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RECENT EXPERIMENTAL WORK RELATING TO SOUND AND HEARING

by

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The title of this lecture is perhaps misleading, in as much as I have no intention to discuss such aspects of it as "Localisation of Sound or the Evolutionary Rise of the Sense of Hearing" study of which subjects have recently added much to our already meagre store of exact knowledge on Sound and Hearing. My intention is to relate to you the outline experimental work recently done principally in an effort to correlate types of impairment of hearing with the causative pathological condition so as to enable us to interpret correctly the audiometeric curve as regards the location of the lesion. This experimental work has been conducted in the Otological Research Laboratories of the John's Hopkins University, Baltimore.

In the first place let me state that diseases of the ear can be divided into two fundamental groups (1) Acute and Chronic infective diseases such as Otitis Media, Mastoiditis, Labyrinthitis, Tuberculosis, Syphilis and (2) Functional Impairments of unknown etiology which affect both ear about equally. Our knowledge of infection of the ear is very satisfactory and practically all that is known concerning the cause, diagnosis, pathology and effective treatment of diseases of the ear is limited to this group. Our difficulty arises with that numerous type of case that has no history or visible evidence of an ear infection. The point has been arrived at, when it seems impossible to learn more by clinical and pathological methods about the etiology and location of the lesion that is primarly responsible for the hearing defects in these cases. Therefore, it was particularly welcome, when a new channel of experimental research was opened up to us by the work and phenomenon described by Wever and Bray in 1930 in their original paper. "The Nature of Acoustic Response": "The Relation between Sound Frequency and the Frequency of Impulses

in the Auditory Nerve." Through the experimental method introduced by them it was made possible for the first time to determine in experimental animals the part played by the Tympanic membrane, the Ossicle, Round Window membrance, Eustachian Tube, Tensor Tympanic muscle and the Stapedius muscle in the transmission of voice and sound waves. It also enable us to study the transmission of high tones in relation to middle ear structures, and this is important because the majority of these cases of deafness were impairment of transmission of high tones. Let us take a typical book case:—Low tones are heard normally: the greatest impairment is for tones above middle C air conduction is better than bone conduction. Bone conduction in some patients seems shortened, in others it is normal for 256 and 512 double vibration. This condition is described as a "lesion of the inner ear due to Toxic Neuritis of the acoustic nerve or to nutritional disturbances in the basal coil of the cochlea."

Clinically there are two distinct groups of high tone defects. In one the higher pitched forks and even the intense penetrating tones of the monochord are not heard; in the other there is marked impairment, but if the sound is of sufficient intensity it can be recognised. Degeneration changes are always found in the microscopic section of the cochlea, when there is complete loss for the high tones. Lesions in the middle ear are hard to interpret as they are rarely confined to one place.

Now let us turn to what evidence we get from experimentation on animals through the Wever Bray effect. Cats are mainly used because of the easy exposure of the middle ear structure. The Wever Bray experimental "set up" is as follows:—The animal is anæsthetised by ether, a tracheal tube is introduced into the trachea and connected by a tube with a Woulfe bottle containing ether and through which is passed a current of compressed warm air. A small trephine opening is made over the cerebellum and a silver electrode placed on the auditory nerve. (7th nerve facial twitch is evidence of correct placing). Another electrode is grounded in the muscles of the neck. Wires from the two are carried to a six tube amplifier in another room of the building. Connected with the output of the amplifier is a microphone. Now if spoken words or tuning fork tones are conveyed to the cat's ear, they are reproduced with great clarity in the microphone. The sound waves are transmitted by the cat's ear to the nerve causing a change in potential or modifying in some way circuit leading to the amplifier. If cats are used the middle ear may be exposed, without injury, by opening the mastoid bulla through an incision in the neck. An inspection of the middle ear through a binocular microscope and a preliminary test with voice, tuning forks, Galton whistle are made to asertain that the middle ear is normal and conducts sounds normally. The different experimental pro-

cedures on the different middle ear structure can be carried out and the results noted and compared with the original normal test results. Thus the drumhead can be cut in different quadrants, the ossicular chain may be fixed with tension or rendered lax by pulling on or cutting the tendon of the tensor tympani muscle, the niche of the round window sealed with cement, or the round window membrane rendered immobile by packing cotton against it, etc.

Experiment No. 1. The animal is anæsthetised, and the Wever Bray experimental set up established. The mastoid bulls is exposed and opened exposing the tensor tympani muscle. A hook is placed round the tensor tympani tendon: a thread is attached to the hook and carried over a pulley and made to suspend a small pan in which different weights are placed. The animal's normal is first established and then 5, 10, 20, 30, and 50 gram weights are applied in turn. Little, if any, effect can be noted with 5 grams but when 10 grams is added the spoken voice and all low tones are reduced in intensity. This effect is increased with each higher succeeding weight until when 50 grams is added no sounds are transmitted except those of the higher tuning forks. Spoken voice, (256 double vibration to 800 double vibration (Bezeld) and all tones up to 2,048 double vibration, are entirely inaudible in the loud speaker. If the pull of the weight is released momentarily all sounds return to their normal intensity, but the moment the weight is again applied they disappear. This procedure may be repeated over and over again provided the weight is not so great, that it breaks the Incus near the Incudo-Stepedial joint.

This demonstrates the fact then that with extreme tension of the tensor tympani muscle and consequent fixation of the ossicular chain transmission of all tones below 2,048 double vibration is reduced until they are no longer audible. This is analogous to the fixation of the stapes with adhesions or Oto Sclerosis, or the fixation of the head of the malleus and Incus from inflammatory processes in the attic.

Then the effect of division of tensor tympani tendon was studied in another series of experiments, using the same Wever Bray effect. If the tendon is divided at its insertion into the neck of the malleus and the hearing tested immediately afterwards no appreciable effect on the transmission of sound is noted. If the tendon is divided under strict aseptic technique, the wound closed and two days later tests made again under the same experimental "set up" still no difference is noted. If, however, the tests are made nine days or ten days after, then, provided there is no infection of the wound or interference with transmission due to blood clot in the middle ear, a striking and constant effect is noted. Though transmission of none of the tones was particularly loud at any time, the 1024 and two higher forks were completely inaudible. The Galton whistle was not heard. Spoken voice (256-800 double vibration) was muffled but heard and 256 and

512 double vibration sounds heard distinctly. The middle ear was then opened after the tests were made and found to be quite free from blood clot and infection. The tensor tympani muscle was found retracted and the hammer bone rotated anteriorly, so that the short process was in quite a different position from normal. With the middle ear opened in this way the tests were made again and found to be the same as before. At this time a constant tone phonograph record was tried and was barely heard at a distance of 6″ from the loud speaker. *A small pledget of cotton wood was placed in the round window niche and the effect was striking.* All tones were greatly increased in volume and clarity the higher tones relatively more than the lower. The 1,024, 2,048 and 4,096 double vibration forks were now extremely clear and the words of the phonograph record were heard distinctly at a distance of twelve feet from the loud speaker. The Galton whistle was also heard clearly and distinctly for the first time. When the cotton was removed tones again become faint and this procedure was repeated 7 or 8 times without variation in effect, even although the animal had been under anæsthetic for three hours. Another test made was to place the phonograph at such a distance from the cat that the words were inaudible in the loud speaker. When cotton was again introduced into the round window niche, the words immediately became clear and distinct with the phonograph in the same position.

