TABLE I.—*Pituitary Gland Function.* (From Schafer.)

Absent.	Deficient.	Excessive.	Injection of Extract.
Anencephalics	Dwarfs	Skeletal overgrowth	
Paralysis C.N.S.	Hibernation		
Somnolence	Drowsiness		
Lethargy	Lethargy	Mental depression and stupor	
Loss of muscle tone	(Lassitude)		
Metabolic depression	Lowered basal metabolism		Increased basal metabolism.
Subnormal temperature	Low temperature		Rise in temperature.
Respiratory failure	(Sub-breathing)		
Rapid loss of weight	Fat storage		Stops water diuresis.
Refusal of food	(Alimentary dysfunction)	Inordinate appetite	Alimentary stimulation.
Polyuria or oliguria	Polyuria	Polydipsia and polyuria	Glycosuria.
	Atrophy of endocrines, sex characteristics, and functions	Coarsening of features	Nitrogen retention phosphorus and calcium increased.
	Skin and hair feminine	Excessive hair	Prevents experimental oedema.

TABLE II.—*Nerve Centres of the Hypothalamus.*

Control the smooth muscles of: Eye, bladder, uterus, blood vessels, ?stomach, ?small intestine. Also: Striped skeletal muscle (involuntary), plastic muscle tonus.

Control the secretion of: Sweat, saliva, tears, urine, pancreatic secretion, ?gastric secretion, ?cerebro-spinal fluid.

Control the metabolism of: Sugar, protein, water, temperature, fat, trophic skin, sex-gland activity, sleep, mineral salts of the body fluids, ?acid-base equilibrium, ?digestion.

Symptoms of dysfunction: Glycosuria, albuminuria, polydipsia, pyrexia, subnormal temperature, obesity, sudden loss or gain of weight, amenorrhoea, impotence, insomnia, drowsiness, apathy, trophic ulcers, abnormal hunger, catalepsy, marasmus, hyperidrosis, salivation, seborrhoea, lacrymation, polyuria, constipation, polypnoea, retention of urine, ?achlorhydria, ?cyanosis, ?dilatation of stomach, ?dilatation of small intestine, ?sudden lassitude, ?hypochondria.

Pathological changes occur in: Diabetes insipidus, dystrophia adiposo-genitalis, narcolepsy, Graves's disease, encephalitis lethargica, Parkinsonism, ?some forms of epilepsy, ?some forms of mental disease.

TABLE III.—*Clinical Symptoms, possibly Referable to Pituitary Hypothalamic Disturbance, in 69 Cases of Insanity with Pus in Sphenoidal Sinus.*

A. PITUITARY-HYPOTHALAMIC DYSFUNCTION.

Symptoms.	Before Treatment.				After Treatment or Recovery.			
	0	+	++	+++	0	+	++	+++
Cyanosis ...	22	5	16	26	44	23	2	0
Pallor ...	19	5	15	30	45	21	3	0
Oedema ...	41	5	16	7	60	7	2	0
Stupor ...	31	8	13	17	54	12	3	0
Drowsiness ...	32	9	13	15	54	11	4	0
Refusal of food ...	26	2	12	19	64	3	1	1
Delusions of poisoning	48	2	4	15	67	1	1	0
Abnormal hunger ...	61	3	2	0	68	0	0	1
Constipation ...	6	3	20	40	33	31	2	3
Sub-breathers ...	3	20	22	24	21	34	13	0
Coarsening of face ...	48	8	11	2				
Variations of weight ...	31	17	16	5				

Other Common Symptoms—Vasomotor defect; subnormal temperature; gross fattening; asthenia (suprarenal); thyroid (excess and deficit); retrogression of sex characteristics.

0=Absent or normal. +=Slight. ++=Moderate. +++=Very marked symptoms.

TABLE IV.
B. MENTAL DISORDER, ETC.

