things to learn. For nineteen years we were fortunate in having a matron who possessed all the qualifications I have enumerated. She commenced with only a few weeks' training in St. George's Hospital, and then took charge of St. Leonard's, where her careful management and attentive nursing contributed much to the success and popularity of the institution. Since she left we have had two changes of matron.

Our nursing staff of two persons is small, and, though sufficient to meet the average work, it is overstrained in times of maximum pressure; we have sometimes, therefore, to obtain temporary help, and particularly so when night duty is required.

Having said so much respecting the organisation of the hospital, I shall now refer to the work among the patients.

The hospital was opened for the reception of patients on July 13th, 1868. From that time up to the end of 1888 the number who have been admitted amounted to 2,543; of these, 1,657, or nearly two-thirds, were discharged cured; 566 were discharged more or less relieved; 264 were discharged unrelieved, or left at their own request, or were sent to other hospitals; 56 died.

The number of medical cases treated was 1,395, and in this number are included instances of most of the diseases met with in country practice. A large proportion, 274 in number, were cases of debility and anæmia, and in cases of this kind the active good done by a cottage hospital is very apparent. Convalescence in the homes of the labouring poor is, we know, a very slow affair; the unappetising and scanty food, the close, unaired rooms, the worries and cares of a family—all tend to keep back the return of health. Then there is the debility and anæmia which precede an illness, and which often lead to years of misery if not arrested. For all these cases a few weeks' residence in the hospital, with nourishing food, pure air, cheerful companionship, and spirit of briskness, work marvels of restoration.

The number of patients admitted for pulmonary diseases was 313; of these, 151 were suffering from phthisis, generally in the incipient stage; most of the cases derived marked benefit from the care and treatment. Other lung diseases were principally bronchitis and pneumonia. Eight patients were admitted with pleuritic effusion; these were successfully aspirated, all recovering except one, who died afterwards from empyema and phthisis. The instrument we have always preferred using for aspirating is

the simple adaptation of the stomach-pump to this purpose. In a recent case we used Allen's pump, which worked very satisfactorily that in future we intend resorting to it entirely.

Only two cases were admitted with existing empyema. One was aspirated seven times in three weeks, a diminishing amount of pus being drawn off each time, until the abscess healed. The patient, a man aged 30, was discharged quite cured, and has ever since—for now nine years—continued in active work and robust health. The other case, a man aged 35, was not so fortunate; when admitted, spontaneous perforation of the empyema had already occurred just below the right nipple, the part of the chest which possesses the least resistance; aspiration was made four times behind in the usual site, and afterwards a drainage tube was inserted; relief was obtained, but the pectoral fistula kept open for some months; he never recovered, as phthisis set in the following year.

There were 47 patients admitted with rheumatic fever. The treatment with salicylic acid combined with soda and ammonia was generally adopted, and proved successful in relieving the pyrexia and pain.

Twenty-four cases of chorea were treated; some of these were severe attacks. Where the jactitations were much exaggerated, we found that the influence of chloral was most effective; when administered in continued doses sufficient to maintain sleep for two or three days, the choreal violence ceased and the habit of quietude was restored. Progressive doses of arsenic gave the best results in other cases.

In the year 1870, 17 cases of relapsing fever occurred in the hospital. This rather unusual infectious disease was then prevalent in the neighbourhood; the cases all recovered without any complication or fatality.

In 1871 we experienced a warning with regard to erysipelas. A patient was admitted suffering with extensive burns, followed by erysipelas, which proved fatal; 6 other patients were successively attacked with the same complaint, one, a woman in weak health, so seriously that she died from meningitis. After this the hospital was closed for a week, well cleansed and disinfected, and no further cases occurred.

Since then it is one of our rules not to admit anyone suffering from erysipelas. Rules, however, are not much of a safeguard, there is no knowing when the complaint may arise in connection with some other disease or injury. We therefore took the precaution of having a small ward fitted up in a detached building next the washhouse, capable of containing two beds. This has been used on several occasions, for as soon as any case of erysipelas, gangrene, pyæmia, or other offensive or septic disease arises, it is at once removed from the general wards to this isolated ward, and separately treated. Since we adopted this necessary precaution we never have had any difficulty in maintaining the wards in a pure and sanitary condition. Three cases of tetanus were treated, all of which were of traumatic origin; one recovered when nearly moribund by removing a spicula of bone from an injured hand. Other medical cases admitted included a large proportion of dyspeptic, hepatic, and uterine disorders, and diseases and skin affections.