These experiments clarify our ideas about the tensor tympani muscle and suggest that impairment of function of this muscle may be one of the common causes of impairment, not the loss, of hearing for high tones in patients, and indeed treatment founded on this experiment is bearing such results as to justify this hope. In man this muscle lies against to the Eustachian Tube and is even more exposed to infection than the intrinsic muscles of the larynx. The experiments on the result of fixation of the round window indicate that this increases the sensitivity of the cochlea and more than counteracts deafness caused by lesions in the middle ear. If we could develop a technique that would enable us to say place a graft against the round window, we would be encouraged to hope that in suitable cases a useful degree of hearing could be restored. Such technique in the shape of periosteal grafts have since been succtssfully used.

In cases of deafness coming outside the field of improvement by operative procedure and Eustachian Tube treatment, the latter based on our knowledge gained from these experiments is meeting with confirmed success, we are heartened by the great strides recently made in our knowledge of the application of artificial aids to hearing to the deaf.

THE PATHOLOGY OF ACUTE (HEMATOGENOUS) OSTEOMYELITIS

by

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Definition.

Acute osteomyelitis is an acute inflammation of bone caused by pyogenic organisms. The term osteomyelitis is, strictly speaking, incorrect because the disease affects all the constituent parts of the bone. For this reason some surgeons prefer the term acute diaphysis, periosteomyelitis, osteitis or acute necrosis. But for convenience the term osteomyelitis will be retained throughout this paper.

Acute osteomyelitis is essentially a disease of childhood affecting usually the long bones which are in a state of active growth and are frequently exposed to injury.

Anatomy of Bone.

A growing long bone consists typically of a shaft or diaphysis and two epiphyses one at each end of the bone. The epiphyseal side of the diaphysis is known as the metaphysis where new bone is actively laid down.

Blood Supply of Bone.

Since the disease is blood-borne, it is of vital importance to have a clear understanding of the blood supply of bone. Lexer was the first to prove that there are three chief sets of arteries supplying a growing bone.

(1) The nutrient or, better named, the osteo-medullary artery. This vessel enters the shaft usually in the middle through the nutrient foramen. After traversing the cortex of the shaft it divides into an ascending and a descending branch. The direction of the nutrient foramen i.e., the direction of the nutrient artery as it enters the bone, is remarkably constant, being always away from the more actively growing end of bone. This peculiarity is explained by the fact that the 'epiphyseal line,' a plate of cartilage separating the ossific centre of the epiphysis from the diaphysis, actively grows towards the diaphysis and only slowly towards the epiphysis: hence we have the well known tip of 'towards the elbow and away from the knee.'

The branches of the nutrient (osteo-medullary) artery divide successively and ramify in the medullary membrane lining the medullary cavity. These ramifications anastomose freely with the metaphyseal vessels, and also with the periosteal vessels in the

Haversian Canals. The main branches of the nutrient (osteo-medullary) artery finally end just short of the metaphysis in terminal branches which form dilated venous loops in which the circulation is considerably slowed.

(2) The periosteal vessels. In young bones the periosteum is very vascular: the pereiosteal vessels ramify in the substance of the periosteum before entering the compact bone of the shaft.

(3) The circulus vasculosis of Hunter. The articular vessels unite around the reflection of the synovial membrane on bone surface forming a freely anastomosing circle at this point and from this, vessels proceed to *(a)* the epiphysis and *(b)* the metaphysis.

In the course of studying bone pathology the anatomical facts of the circulation in bone as established by Lexer have not proved, according to Robert Johnson of Johns Hopkins' University, a satisfactory basis for the clear understanding of the pathological changes unless these facts are supplemented by a knowledge of the physiology of the circulation in bone. Accordingly, he carried out a series of experimentes on dogs by injecting india-ink into the different sets of vessels of the tibia and at the same time drilling a number of holes in the same bone. The animals were killed after certain intervals and the affected bones were examined under the microscope to observe the amount of repair in the drilled holes and the extent of bone supplied by each set of vessels. The conclusions of his experiments were as follows:—

(1) The nutrient vessels maintain viability throughout the medulla and supply the inner half of the cortex. Repair is active when the nutrient vessels alone are intact.

(2) The metaphyseal vessels maintain viability throughout the medulla and inner half of the cortex, but repair is not as active as in the controls except close to the metaphyseal ends, being notably delayed in the middle of the shaft.

(3) The periosteal system does not normally supply more than the outer half of the cortex and is unable to afford an effectual collateral supply to the medulla under four weeks' time.

(4) Regarding the shaft as a whole the nutrient vessels are the most important, metaphyseals next and the periosteal system least.

(5) In all conditions affecting the diaphysis the blood supply is a most vital factor.

Etilogy.

This can be conveniently divided into predisposing and exciting causes.

Predisposing Causes.

(1) Age. The majority of the cases occur before puberty mostly between 3-17 years with a maximum between 8-12. During the period of active growth the blood supply of the metaphysis is especially rich and the liability of the growing ends of long bones to trauma is particularly marked.

(2) Sex. On an average the proportion of males to females affected is 4-1. It is difficult to explain this difference unless we believe that boys are more frequently exposed to wet and cold and to injury, etc. As a rule boys are less cleanly and their skin is therefore more subject to infections.

(3) Trauma. This may occur in a variety of forms mostly as a sprains or twists over the growing end of the bone. The effect of trauma according to the usual teaching is to cause a hematoma in the region of the metaphysis which can be looked upon as the most vulnerable part of the bone. The blood clot thus formed holds up the organisms circulating in the blood stream and affords a favourable nidus for their growth. There has been a discrepancy of opinion with regard to trauma as an essential predisposing factor. We may summarise the different views as follows:—

Evidences in Favour.

(1) History of trauma from a few hours to two weeks before the onset of clinical symptoms is obtainable in over 60% of cases.

(2) Since the disease starts as a bacteremia, organisms will have equal chances in settling down in the metaphyses of many long bones but actually only one bone is affected and hence trauma here must play an important rôle in precipitating the infection.

(3) Bones of the lower extremities are most frequently affected on account of their greatest liability to injury.

(4) Experiments (as mentioned by Beekman) by injecting organisms intravenously into animals always resulted in an acute osteomyelitis of a long bone previously injured.

Evidences Against.

(1) The recent work of Robertson of Toronto has shown that organisms can produce inflammatory centres in the metaphysis independent of trauma.

(2) There are many cases on record in which a history of trauma is lacking.

(3) It is not likely that every kind of injury may predispose the condition, as Robertson has shown that trauma must be of the nature of a traction on the ligaments of the epiphysis of bone thus causing the epiphysis to move over the metaphysis.

(4) It is possible in some cases that the infection may have preceded the occurrence of trauma.

(5) In rare cases where multiple lesions occur, trauma is most unlikely to have any effect.

From a consideration of the above points one ventures to conclude that trauma is not essential to the occurrence of acute osteomyelitis, but if it does occur it is a favourable factor in localising the primary focus in bone.