Symptoms.	Before Treatment.				After Treatment or Recovery.			
	0	+	++	+++	0	+	++	+++
Mental disorder...	0	4	11	54	22	26	13	8
Confusion ...	11	7	12	39	43	15	7	4
Apathy ...	20	12	20	17	47	13	7	2
Catalepsy ...	48	4	11	6	64	3	2	0
Insomnia ...	19	5	6	39	42	22	4	1
Headache ...	17	6	12	34	48	15	2	4
Naughtiness ...	54	3	2	10	57	6	3	3
Fear processes ...	20	6	14	17	41	8	6	2
Influenza ...	39	4	19	16				
Family history ...	31	20	12	3				

Mental Classification.

Dementia praecox ...	25	Epileptic ...	4
Confusional ...	14	Mania ...	2
Imbecile ...	3	Melancholic ...	14
Paranoia ...	3	Alternating mania, melancholic	4

0=Absent or normal. +=Slight. ++=Moderate. +++=Very marked symptoms.

My thanks are due to Dr. J. M. Mackenzie for kindly showing me the case and for the clinical notes, and to the Medical Research Council for incidental help from Mr. A. T. Rennie, my laboratory assistant.

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WOUNDS OF THE HEART.

A STUDY OF THREE CASES.

BY

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WOUNDS of the heart have been recorded from classical times, and though they were then regarded as being invariably fatal, it is now well recognized that the heart is an organ which is able to tolerate mechanical interference reasonably well. Not only have wounds of the myocardium been successfully sutured,¹ branches of the coronary arteries ligated,² and foreign bodies extracted,³ but in more recent years even the cavities of the heart have been explored in the hope of alleviating the mechanical handicap of a stenosis of the valve leaflets.⁴

TYPES OF FATAL CARDIAC INJURY.

While this is true, yet in war many combatants must die instantaneously from the immediate effect of wounds of the heart. In these days such injuries as result from the use of bullets, shrapnel, fragments of high explosive shells, and the like, are probably a more frequent cause of immediate cardiac arrest than statistics would indicate. Death, when it occurs instantaneously, is the result of a number of factors, notable amongst which must be the extent and severity of the lesion produced in the heart. The momentum of such missiles may be very great and the damage to the heart may be beyond all hope of repair. Sudden gross destruction with gaping lacerations of a wide area of ventricle or auricle is incompatible with life. Even a large proportion of the wounded in whom the damage is less severe must die before surgical aid can be made available, and in these shock and haemorrhage may be profound. Others, again, may survive a matter of minutes to hours, and die from the effect of the accumulation of blood within the pericardium. Blood leaking from a wound of

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the heart muscle into the pericardial sac may raise the intrapericardial tension to a level approaching that in the great veins. The work of the heart is then greatly embarrassed by a decrease in the venous return, the systolic arterial pressure falls, and death results largely from mechanical causes. Such cases are eminently suited for surgical intervention. The risk of sepsis, secondary haemorrhage, and shock all tend to increase the death rate amongst those who survive the initial stages of the injury.

SURVIVAL AFTER HEART INJURY.

There remain to be considered those patients who survive the immediate effects of the wound, and in whom a bullet or other foreign body lies embedded in the myocardium for months or years. In such cases it is probable that the original injury was relatively slight, and that the missile, by acting as a plug, effectively checked any severe haemorrhage. It is the purpose of the following notes to record the effect on cardiac function of the presence of a foreign body retained in the heart muscle for a number of years. Three such have come under observation, and it was possible in two of the patients to study their cardiac functions thirteen years after the original injury, the foreign body being still *in situ*.