The patients admitted suffering from surgical diseases numbered 1,148; of these 295 were for recent injuries or accidents. Though this is an agricultural district, the great increase of machinery and mechanical implements in all farming operations has considerably augmented both the number and the severity of accidental injuries; and such cases in this neighbourhood are, as a rule, brought to St. Leonard's Hospital.

There were 161 persons admitted suffering from fracture of various bones, of whom 28 had fracture of the thigh, 2 being compound. The majority of these fractured thighs were treated with Mr. Buckston Browne's extension splint, which always gave excellent results, especially in cases of oblique fracture, the shortening being almost imperceptible on recovery. The only drawback to this useful splint is that the perineal band is necessary for counter-extension. In order to avoid this source of so much discomfort and pain, we have for the last few years used the combination of long splint and weight extension; that is, the ordinary stirrup of adhesive plaster, extending above the knee, is fastened below to a block wood, to which the cord and weights are attached; the pulley is adjusted in a line with the axis of the limb by means of a board passing beneath the mattress; counter-extension is effected by raising the foot of the bed 6 inches. A well-padded long splint, with a crosspiece below to prevent tilting.



ing, is applied, with short splints strapped round the seat of fracture. The results have always been most satisfactory.

Of leg fracture 50 cases were admitted, 7 of which were compound, 2 so severe that amputation of the thigh was necessary. The treatment of this fracture, if confined to the tibia and uncomplicated, was usually the plaster-of-paris bandages applied directly; otherwise, the leg was put up in the box splint, which, though rather clumsy looking, is most convenient for the observation or dressing of this injury, whether simple or compound.

All fractures were put up in plaster-of-paris bandages after the removal of the splints.

The other fractures amounted to 58, and included fracture of arm, forearm, fingers, clavicle, patella, etc.

Besides fractures, there were 134 other accidental injuries admitted; 8 of these were gunshot wounds, 1 of which ended fatally. Among the rarer accidents I might mention the case of a man whose axilla was gored by a bull; the wound exposed the large vessels without injuring them. Another man had the posterior length of his thigh laid open by a ploughshare which his frightened horses had drawn over him. Another case was that of a lad who was admitted asphyxiated by having fallen from a height into a wheat granary; inflammation of the lungs ensued from numerous wheat grains having got into the bronchial tubes. For a fortnight afterwards he kept expectorating bloody sputa along with soft swollen, and even sprouting wheat grains. All these cases recovered.

Of the surgical cases, 417 required operations to be performed; of these 89 were amputations, namely, 8 of the thigh, 8 of the leg, 11 of the arm, 5 of the forearm, 37 of parts of hand or foot, and 20 of the breast, all of which recovered except 4; 1 amputation of the thigh died from gangrene, 1 of the leg from pyæmia, and 2 of parts of the foot from gangrene.

In 1878 Mr. H. C. Burdett, the historian of cottage hospitals, collected and afterwards published the results following major amputations in small, as compared with those in large, hospitals. He showed that while in cottage hospitals the death-rate was 17 per cent., in the large hospitals of London and Edinburgh it was 40 per cent. Since that time the general adoption of the antiseptic treatment of wounds marked a new departure in surgery, so that the mortality after amputation is now reduced in both large and small hospitals to an equality of something about 4 per cent.

In 1876 we began to follow the principles of antiseptis in all operations. Before that time we had 24 amputations and 4 deaths, since that time we have had 65 amputations and no deaths. We at first used Lister's sprays, and followed all his antiseptic precautions and appliances, but of late years have omitted the spray, while more carefully continuing surgical cleanliness and antiseptis.

I may say we have had equally good results in the dressing of wounds with carbolised glycerine, iodoform, perchloride of mercury solution, and surrounding them with Lister's gauze or salicylic wool.