The 4th predisposing factor is the lowering of the general resistance of the body as after exposure to cold or following acute infective fevers notably measles or scarletina and other debilitating diseases. In this connection it is interesting to note that Choyce has found that most of his cases had a previous history of apparent robust health.

Exciting Cause.

This is usually the staphylococcus pyogenes aureus (about 80%) though according to some authorities the staphylococcus albus is not uncommon. The streptococcus, pneumococcus, and the B. typhosus are rarely found. The severest form of acute osteomyelitis is said to be due to staphylococcus aureus. Beekman of New York in his paper on acute osteomyelitis quotes Lexer's view that the common association of staphylococcus with ostcomyelitis is probably due to the fact that it forms in clumps which are more apt to be stopped in the loop of vessels in the metaphysis and that the aureus type is more frequently met with than the albus as the primary focus is in most cases of the aureus variety. Moreover Rodet even as early as 1884 showed that the staphylococcus has a predilection for bones and especially for their most rapidly growing parts.

The staphylococcus aureus produces endotoxins and also exotoxins according to some authorities (Bigger): the existence of the latter is very doubtful. The presence of endotoxins is proved by the fact that a dead culture exerts a positive chemotaxis and may cause a local abscess when injected.

Besides these toxins the staphylococcus aureus elaborates two other soluble poisons namely hemolysin and leucocidin. The latter has a destructive action on leucocytes which are at first immobilised, then become granular and are finally dissolved. The hemolysin has the property of dissolving red blood corpuscles. Normally an anti-leucocidin and anti-hemolysin are contained in the sera of all animals especially of the horse and man and may be increased in quantity in osteomyelitis and other diseases caused by staphylococcus aureus.

Origin of Causative Organisms.

The primary focus is generally on the external surface of the body in the form of a boil or an abrasion of the skin or mucous membrane. In many cases, however, the primary focus is indetectable. From the primary focus the organisms migrate into the blood stream causing bacteremia under favourable conditions. Invasion of the blood stream depends on such factors as the virulence of the organism, the number ot bacteria present and the resistance of the host.

The Bones Affected.

Almost any bone in the body may be affected: cases of acute osteomyelitis of the spine though rare have been recorded from time to time. The vast majority of the cases, however occur in the long bones of the upper and lower extremities. Fraser's cases show that the bones of the lower extremity are much more frequently affected, over 40% occurring in the tibia. It is generally agreed upon that the upper end of the tibia is the commonest site. This peculiar predilection of lower extremity bones is explained by their greater liability to injury.

Usually only one bone is affected but in rare cases multiple lesions may be observed. In the latter cases it is rare to find a simultaneous development of lesions in several bones: more commonly the primary lesion is established first, the secondary lesions following as a result of the pyemia set up by the primary lesion. The secondary lesions are much less severe and may be so masked by the intense toxemia as to escape recognition entirely.

Site of Infection.

This is as a rule in the metaphysis. It is the site of the most active growth and hence the blood supply is extremely rich. The principle that undue demands owing to excessive growth of a part usually results in weakening can probably be applied here as elsewhere. In the metaphysis the capillary net work is composed of minute vessels with frequent bends resembling hair pins, the result of such an arrangement being a retardation of the blood flow. Moreover the work of Hobo with regard to vital staining of the vascular system of bone shows that close to the metaphysis the arterial capillaries pass over to dilated venules. The venous circulation is therefore slowed and the deposition of bacteria favoured. According to him bacteria and other substances entering the circulation are deposited chiefly in the liver, spleen and marrow of bones as well as the metaphysis. In the marrow infection with these organisms cannot take place as the reticulo-endothelial system and marrow celis have a powerful phagocytic action. In the metaphysis, however, Hobo has observed that there is great difficulty for the phagocytes to assemble to overcome the infection: there is very little tissue reaction and no sign of

leucocytic infiltration. Hobo's views as mentioned above have been conclusively confirmed by the recent work of Robertson. Robertson produced experimental osteomyelitis in rabbits and from these experiments he arrived at some definite conclusions which are more or less confirmation of Hobo's views, for instance, he found that organisms introduced into the blood stream are deposited, among other places, in the long bones: in bone there is active phagocytosis except in the metaphysis: It is impossible to produce a general infection of the medulla by simple innoculation of organisms into the blood stream.

Pathological Changes.

Inflammation of bone is in many ways similar to that of other tissues but there are a few distinctive features which are unique to inflammation of bone itself.

(1) Bone is a rigid structure and the inflammatory exudate formed in it is therefore under considerable tension. The effect of such a tension will be manifested by the excruciating pain as a result of pressure on the nerve endings and early death of bone in consequence of the toxic action of septic pus, which is in direct contact with bony walls, and the deprivation of blood supply resultant from the obliteration of capillaries.

(2) The venules of the cancellous portion of bone especially in the metaphysis have their walls closely attached to bone and are therefore non-collapsable. Hence septic thrombi formed within these vessels are liable to be detached, mingled with the venous current and widely disseminated in the blood stream causing pyemia which is chiefly responsible for the gravity of the condition.

To recapitulate, we have seen that the organisms from some septic focus are carried by the blood stream in the condition of bacteremia to the metaphysis where they are held up in the metaphyseal vessels, thus setting up a focus of infection. The question of trauma as an aid to the deposition of organisms has already been discussed. The earliest changes are perivascular in character but the infection readily extends to the surrounding structures. An intense hyperemia and other stages of inflammation occur just as in inflammatory conditions of other tissues but here the changes are much more rapid and the marrow is soon converted into a thick, oily pus. Thrombosis occurs readily in the blood vessels of the parts involved and around and grey patches of necrosis appear within twenty-four hours.

Spread of Infection.

The orthodox teaching is that the septic pus being under considerable tension rapidly invades the medullary cavity from which pus may reach the periosteum by traversing the Haversian and Volkmann's canals. Many modern surgeons led by Starr of Toronto are gradually

refuting this view. Starr as a result of his experiments clearly showed that the infection does not spread by way of the medulla but along the line of the epiphysis i.e., transversely to the periosteum. To substantiate his belief he has brought forward the pathological findings of the bodies of persons who died of concomitant disease in which the epiphyseal line and the periosteum were extensively involved but no lesion was found in the medulla. Moreover it has been demonstrated experimentally that although extensive periostitis occurred after injection of virulent organisms into the nutrient artery of dogs, there was little involvement of the medulla. The medulla according to Starr may however be secondarily infected from the periosteum via the Haversian and Volkmann's canals. As a further support of Starr's views Choyce has found that treatment of acute osteomyelitis based on Starr belief of the mode of spread has yielded much better results than what he obtained previously when he adopted the usual method of gouging freely into the medullary cavity—an operation which in the opinion of Starr is to be condemned.

Stage of Necrosis.