Similar cases have been mentioned from time to time in the literature. Apparently the first recorded observation of such a condition was made on the heart of a wild animal when, about the year 1600, J. C. Weber⁵ described the finding of a bullet firmly encapsulated in the heart of a stag. A similar incident has been reported by Grainger.⁶ "The animal was remarkably fat and healthy in condition," and had been wounded in the heart apparently some years before death, for the bullet was contained in a cyst in the substance of the muscle. That such a state is compatible with a long life is an old observation. Croly⁷ mentions a Napoleonic veteran who was wounded in 1812 and lived for fifty-two years with a round bullet embedded within the pericardium. Delorme⁸ quotes a case in which a bullet was found encysted in the wall of the right ventricle twenty years after wounding; the patient died of pneumonia. During the war years many similar cases came under observation, and, by the more general use of x rays, bullets and other foreign bodies have frequently been localized in the heart muscle. Vacquez and Bordet in 1918 were able to collect eight reported cases in which foreign bodies were situated in the heart and had not been extracted. A total of thirty-eight cases of war wounds of the heart came to their notice, and of these nineteen required surgical intervention on account of symptoms such as pain or dyspnoea attributable to the presence of the projectile.⁹ Vance¹⁰ has recorded three interesting cases of bullet wounds of the heart in which death resulted at a later date, and was not the result of the cardiac damage. In one of these the remarkable feature was the encapsulation of the bullet in the wall of the right ventricle with healed scars of the right auricle and lung demonstrating the route pursued by the missile in reaching its resting place. This man had been shot in the chest at least three years previously.

The older statistics¹¹ on the distribution of injuries to the heart show a much higher proportion in favour of the ventricles as compared with the auricles. The anatomical relation of the chambers of the heart is often considered a sufficient explanation of this fact, the ventricles presenting a larger surface to external injury. Moreover, the auricle walls are of finer texture and, being less substantial than those of the ventricles, suffer more severe damage from the lodgement of a missile. Greater laceration is to be expected in such tissue, and immediate death more probable. Statistics have been largely compiled from those cases surviving the initial injury. Mention is made of only four specimens of wounds of the auricle in the War Office collection of hearts,¹² whereas a great variety of wounds of the ventricle is shown in fourteen other specimens. In some of these the projectile had passed through the ventricles in its flight, in others it had embedded itself in the muscle, the degree of damage varying greatly. Sepsis was a fairly common complication in the specimens collected. Interesting observations on the localization of projectiles in the heart have been made by radiological examination.

In a few instances the missile has perforated the muscular walls and remained free within a cavity of the heart. Whirling movements of the foreign body have been observed on screen examination, as though it were buffeted from side to side by the currents of blood within the chambers of the heart. Embolic phenomena have occurred on more than one occasion in such circumstances.¹³

While in certain cases surgical intervention for the extraction of a foreign body may be imperative, yet this is a procedure not to be undertaken lightly. If symptoms be in abeyance, then such objects as bullets or fragments of shell may well be permitted to remain innocent tenants of "the chief and most noble organ of the body."

CASE I.

A. R., now aged 35, was first seen on February 25th, 1928. He was wounded in France on August 18th, 1916. While standing in the trench he received a sharp knock on the back and then felt a sudden twinge in the region of the heart. He fell forward, but rose immediately, and after the application of a field dressing to the wound in the back he was able, a few minutes later, to walk a mile in comfort to the nearest dressing station. Later

FIG. 1.—Case I. X-ray photograph (6-foot plate) showing the presence of a spherical ball of shrapnel lying within the pericardium and dimpling into the ventricular muscle near the apex.

the same day he began to suffer pain in the region of the heart, and was transported to hospital at Etaples, being under the care of Dr. Nathan Raw. He was transferred to England, and was a patient in several hospitals. The question of operation was considered, but a surgeon consultant, who saw him in April, 1917, discouraged the suggestion and told the patient that no one could

FIG. 2.—Case I. Electro-cardiogram showing the presence of normal sinus rhythm. The T waves are upright and well formed in all leads. The time-marker records 28.57 vibrations per second. 1 cm. deflection equals 1 millivolt.

guarantee him to be as physically fit without the bullet as he was with it. He was discharged on May 17th, 1917, and returned to civil life and his former occupation—a grocer's assistant. This man has been under observation for a year and has complained of no symptoms. He had had no previous illnesses of any importance, and had always been healthy.