In two cases of amputation, one of the thigh and one of the arm, performed this year, and therefore not included in the twenty years' work, we adopted a dry mode of dressing as described in our JOURNAL of January 19th, 1889, by Mr. Jordan Lloyd, of Birmingham, the main point of which is before closing the wound to thickly salt the raw surfaces with powdered boracic acid, and to remove the drainage tubes without disturbing the antiseptic dressings, so that for two or three weeks, if no necessity arises, the wound is left untouched. In the thigh case the dressings were removed on the twelfth day, and the wound was found healed by first intention. In the arm case, which had suffered great contusion, a rise of temperature necessitated the removal of the dressings on the fifth day; the wound was found to be healing most satisfactorily, but suppuration occurred higher up, which, however, only delayed recovery. I mention this method of treating wounds as one well worthy of our attention. Among our cases of amputation was one in which both arms were removed close to the shoulder-joint. We had three excisions of joints, one of the hip, and two of the elbow, all of which did well.

In 1884 two cases of recent fracture of the patella were admitted. The previous year Sir Joseph Lister had described his operation for this injury by uniting the fragments with a metallic suture. We, therefore, performed this operation in both cases, strictly following the aseptic lines which he laid down. The operation has been severely criticised and even condemned, owing

to the risks of opening and draining the knee-joint, as instances have occurred of suppuration, ankylosis, and even death following. However, our two cases did remarkably well, and at the end of four weeks they had sound osseous union, and were beginning to use gentle flexion of a perfect joint, results which could not be obtained by any of the usual methods of treating this troublesome fracture. I find among my notes at the time a few hints of some importance, not mentioned by Sir Joseph Lister. One is to pierce and wire the smaller of the two fragments first; the apposition is then effected more easily. Another is to twist the wire over the larger fragment and not over the line of fracture, as the ends can be hammered down more firmly on to the bone without disturbing the tightness of the suture. Another is to avoid having the cicatrix of the first incision immediately over the twisted wire.

Among other surgical operations, there were 47 for caries of various bones; 44 for anal diseases, chiefly fistula and hæmorrhoids; for the latter we always used the clamp and cautery. Eight cases were operated on for strangulated hernia, 2 femoral and 6 inguinal; in 2 of the latter, finding the sac thick at its base and somewhat adherent to the ring, after returning the gut, we performed the radical cure. The sac was drawn forward and a double catgut ligature passed through its centre, as high as possible, and the two halves tied; the outer portion of the sac was then cut off, the wound was sutured and carefully kept aseptic. Both did well; one, an old man, has quite discarded the truss; the other wears one occasionally. One of our eight cases was unsuccessful, as gangrene of the strangulated part had set in before admittance; this patient lived for six weeks after the operation with artificial anus.

Cases of cancer are numerous in this neighbourhood, as we have the misfortune of being in a district which ranks second in England with regard to its prevalence. Fifty-six persons were admitted, seeking relief from some of its various forms, 40 of whom underwent operation for its removal; of these 20 were women with scirrhus of the breast, and of this number only 3 are still living, the periods since the operation being twelve years in one, three years in the second, and nine months in the third. No secondary deposits have yet appeared. There were 8 cases of cancer uteri admitted; in 4, where the disease appeared limited to the cervix, it was destroyed by cautery, but only with temporary benefit. Epithelioma of the lip was removed in 9 instances, reappearing in one case in the glands of the neck, and in another in the rectum, with fatal results.

There is a form of cancer which is not unusual here, and of which 4 cases were treated in the hospital. It commences like an epithelioma wart, but, instead of ulcerating, develops a fungoid growth, which is encrusted with a dark scab and bleeds freely when disturbed. This form is most effectually extirpated by an old remedy—the arsenical paste, made by mixing mucilage with arsenious acid; one or two applications, followed by poulticing, causes the tumour to slough away, leaving a healthy granulating surface, which soon heals. In no instance was there any return of the disease. The pain of the application may be considerably ameliorated by cocaine. The parts affected in the four cases mentioned were the thumb, the wrist, the thigh, and cheek.

Among the other operations were 2 of lateral lithotomy. Calculus in the bladder is a very rare complaint in this neighbourhood, why it should be so it is quite impossible to say, as our drinking water and dumplings are quite as hard as those of our neighbours in Norfolk. Of the two operations one was successful, the other, a case of great debility from the disease, died.