We have seen how the pus formed under tension caused the obliteration of capillaries and was in direct contact with bone. As a result of these two factors—cutting off of blood supply and toxic action, the cancellous bone is rapidly destroyed. As the inflammatory exudate accumulates, it tracks outwards parallel to the epiphysis to the periosteum. Failing to reach the joint on account of the firm attachment of the periosteum to the epiphysis, the pus tracks upwards stripping the periosteum in its course, thus depriving the superficial part of the cortex of the bone of its blood supply, as a result of which necrosis supervenes. Here it is well to remember that the necrosis of the shaft is seldom extensive as the periosteal arteries supply only the outer half of the cortex. In case where massive death of bone occurs, it is reasonable to suppose that the nutrient artery must have been implicated in the infective process with resulting thrombosis and hence deprivation of the chief blood supply to bone (vide supra).

Now let us continue to trace the course of the inflammatory exudate under the periosteum. If surgical measures are not called for to remove the pus, it will burst at the point of least resistance in the periosteum into the neighbouring tissues and finally work its way to the exterior leaving a sinus behind. This may be long and tortuous on account of the interception of fascial planes and therefore the opening of the sinus may be well below or above the point where it has burst in the periosteum.

The Sequestrum.

The necrosed portion of bone surrounded by pus is known as a sequestrum. This is gradually separated from the healthy bone

by a process of rarefying osteitis around it, this process being brought about chiefly by the action of osteoclasts. Complete separation of the sequestrum takes usually about six weeks or longer. In this connection it is interesting to note that the tibia is said to the bone the shaft of which is most frequently sequestrated intact. Speed explains this frequency by assuming that the periosteum is not stripped where muscles are attached, for where the periosteum cannot be stripped as in the femur, the nutrient artery is not so apt to be destroyed while in the tibia which has few muscle attachments, the periosteum is easily separated thus allowing the entire circulation to be cut off.

The sequestrum has uneven edges on account of the rarefaction taking place irregularly in the process of separation from the shaft this irregularity being more marked where the sequestrum has been in contact with granulation tissue which has an erosive action, thus giving the sequestrum a worm-eaten appearance. The sequestrum is usually dead white in colour unless it has been exposed to air as may happen in case where a superficial bone such as the tibia is involved or more commonly where osteomyelitis supervenes upon a compound fracture—so called open osteomyelitis, when the sequestrum becomes black owing to formation of calcium sulphide.

Recently the importance of the sequestrum has been brought to prominence by Bancroft and others. As a result of his investigations Bancroft states that it is impossible in the early stages of acute osteomyelitis to tell at what point the separation between living and dead bone will take place. He has further observed that much bone which was apparently destroyed acted as a scaffolding over which new bone is laid. Beekman as a result of a study of cases at the Bellevue Hospital has drawn a further conclusion that "the presence of sequestrum is important to the part in preventing deformity as it acts as a splint until the formation of an involucrum (or new bone case) has taken place: cases in which the sequestrum was too early removed resulted in a pathological fracture of bone." It is well to remember that the sequestrum acts as a foreign body and provides a suitable medium for the growth of organisms. This results in a prolongation of the suppurative process which leads to the formation of a dense, strong involucrum. However, it must be borne in mind that as long as the sequestrum is not removed either spontaneously or through surgical interference the condition will assume a chronic character and may persist for years.

Formation of New Bone.

This is entirely pathological and is an evidence of a reparative reaction. New bone formation occurs in two places (1) under the periosteum and (2) in the interior of bone.

Formation of Subperiosteal Bone.

The periosteum is congested even at the onset of the disease and becomes markedly inflamed when it is stripped off the shaft by pus. The osteoblasts in the inner layer of the periosteum are stimulated to activity and thus new bone is laid down. Beekman believes that "the osteogenetic layer of the periosteum starts to function almost immediately after the membrane has been separated from the bone but is not in evidence by the X-ray until calcium salts have been laid down which takes a period of from 3-4 weeks."

The subperiosteal bone is laid down uniformly over the surface and when it has reached a certain degree of completeness it then constitutes an involucrum. This is at first soft and vascular but later as the suppurative process continues, it becomes denser and less regular than normal bone. The size of an involucrum depends on the extent to which the periosteum has been stripped. The involucrum forms a sort of new bone-case for the underlying sequestrum and is attached at either end to healthy bone. In order that the inflammatory exudate may be got rid of externally the involucrum is perforated by numerous openings or cloacae. Through these cloacae small sequestra may also be extruded.

Subperiosteal new bone, however, is not necessarily deposited over dead bone alone, as Beekman states "when a local focus within a metaphysis has perforated the cortex producing a diffuse separation of the periosteum, new bone may be laid over a perfectly normal shaft, irregularly thickening its cortex. At times such a deposit may obscure the texture of bone to X-ray. This fact must be borne in mind when studying a roentgenogram to discover the extent of the disease within a bone."

Sometimes subperiosteal bone formation is absent on account of damage to the periosteum. Failure in formation of an involucrum is especially apt to occur when a subperiosteal abscess has burst through the periosteum and has separatel it from its surrounding soft parts, thus depriving the membrane of its blood supply.

New Bone Formation in the Interior of Bone.

In the interior of bone granulation tissue not long after the onset begins to appear on the bony walls surrounding the inflammatory exudate and through it, part of the necrotic material is disposed of. Later endosteal bone formation takes place and the shaft of the bone is gradually remodelled to its normal condition. The younger the patient the more perfect will be this remodelling. According to Fraser the subperiosteal bone gradually becomes absorbed as the endosteal bone is formed.

Effect of Growth on Bone.

Speaking generally, osteomyelitis does not usually interfere with the subsequent growth of the affected bone but occasionally growth may be partially or entirely arrested according to the extent to which the epiphyseal cartilage has been destroyed. Speed and others believe that the greatest interference with long bone growth results from destruction of the cartilaginous plate and columns of cartilage cells in the epiphysis either directly or by cutting off the epiphyseal vessels. This has been amply confirmed by the experimental work of Haas and many others.

If the affected bone is single, shortening as a result of cessation of growth does not curtail the activities of that particular limb to any extent especially when the affected bone is a humerus, although if shortening occurs in the femur the act of walking may be interfered with but this may be sufficiently compensated for by the downward tilt of the pelvis of the same side.

In cases where the affected bone is paired as in the leg, deformities may occur because although the affected bone ceases to grow from one of its epiphyses, the corresponding epiphysis of the companion bone continues to grow thus pushing the affected bone to one side. Furthermore the companion bone may grow past a joint causing limitation of movement, and may interfere with function owing to an alteration of the axial relations of the limb (Speed).

Complications.

A. Joint Involvement.

This usually results in a septic arthritis. Joint involvement is not common unless the epiphysis lies inside the joint as in the upper end of the femur. Infection may reach the joint in one of four ways :—

(1) Via the epiphysis. The inflammatory exudate within the metaphysis may perforate the epiphyseal cartilage into the joint. This seldom occurs because the epiphyseal cartilage is quite resistant to acute infections and there is no communication between the circulation within the metaphysis and that within the epiphysis. In very young children, however, involvement of the joint in this way is probably more common as the epiphyseal cartilage is thin and is therefore more liable to be perforated by pus within the metaphysis.

(2) Pus may reach the joint while it is underneath the periosteum. This route is seldom taken on account of the firm attachment of the periosteum to the epiphysis.