Examination revealed a well-built, muscular man, 5 ft. 4½ in. in height and 10 st. 4 lb. in weight. There was a healed scar in the right interscapular region. The heart was not enlarged,

the apex being in the fifth space 0.5 cm. within the mid-clavicular line. The heart sounds were pure in character. The pulse was regular in rate, 64 per minute, and of good volume. The lungs were healthy, and no evidence of disease was detected. The skeletal muscles were rather flabby.

Seen again in February, 1929, he admitted that since the occurrence of the wound he had avoided all strenuous exercise, though he felt able for work, and could enjoy a round of golf without fatigue. He could play a game of football, but did not feel justified in making it a habit on account of the effort involved. He believed lack of training to be the cause of a bursting feeling in the head which he occasionally experienced after a game of football.

X-ray examination revealed the presence of a spherical ball of shrapnel lying within the pericardium and dimpling into the surface of the left ventricle above the apex (Fig. 1). Screen examination showed that it moved in a transverse direction with each cardiac contraction. A radiogram taken a year after the first examination demonstrated that the missile was in exactly the same position and had not "wandered." An electro-cardiogram taken on two occasions revealed no significant changes (Fig. 2). His vital capacity was 3,050 c.cm., being 73.8 per cent. of normal for his surface area.

CASE II.

J. B., aged 35, was seen in February, 1929. While serving in France he was wounded in the right foot at Hill 60 in 1915. After

FIG. 3.—Case II. A-ray photograph (stereoscopic view) showing the presence of two fragments of metal (A and B) within the chest. "A" lies in the hilus of the lung; "B" is smaller and is embedded not far from the apex in the posterior wall of the left ventricle.

treatment he rejoined his unit and was again wounded in July, 1916. He was hit in the chest, fell to the ground, and was

FIG. 4.—Case II. Electro-cardiogram showing the presence of normal sinus rhythm with a left ventricular preponderance. The T waves are upright in all leads. Time-marker and standardization as in Fig. 2.

was regular in rate and not enlarged. The apex was 0.5 cm. within the mid-clavicular line. The sounds were pure and no murmurs were heard. The pulse rate after fifteen minutes' rest was 75. Blood pressure readings were 128 systolic, 94 diastolic. There was no evidence of disease elsewhere.

During the course of a routine examination a radiogram of the chest (Fig. 3) showed the presence of a fragment of metal buried in the left lung and another smaller piece in the wall of the left ventricle. It was noted on screen examination that with each heart beat the latter fragment moved to and fro in a transverse direction. Stereoscopic radiograms demonstrated that the fragment was embedded near the posterior aspect of the left ventricle. Another fragment was found in the left lung near the hilus. An electro-cardiogram (Fig. 4) showed the presence of normal sinus rhythm with a left ventricular preponderance. The vital capacity test gave a reading of 3,825 c.cm., being 92.7 per cent. of normal for his surface area.

CASE III.

This patient was a German soldier, aged 23, who died of a fat embolus in France on November 22nd, 1918, as a result of gunshot

FIG. 5.—Case III. Showing the heart, with a small block of tissue cut away to expose a fragment of metal embedded in the posterior wall. The thickened and adherent pericardium can also be seen. The missile is marked by the arrow.

wounds of the left leg and left arm. A *post-mortem* examination was performed the following day. The body was well developed. There was a large open wound across the middle and outer aspects of the left thigh with a transverse fracture of the shaft of the femur above the condyles. The ends of the bone were bathed in an abscess cavity. The left humerus was fractured just above the elbow-joint. There was also an entry wound over the spine of the fifth left lumbar vertebra, which was fractured. There was some extravasation of blood into the retroperitoneal tissue.

Besides these recent wounds, examination showed the presence of a well-healed scar of a wound sustained on a former occasion. It was situated behind the left posterior axillary line. The lower border of the eighth left rib was chipped. The inferior part of the pleural sac was obliterated, and the lung was firmly adherent to the chest wall and pericardium. The posterior surface of the heart was adherent to the pericardium. A fragment of high explosive shell was lodged in the muscle of the left ventricle, just below the transverse vein. It did not penetrate the whole thickness of the muscle. There was nothing else abnormal noted in the heart or other organs. The accompanying photograph (Fig. 5) shows the missile *in situ*.