There were 4 cases of polypus of the uterus, in which the growths of a large size were successfully removed by the *craseur*.

One ovariectomy was performed; in this case we had the benefit of Professor Humphry's assistance, the tumour unfortunately was both multilocular and adherent, and the patient died four days after the operation. Six cases of bronchocele were admitted for operation. Enlargement of the thyroid gland is rather a common disease among women in this district. The determining causes appear generally to be menstrual irregularity at first, and intermarrying afterwards; along with these there is some endemic influence, as the majority of the cases occur along the valley of the Stour. All the patients were suffering from the fibrous form, four were benefited by subcutaneous injections of iodine, one died from dyspnoea and anæmic exhaustion shortly after admittance, and one had the gland removed to try to prevent impending suffocation: in this case the operation was performed by Mr. Timothy

Holmes, but the woman only survived three days. The tumour weighed 7 lbs.

Out of several cases of anthrax which have recently occurred among the workers in the horsehair factories of the neighbourhood, two were sent by Mr. Horsford, of Melford, into St. Leonard's Hospital. In both cases the pustule was situated on the left side of the neck, and was excised as soon as admitted; the wounds were dressed antiseptically. The first case recovered. The second case had a temperature of 103° before the operation, with much swelling of the adjacent tissues; the operation was too late, as it failed to arrest the progress of the bacilli, and, within thirty-six hours, delirium, coma, and death occurred.

With regard to the treatment of this malignant disease, I might mention that in March last I saw, with Mr. Sheenan, of Lavenham, another horsehair worker with anthrax, in a very similar condition to the one who died in the hospital; his temperature was 103°, and there was inflammatory swelling round the pustule. I considered excision would be useless, and therefore freely incised the anthrax, applying strong carbolic acid, which Mr. Sheenan repeated, but, what was probably of more importance, prescribed drachm doses of the liquor hydrarg. perchloridi every three hours, which he took for four days, and quite recovered.

There were 38 eye operations performed; 8 were excision of the eyeball, all for injury, except one case of a child aged 3, who had both eyes removed for glioma. The other operations were for strabismus, hypopyon, lachrymal obstruction; 5 were iridectomies, and 5 for cataract. The latter complaint would furnish many operations if we had room for an ophthalmic ward, but, not having the accommodation, these cases are sent to London.

What constitutes the constant surgical work of a small hospital is not the more important cases I have mentioned, but the larger number of minor ones; such as wounds, ulcers, abscesses, urethral disorders, various tumours, etc., which it would be too tedious to particularise.

With regard to anæsthetics, we generally keep to chloroform, though we do occasionally use ether and the A.C.E. mixture. I regret to say that we have to record one death from chloroform in 1879; the case was that of a girl with caries of the elbow, who twice previously had taken this anæsthetic without exhibiting any distress.

The total mortality in the hospital during these twenty years has been 56, equal to 2.2 per cent. As occurs at all hospitals, patients are often brought in when they are in a hopeless or dying condition; of these, 17 were admitted who died within a few hours or days afterwards; such cases largely augment the death-rate. The deaths after all operations were 11, or 2.6 per cent.

Such, then, is the account I have to give of the history and work of a cottage hospital; and I should hardly have ventured to have brought the narrative of its simple annals so prominently before you, but that it affords an illustration of the origin, mode of working, and results attained by these little institutions in their retired spheres of usefulness.

## REPORTS TO THE SCIENTIFIC GRANTS COMMITTEE OF THE BRITISH MEDICAL ASSOCIATION.

### REPORT ON THE STRUCTURE OF THE VERTEBRATE LIVER (ABSTRACT).

By T. W. SHORE, M.D., AND H. LEWIS JONES, M.D.

THIS research has had for its object the elucidation of the structure of the mammalian liver by an attack upon the subject from the side of comparative anatomy. We have attempted, by examining the liver in a series of types, to trace the steps between the undoubtedly tubular liver of the lower vertebrates and the apparently parenchymatous arrangement of cells which constitutes the proper tissue of the lobule of the liver of the mammal.