(3) Involvement of the joint may occur even when pus has already burst through the periosteum. The pus may tract along the

surrounding tissues such as muscle and finally reach the joint via tenden-sheaths which are in direct communication with the joint as in the case of the long head of the biceps in the shoulder joint. Involvement of the joint in this way is again uncommon.

(4) In cases where the epiphysis is within the join as has been mentioned, infection of the joint readily occurs. This almost invariably happens in the upper end of the femur where the epiphysis is entirely intracapsular. The epiphysis of the lower end of the tibia, upper end of the humerus are partly intracapsular and partly extracapsular: hence involvement of joint from these regions are not so common as in the upper end of the femur. In the upper end of the tibia where the epiphysis is entirely extracapsular, invasion of the neighbouring joint cannot occur in this way.

In comparing acute osteomyelitis with tuberculosis of bone, one finds that in the latter condition involvement of the joint is exceedingly common. Tuberculous infection of bone also starts in the metaphysis but it remains fairly localised here having little tendency to spread down the medullary cavity. The infective process being a slow one, the cancellous bone in the metaphysis is believed to be able to wall off the infection, while the epiphyseal cartilage has to bear the brunt of the attack by tubercle bacilli: hence invasion of the joint, unlike in osteomyelitis, is the rule rather than the exception.

In many cases of acute osteomyelitis a sterile effusion occurs in the neighbouring joint but this is readily absorbed as soon as drainage of the affected area of bone is established.

B. *Suppurative Nephritis.* This is a frequent complication in acute osteomyelitis. It is the result of the general blood infection and occurs in the form of multiple abscesses especially in the cortex of the kidney. Hence in treating a case of acute osteomyelitis it is important to test the urine frequently for pus and to watch for the occurrence of marked tenderness in the loin or loins, these two features being always present if suppurative nephritis has supervened.

C. *Patholgical Frature.* This is an occasional complication to which little attention has been given in the ordinary text-books of surgery. The recent work of Capener and Pierce has thrown much light on the actual cause of this infrequent yet important complication. These authors contend that almost all such cases are due to preventible causes and are attributable largely to the fault of the surgeon.

In their opinion the chief causes lie in

(1) Diagnostic and therapeutic errors of omission such as delayed recognition of the disease and indequate treatment in the earlier and acute stages, both these factors being responsible for the massive sequestration of bone.

(2) Errors of commission. In removing the sequestrum and obliterating the cavity, the surgeon may gouge away too extensively into the supporting involucrum, or he may be over zealous in removing an extensive area of bone round the circumference of the shaft in order to provide for free drainage in the acute stages, especially if he believes that it better to have a wide 'sauce pan' rather than a deep 'gutter.' Violence to the bone during such operations and inadequate splintage after operation are also important factors.

(3) Weakening of the bone through atrophy as a result of disuse, and decalcification consequent on the prolonged hyperemia.

Conclusion.

In conclusion I would like to draw your attention to the fact that acute osteomyelitis as Fraser points out should be regarded as merely a local manifestation of a general infection because wide spread changes appear in the body as a result of the circulation of toxins produced: hence cloudy swelling occurs in the more highly specialised organs such as the heart, liver, kidneys, etc.

I should like to take this opportunity of expressing my indebtedness to Professor Davis who has kindly prompted and helped me to write this paper, and to Prof. Digby for valuable advice and criticism.

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A CASE OF HYDROCELE OF THE HERNIAL SAC IN A FEMORAL HERNIA

by

T. K. Lien, M.B., B.S.

Clinical report No. 198/32.

Name: C. H. Age: 43. Sex: Female.

Date of Admission: 12/7/32.

Date of Discharge: 2/8/32.

It has been regarded that femoral hernia among Chinese patients in this part of the world is rare. The frequency of incidence of femoral hernia compared with that of all the hernia cases as given by Dr. W. B. de Garmo is 18% in both sexes and if the females are only considered, it is raised to 33%. Other observers are in approximate agreement with these figures. They are certainly higher than those we get here. Other surgeons in Hong Kong hold the same opinion. In an annual total, averaging 500 cases in the annual register of the University Clinic, we seldom see more than two of such cases. Considering the in-patients only, within the time limit of ten years, i.e. from 1922 to 1932, out of 94 cases of hernia of all varieties, there were only five cases of femoral hernia recorded, of which four were females and one was male. Therefore, the percentage of frequency is about 5.3% in both sexes. I believe, that this is not due to the Chinese patients' ignorance of the advisibility of going to hospital, because the statistics of the leading hospitals here show that the incidences of strangulated femoral hernia is very low. I, therefore, think it is noteworthy to record this case of hydrocele of the hernial sac in a femoral hernia from our clinic for the interest of its rarity and of the diagnosis.

The patient was a female aged 43, who came to the morning outpatient about one week before admission to the hospital. She complained of having a swelling in the left groin, which was only slightly tender and accompanied by intermittent attacks of abdominal pain. Dr. Khoo Fun Yong, the outpatient officer, was the first doctor to see her. He showed the case to Dr. Wong Hok Nin, the Clinical Assistant to the Medical Unit, who was at that time also in the outpatient department. They came to the conclusion that it was a case of strangulated femoral hernia. I was asked to see the patient later.

The patient lay on a couch quite comfortably. Her look was not anxious. The pulse and temperature were normal. There was no tenderness nor rigidity of abdomen. There was no vomiting nor constipation. Her tongue was clean. The swelling was 2" × 1" in size and was oval in shape and freely movable. On palpation, it

was not tense nor tender; it was situated in the left groin, lateral to the pubic crest with its long axis parallel with the inguinal ligament. The skin overlying the swelling showed no sign of inflammation. It was nodular and a portion of it presented a doughy feeling. It was not translucent to light. There was a suspicion that fluctuation was present. There was no impulse on coughing and it could not be pushed into the abdomen through either the femoral or the inguinal canal. Patient told me that she had had a recent history of white discharge per vulvum. Based upon the above findings I was of the opinion that the case could not be a strangulated hernia. I diagnosed that the swelling was an enlarged lymph gland (perhaps secondary to some inflammatory focus in the genitalia) which had commenced to suppurate.

The following conditions were also considered and excluded:—

(1) A psoas abscess—by the absence of marked fluctuation and of signs of spinal caries.

(I also had in my mind a faint suspicion of the condition being a lipoma, fibroma or even a Richter's hernia).

(2) A hæmatoma—by the absence of a history of local injury and of any fluish discolouration of the skin overlying the tumour.

(3) A saphena varix—(by the absence of varicose veins below it).

It did not empty itself when the patient lay down and there was no exparsile impulse on coughing.

(4) An Ilio-femoral aneurysm—by the absence of an expansile impulse and of a bruit on auscultation.

(5) Secondary malignant or tuberculous glands—by the absence of primary foci.

It did not occur to me that it could be a hydrocele of the hernial sac firstly because it is uncommon and secondly because the patient had never used a truss, which sometimes is responsible for its formation.*

We had some discussion regarding the diagnosis, but none of us could make sure what the condition was, because the history and the signs did not fit into any of the conditions we could think of.

She was told to come to the surgical out-patients on the next day, but she failed to appear.

However, one week later she came. Dr. I. Newton, the acting surgeon in charge of the University Surgical Clinic then saw the case, when a more detailed history was obtained. She said she had had

*(1) Described by Curling.
(2) Le Dran " Observation on Surgery " translation page 260—quoted by Hutchinson.

that swelling for the past four years. It had not increased much in size since it first appeared except on those occasions when she had to strain during physical labour. Occasionally she had intermittent attacks of pain in the abdomen. Last year she had eight such attacks and this year four. The physical signs were found to be the same as those on the first occasion when I examined her, except that the swelling had lost its nodular character and had become uniformly soft. The diagnosis was then changed in favour of a tumour of the round ligament probably a lipoma. She was admitted and was operated on the next morning.

Operation (13/7/32):—

It was performed under open warm ether anæsthesia.

A straight line incision was made along the line of the inguinal ligament from a point mid-way between the anterior supserior spine and the symphisis pubis to just about the pubic crest about 2½" in length. The midpoint of the incision roughly lay over the centre of the tumour. After the skin was retracted and the fascia had been carefully separated a balloon like swelling presented itself. The swelling could be traced to the femoral canal where it was found to be attached to a fibrous stalk. It was then felt to be a femoral hernia. When incised, a gush of amber-coloured fluid escaped from the swelling and a finger could then detect that there was definite communication between this sac and the general peritoneal cavity. The wall of the sac was fairly thick especially at the neck where the constriction had made it thickened all round and altogether the stalk felt like a fibrous cord. Some omentum was adherent to the sac at the hernial opening but was not present inside the sac. The sac was then tied at the neck and its distal portion resected. The femoral canal was then closed by stitching the inguinal ligament to the pectineal fascia. The wound was then closed in the usual way. During the post-operative period, the patient convalesced satisfactorily. She was discharged 3 weeks after the date of operation.

It might worth while quoting the following "Hernia and its Medical Cure" by J. Hutchinson.

"A collection of fluid may form in a hernial sac, whether inguinal or femoral, owing to blocking of its neck by intestine or omentum or to obliteration of the neck by operation, truss pressure, etc. Doubtless the fluid comes down from the abdomen in some cases but it is certain that it may also be secreted through the sac wall just as in ordinary examples of vaginal hydrocele or hydrocele of the cord.

The simplest and most common form of hydrocele of the hernial sac is that in which a lump of omentum, not necessary a large one, becomes adherent to the neck and plugs it like a cork. These cases

are almost always met with in adults, who have had hernia for long; the hydrocele steadily increases in size. In the inguinal region it may reach from the canal to the testis, in Scarpa's triangle it may extend for some distance down the thigh (as in one remarkable case under my observation, where it formed an hourglass or bilobed swelling which extended from Poupart's ligament to six inches below). Unless very tense the tumour fluctuates and translucency can usually be obtained in the inguinal variety sometimes also in the femoral.

A cerain amount of discomfort attends the swelling owing to the tension. The amount of fluid may attain to 1/2 a pint, though usually less; it is clear amber colour.

Several examples have been recorded in which a loop of adherent intestines became adherent to the sac neck and acted as a plug in the same way as the omentum, described above. These are of course more serious in their nature, as strangulation is more apt to occur.

It must not be supposed that hydrocele of the hernial sac is other than an exceptional occurance, but it may give rise to difficulty or to errors in diagnosis and in former days fatal results followed its treatment as a simple hydrocele by irritating injections, etc.

An interesting feature occasionally met with in hydrocele of the hernial sac is its changing size; for example, the omental plug may alter in position and so allow the fluid below to pass into the general cavity. As a rule, when once developed the hydrocele is permanent."

It is not within the scope of this note to discuss the theoretical side of the case or to bring out many references in relation to it. However, it is particularly interesting for the following reasons:—

(1) The difficulty of making a correct diagnosis in such cases.

(2) The rarity of the condition.

I am indebted to Dr. I. Newton, then Acting Surgeon in Charge of the University Surgical Clinic for giving me permission to record this case.

HONG KONG UNIVERSITY MEDICAL SOCIETY.

THE ANNUAL REPORT FOR 1932.

Mr. Chairman, Ladies and Gentlemen,

I have much pleasure in presenting to you the annual report of the Hong Kong University Medical Society for the session 1932-33.

You will notice that we are holding our Annual General Meeting earlier this year, because at the last Annual General Meeting it was decided to hold it at the beginning of the academic year.

The Society on the whole had a very successful year so far as activities were concerned. Several lectures were delivered and were well attended. Our social functions turned out successfully and the same can be applied to Sports.

The Committee.—At the Annual General Meeting held on Wednesday, 13th April, 1932 the following were elected office-bearers for the session 1932-33.

President	Prof. W. I. Gerrard.
Chairman	Mr. Lam Kow Cheong.
Hon. Treasurer	Prof. L. T. Ride.
Hon. Secretary	Mr. Lo Chong Fie.
6th Year Representative	Mr. Tan Hee Choo.
5th Year Representative	Mr. Lim Gim Kheang.
4th Year Representative	Mr. Chiu Put Po.
3rd Year Representative	Miss Cissy Wong.
2nd Year Representative	Mr. Woo Pak Foo.
1st Year Representative	Mr. Wong Ching Kuen.
Graduate Representative	Dr. F. S. Fernando.

Among these you will notice that Prof. Gerrard and Prof. Ride have been re-elected. Prof. Gerrard has been a very sympathetic and energetic helper to the society. His guidance and supervision over the activities of the society have proved invaluable. His re-election would therefore cause no surprise to us. Prof. Ride too, as you know, has been working for and helping the Society since he became a member. The financial stability of the Society will show you that he is not only an able editor of the Caduceus but also a financial expert.

Social Activities.—Launch Picnic: A Launch picnic was held on 2nd July, 1932. Although it incurred a deficit it was nevertheless a social success as was evidenced by the large number of people present.

The Annual Social Function.—The Annual Social Function was held on Saturday, 17th December, 1932 in the form of a Dinner and Dance at the Hong Kong Hotel Roof Garden. There was a large number of members and guests present and a very enjoyable evening was spent.

Farewell Parties.—During the session two farewell tea-parties were given. The first was held on 16th May, 1932 in the Union Assembly Room in honour of Prof. J. Shellsbear who was going away on leave. It was well attended and Prof. Shellsbear was presented with a handsome cigarette box.

The second was given to Dr. S. T. Hsiu in the Union Assembly Room on 28th December, 1932. A large crowd turned up to wish Dr. Hsiu good-bye. As a token of our friendship we presented him with a small camera. We regret very much to have lost such a man as Dr. Hsiu who has been an energetic and concientious worker in the Medical Staff and was very popular among the students. However, we wish him every sucess in his future field of research in the Lester Institute in Shanghai where he is at present working.

Another member of the society who left the University was Dr. S. Y. Wong our former lecturer in Pharmacology. We tried to arrange a farewell party for him but somehow or other he refused it as he thought it was not necessary. However, we presented him with a hand-turn centrifuge and a set of books entitled "Extra Pharmacopoeia" by Martindale. We wish him every success in the Central University in Nanking where he is a lecturer at present.