It has long been known that the livers of many of the lower

vertebrates are tubular glands, and Eberth,<sup>1</sup> in 1867, figured and described the microscopical appearances of the liver in *Cyprinus*, *Triton*, *Gallus*, and several other genera; and the literature of the subject shows that the problem of explaining the appearances seen in sections of the mammalian liver on the hypothesis that it also is a modified tubular gland, has been several times taken in hand by histologists, but with no satisfactory results, so far as we can learn.

Heidenhain<sup>2</sup> copies from Hering<sup>3</sup> a drawing of the liver of a snake to show that it is composed of a system of anastomosing gland tubules, and gives several schemes of the mammalian liver, arranged as a network of tubules densely packed together, and points out that in some mammals the minute bile channels are situated at the angles of the liver cells, and in others are found on the flat side between two neighbouring cells. This point has also received attention from Hering and Peszke,<sup>4</sup> and we believe that its significance will shortly become apparent.

In the course of our investigations we have made as complete an examination as possible into the structure of the liver in the following animals:—

*Fishes*: Lamprey, dogfish, skate, eel, flounder.

*Amphibians*: Frog, newt, cæcilian.

*Reptiles*: Snake, tortoise.

*Birds*: Pigeon, fowl.

*Mammals*: Rat, mole, pig, cat, dog.

We have made use of mature and of young animals, and in several cases of embryos also.

Briefly we may say that in all of these animals, below mammalia except the lamprey and the newt, the liver shows quite plainly that it consists of a network of tubules, lined by four, five, or six rows of cells, with capillary blood spaces between the tubules. In the adult bird the density of the liver obscures the appearance, but in the newly-hatched chick the tubular arrangement is very clear. In the liver of the newt there are evidences of a network of tubes, although these evidences are not very distinct, and the large liver cells of this animal appear at first sight to have a parenchymatous arrangement resembling that of the mammal.

The liver of the lamprey differs remarkably in structure from all the others which we have seen, and we shall therefore describe it fully. In this creature (*Petromyzon*) the liver cells are very small, and are disposed in solid anastomosing cylinders of several layers of cells, with fine blood channels sparsely scattered among them. The relative proportion of blood-vessels to cell-cylinders is extremely small, the number of layers of cells composing the solid cylinders reaching five or six. The cells can be divided into

(1) a parietal layer immediately adjacent to the blood-vessels, and having the form and arrangement of a columnar epithelium; and (2) central cells situated within the cell cylinders, polyhedral slightly elongated in shape, disposed in a spongy manner, and showing in hardened specimens a series of fine channels running between them. Thus the liver of the lamprey may be regarded as a mass of cells permeated to a slight extent only by a network of narrow capillary blood channels which divide the organ into a number of anastomosing broad cylinders.

In the mammal we find that at an early stage of development the liver bears a very close resemblance to that of the lower types in an embryo cat measuring 15 millimètres in length the liver is composed of a network of anastomosing tubules measuring 30 $\mu$  in diameter with five rows of cells around a small lumen; in fact the section has a close resemblance to one of the liver of the eel. The appearance of the adult mammalian liver is so well known that any detailed description of it is unnecessary. Sections of a mammal's liver, the bile capillaries of which have been injected, the closeness of the meshwork of the bile channels can be well seen. This is important as showing that the change through which it has passed in its development have been in the direction of increased production of secretion channels with the formation of a finer anastomosis.

In none of the livers which we have examined have we been able to find any distinct basement membrane.

The most striking feature brought out by an examination of the series of vertebrate livers is that this organ, even in the lower types, is a meshwork of anastomosing tubes, and that its structure is remarkably uniform throughout, from the selachian fishes upwards through amphibia, reptiles, and birds, to the embryo

<sup>1</sup> Eberth, *Arch. f. mik. Anat.*, 1867.

<sup>2</sup> In Hermann's *Handb. der Physiologie*, 1883.

<sup>3</sup> In Stricker's *Manual of Histology* (Eng. translation), 1867.

<sup>4</sup> Peszke, *Beitr. zur Kenntniss der fein. Bau d. Wirbelthierleber*, Dorpat, 1874.