Lectures.—The following lectures were delivered during the session:—

"Acute Empyema Thoracis and its Treatment" by Dr. S. T. Hsiu on 21st April, 1932.

"Problem that medical men have to meet at an emergent call" by Dr. W. S. New on 2nd June, 1932.

"Our present conception of the Relation of Yaws to Syphilis" by Dr. C. M. Hasselmann on 26th September, 1932.

"Some topics in Surgery as seen during my visit to Canada and England" by Prof. K. H. Digby on 9th November, 1932.

Sports.—As regards to sports we still remained supreme over the other Faculties as was evidenced by the fact that we won the championships in Tennis and Basketball, while in Cricket we drew with the Engineers in the finals, after defeating the Arts.

The Caduceus:—We have to thank our Editor, Prof. L. T. Ride for his untiring work in running the Caduceus. The issues came

out a bit late this year and this was due to lack of contributions from the students and members: I would like to appeal to you all to do your bit for the Caduceus as it is only through it that we can make ourselves known to the other parts of the world, and moreover it acts as a living voice of the Society.

Finance:—The financial basis of the Society I am glad to say still remains sound as it shows a balance of about $3,000 but I would like to appeal to every member to pay in his subscription, for the year 1932 showed a bad record of arrears in subscriptions. As regards to other accounts I would refer you to the statement of accounts which was closed on 31st December, 1932. From the Hon. Treasurer I learned that the Balance Sheet would not be ready this afternoon owing to the Chinese New Year Holidays falling on just before this meeting. However, it will be produced at the next General Meeting.

Prof. C. Y. Wang Memorial Fund.—The raising of the Prof. C. Y. Wang's Memorial Fund was not so successful as was expected. Various attempts were made to raise the sum of $2,250 the cost of the bronze bust of the late Prof. C. Y. Wang. So far only about $1,200 was realized leaving still about $1,000 to be raised. The campaign of raising this fund is still on and I hope it will meet with better success.

In conclusion I wish to thank the President, Prof. W. I. Gerrard for his kind guidance and invaluable advice; Mr. K. C. Lam for the great help he rendered me in the fulfilment of my duty; the committee members for their kind co-operation and the members for the interest they have taken in the society.

Review of Books

Reports, National Quarantine Service, Series III—1932. Edited by Wu Lien-teh and Wu Chang-yao. Pub. National Quarantine Service 2 Peking Road, Shanghai, p. 331, $4.50.

This volume incorporates the annual report of the Chinese National Quarantine Service and that of the Plague Prevention Service; for owing to changing political conditions in Manchuria, the work of the latter service which has been carried on in Manchuria during the past twenty years has now come to a standstill. It is, however, a consolation to read in the preface to the present volume that the work will be continued with undiminished vigour within the Great Wall.

Forty-eight pages are devoted to an account of the cholera epidemic in Shanghai last year. This makes most interesting reading. We learn for example that in the International Settlement the epidemic showed a morbidity rate of 0.10% for foreigners and 0.15% for Chinese, while the respective mortality rates were 29.5% and 9.6%. The mortality rate for the whole of Shanghai worked out at under 7%. The statement on page thirty-seven that anti-cholera vaccination may be expected to yield full immunity after one week and that it will last for six months would appear to be somewhat dogmatic. One regrets that it was not feasible to conduct a controlled large-scale experiment to test the actual efficacy of prophylactic vaccination in Shanghai. No mention was noticed of any work on bacteriophage, either its presence in the stools of patients or its experimental use in prophylaxis and treatment.

For the first time in China, a systematic rat-flea survey of the principal ports was organized, and the preliminary results are reported in the present volume.

Over a hundred pages are devoted to a survey of plague in wild rodents and of pneumonic plague. This should be of great value for reference purposes.

The remainder of the report is mainly devoted to various phases of public health work and amply illustrates the manifold activities of the Service.

The perusal of the volume is to be strongly recommended to all senior medical students of this University. They will derive from it an insight into many aspects of practical sanitation, and those who are Chinese will be gratified by the knowledge of what is being accomplished in this field by their countrymen. It is to be hoped that some of the abler among them may be stimulated into adopting preventive medicine as a career.

L. J. D.

Notes and Comments

We are indeed sorry to loose the valuable services of our Editor Professor L. T. Ride who went on leave at the beginning of May, 1933. It won't be far wrong to state that the financial stability of the Society was due to his untiring work in connection with the "Caduceus." We wish him, Mrs. Ride and family a very enjoyable holiday at home.

Congratulations are extended to Prof. L. J. Davis on being elected Editor of this journal. We are sure he will be able to keep up the high standard that has been set up by his predecessors. Prof. Davis will have the help of Dr. K. D. Ling and Mr. Ong Ewe Hin who were nominated Associate Editors by the Committee.

We wish to congratulate Prof. L. T. Ride on his being appointed by the University authority to be an Official Representative of this University at the fifth Pacific Science Congress to be held this June in Vancouver.

The Medical Faculty has lost one of its best teaching staff in the person of Dr. T. Y. Li, Assistant to the Prof. of Medicine who resigned to join an appointment with the Henry Lester Institute for Medical Research at Shanghai. High tribute to the good work done by Dr. Li during his six years' service to the University was paid by Prof. Gerrard when he presided at the Medical Society's farewell tea-party. Referring to Dr. Li's departure, Prof. Gerrard said he felt more because Dr. Li had been his right hand man in the medical section for the last three years, during which time he had always found Dr. Li to be a very able man, and knew that he could always depend on him whenever there was work to be done. We wish Dr. and Mrs. Li the best of luck in Shanghai.

We welcome Dr. T. S. Sze and M. W. Shi who were appointed to fill the posts vacated by Dr. T. Y. Li and S. T. Hsiu respectively

as first Assistants to the Professors of Medicine and Surgery. We have found them to be very energetic and we are sure that they will endear themselves to those clinical students who come under them.

The University Authorities have made additions to the staff of the clinical departments this year by creating second Assistantships to the Professors of Medicine, Surgery, and Obstetrics and Gynæcology. Drs. T. K. Lien, F. Y. Khoo and S. F. Cheung were appointed to the respective posts.

In addition to the above, Demonstratorships in the Pathology and Physiology departments were also created. The former appointment has been filled by Dr. F. S. Fernando and the latter by Dr. K. D. Ling.

Mr. Mak Kai Chum is to be congratulated on winning the Anderson Gold Medal for 1932. He is at present doing research work under Prof. C. E. Lim at the Peking Union Medical College.

To Mr. Lee Hua Ngak and Mr. Ong Ewe Hin we extend our congratulations the former for winning the Ng Li Hing Scholarship for Anatomy and the latter for being awarded the Ho Fook and Chan Kai Ming Sscholarship for Anatomy, Physiology, and Pharmacilogy.

It is with pleasure that we learn that Dr. Yang Lin has attained the Fellowship of the Royal College of Physician, Ireland. Dr. Yang has had a brilliant career here in this University. After his graduation he went to Rotunda, Dublin where he obtained the L. M. and D. G. O. He received the M.R.C.P.I. at the beginning of this year and was admitted to the Fellowship on 10th April, 1933. He is probably the first among our graduates to have been honoured with such a high qualification. To Dr. Yang we extend our heartiest congratulation.

We congratulate Dr. T. Z. Bau, M.D., B.S., on his appointment as the Superintendent of the Kwong Wah Hospital.

We record with our deepest regret the death, on December 4th, 1932, of Mr. R. E. G. Leong, a fourth year medical student of this University. Mr. Leong was a brilliant scholar and a well known sportsman. To his parents anl his brothers we extend our deep sympathy.

We print below a list of the new appointments made to fill the posts of House Officers at the Government Civil Hospital from July 1st to December 31st, 1933, and of the clinical appointments of students from June 1st to September 11th, 1933.

We are also publishing a complete list of the examination results of the Degree Examinations held in May 1933, and in doing so we take this opportunity of offering those successful candidates our heartiest congratulations.

HOUSE OFFICERS.

Clinical Assistant to the:—

Medical Unit .....Bee Hoat Teck, M.B., B.S.

Surgical Unit .....Teoh Thean Ming, M.B., B.S.

Obstetrical & Gynæcological Unit...Cheng Hung Yue, M.B., B.S.

House Physician .....Lee Hah Liong, M.B., B.S.

House Surgeon .....Khoo Fun Yong, M.B., B.S.

House Obstetrician .....Hilda Yuen, M.B., B.S.

Out-Patient Officer .....Kuo Shao Hong, M.B., B.S.

CLINICAL APPOINTMENTS OF STUDENTS for the Period June 1st—September 11th, 1933:—

Surgical Ward Clerks:.....Gosano, E. L.
Ng Yew Seng

Junior Medical Ward Clerks:.....Cheng See Yan
Miss Cissy Wong

Surgical Dressers: .....Leung Tin Sun
Ong Ewe Hin
Souza, O. I. E. de

Senior Medical Ward Clerks:..... Alvares, R. E.
Lee Hua Ngak
Wu Hung Tak
Yeung Tsaw Che

Pathology Clerks:..... Goh Tiek Wah
Wei Cheuk Sheng

Anæsthetics Clerks:..... Chan Seck Fong
Nagalingnam, K.
Sung Sheung Hei
Tan Wee Han

Obstetrics Clerk:..... Szeto Eng Kee

Extension Medical Ward Clerks:..... Chiu Put Po
H. Mahan Singh
Ng Yeok Kiw

Extension Surgical Dressers:..... Cheng Wing Kwai
Chew Poh Heng
Lau Man Hin
Pang Iu Ki
Wing Shun Fong
Wong Siong Hing

Extension Obstetrical Ward Clerks:... Chau Woon Nin
Chung Hon Kwan
Lam Kow Cheong
Lau Yong Boon
Lew Koon Shin
Leung King Hon
Lim Gim Kheang
Lo Chong Fie
Quek Cheng Kim

Radiology & V. D. Clerks:..... Lai Fook, Wm.
Lee Pitt Siew
Rodriques, A. M.
Roy, D.
Wong Shing Hang

White Cards:..... Chan Fook
Miss Hiu Luk Yip
Hiptoola, F.
Loh Seng Poh
Khoo Keng Wah
Lee Ho Tin

The following have now completed the FINAL M.B., B.S. EXAMINATION :—

Bee Hoat Teck
Kuo Shao Hong
Loke Kam Thong
Teoh Thean Ming
Tseng Wah Kit

The following have passed in MEDICINE in the FINAL EXAMINATION :—

Bee Hoat Teck
Hiu Luk Yip (Miss)
Lee Ho Tin
Loke Kam Thong
Teoh Thean Ming
Wong Siong Hing

The following have passed in SURGERY in the FINAL EXAMINATION :—

Bee Hoat Teack
Loke Kam Thong
Teoh Thean Ming
Tsu Tsoon Ji

The following have passed in OBSTETRICS & GYNÆCOLOGY in the FINAL EXAMINATION :—

Bee Hoat Teck
Chan Fook
Kuo Shao Hong
Lee Ho Tin
Loke Kam Thong
Scully, G. S.
Teoh Thean Ming
Tseng Wah Kit
Tau Tsoong Ji
Wong Siong Hing

The following have passed MEDICAL JURISPRUDENCE & PUBLIC HEALTH :—

Chau Woon Nin
Cheng Wing Kwai
Chung Hon Kwan
Hiptoola, F.
Leung King Hon
Lew Khoon Shin
Lo Chong Fie
Quek Cheng Kim
Rodriques, A. M.

The following have passed in PATHOLOGY & BACTERIOLOGY :—

Cheng Hon Kwai
Chung Hon Kwan
Lau Man Hin
Leung Kin Hon
Lew Khoon Shin
Lo Chong Fie
Pang Iu Ki
Quek Cheng Kim
Wong Shing Hang
Wong Shun Fong

The following have passed in THERAPEUTICS & PHARMACY :—

Chau Woon Nin
Cheng Wing Kwai
Chung Hon Kwan
Lai Fook, Wm.
Lam Kow Cheong
Lau Yong Boon
Leung Kin Hon
Lew Khoon Shin
Quek Cheng Kim
Rodriques, A. M.
Roy, D.

The following have passed in SENIOR ANATOMY & PHYSIOLOGY, including PHARMACOLOGY :—

Cheng See Yan
Gosano, E. L.
Ng Yew Seng
Wong, Miss Cissy

The following have passed in JUNIOR ANATOMY AND PHYSIOLOGY :—

Foo Chee Guan
Khoo Soo Lat
Ribeiro, G. A. V.
Tan Eng Gwan
Yong Pung Fook

The following have passed ORGANIC AND PHYSICAL CHEMISTRY :—

Foo Chee Guan
Heng, Willie
Khoo Soo Lat
Lee Ching Iu
Ribeiro, G. A. V.
Tan Eng Gwan

The following have passed in PHYSICS :—

Chan Ping Kwok
Fok Wing Kwai
Hugh Chee Ngie
Ip Kung Chiu
Kwok Yu Kong
Lee Cheng Ong
Lymn, Miss K. I.
Tan Hai San
Tsang Kwong Kau
Waryam Singh Tibb

The following have passed in INORGANIC CHEMISTRY :—

Hugh Chee Ngie
Ip Kung Chiu
Tjoa Som Gwan
Waryam Singh Tibb
Wong, A. W.

The following have passed in BIOLOGY :—

Ampalavanar, T.
Chan Ping Kwok
Feng Tze Chiu
Fung Fa Lun
Ip Kung Chiu
Kwok Yu Kong
Lee Ek Leong
Symons, R.
Tan Hai San

Acknowledgments

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Chiba Iggakai Zasshi.
Mitteilungen Aus Der Medizinischen Akademie Zu Kioto.
Journal of the Chosen Medical Association.
Fukuoka-Ikwaidagaku Zasshi.
Okayama Igakkai Zasshi.
Keijo Journal of Medicine.
Cambridge University Medical Society Magazine.
Health & Empire.
Ulster Medical Journal.
University College Hospital Magazine.
St. Thomas Hospital Gazette.
Post Graduate Medical Journal.
Bristol Medico Chirurgical Journal.
New Zealand Medical Journal.
Bulletin of the New York Academy of Medicine.
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