The *post-mortem* evidence in this case indicated that the heart wound was obtained some time previous to the wounds which were the immediate cause of the man's death.

These cases are of interest in that they substantiate the view that the presence of foreign bodies embedded in certain sites of the heart muscle is compatible with an active and vigorous life. Just as a foreign body situated elsewhere in the body may give rise to no symptoms, so also may a small piece of metal in the myocardium be of no apparent disadvantage to its owner. This may be of

some importance from a medico-legal point of view. It also suggests that the immediate extraction of a foreign body from the heart is not always justifiable unless symptoms are urgent.

SUMMARY OF CLINICAL FINDINGS.

The electro-cardiograms show that the spread of the excitation wave through the heart muscle is not significantly altered in its course or time relations in these cases. It is well known that after infarction of the heart muscle certain changes may occur in the electro-cardiogram particularly affecting the form of the T waves. These alterations are more frequently observed when the lower part and apex of the left ventricle are involved in the infarcted area. The T deflection is said¹⁴ to show a certain sequence of changes in shape and direction, gradually returning to normal as healing in the muscle takes place. It is possible that shortly after the injury sustained by the heart in the above cases, some deformity of the T wave might have been observed. After a lapse of years no abnormalities are to be detected in the T waves of these patients, even in the presence of inert metal buried not far from the apex. Apparently but few cases with retained missiles have presented themselves for electro-cardiographic examination. Lea¹⁵ has recorded one instance in a young soldier with a fragment of shell embedded near the apex of the heart, in whom complete heart-block was present. In the single electro-cardiogram published the T waves were upright and of normal form. In the case of Jones¹⁶ the T waves were inverted in lead 2 thirteen weeks after the injury. The left ventricular preponderance observed in Case ii of this series is not considered of much significance. The heart was not found enlarged or displaced by clinical or x-ray examination. Pericardial adhesions over the posterior surface of the heart might possibly account for this change.

The vital capacity test indicates that these men suffered from no diminution in ability to take a full deep breath. The test has been used to some extent as a measure of physical fitness, and has proved of value in following the course of heart disease. The fact that the result obtained in Case i was a little lower than might be expected is probably attributable to his voluntary abstinence from most forms of physical exercise. The man was flabby and in poor physical training. In Case ii the high reading recorded indicates that, so far as this test is concerned, there was no impairment of his respiratory powers.

In Case iii it is assumed that, after obtaining a heart wound, this man was sufficiently fit to rejoin a front line regiment. Any cardiac disability under such circumstances is extremely unlikely. The man survived a heart wound, and must have led a vigorous life thereafter, ultimately to succumb to the effects of a compound fracture of the femur.

CONCLUSIONS.

1. Foreign bodies such as bullets, shrapnel, or fragments of shells may remain buried in the myocardium for years without the production of symptoms.
2. Two cases are described in which missiles were found embedded in the muscle of the left ventricle of the heart by x-ray examination thirteen years after wounding.
3. Both men are in good health and fit for active work at the present time, the foreign bodies being *in situ*.
4. The electro-cardiograms presented no significant alterations in the form of the T waves or other deflections.
5. In the third case, at *post-mortem* examination, a fragment of shell was found buried in the left ventricle. It was not related to the death of the patient.

My thanks are due to Professor D. Murray Lyon, who kindly placed Cases ii and iii at my disposal. The x-ray photographs were taken in the radiological department of the Royal Infirmary, and I am indebted to Dr. Woodburn Morison for the reduced prints. Case i was kindly sent to me for examination by Dr. S. Lipetz, to whom I am indebted.

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THE TREATMENT OF NEPHRITIS.*

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THOUGH nothing as dramatic as insulin, or as specific as liver extract in pernicious anaemia, has yet been applied to the treatment of nephritis, great advances have been made within recent years; and there comes a time when, with the gradual accumulation of new facts and theories, it is useful to review our knowledge of a subject, and bring our plan of campaign as far as possible up to date.

The more important functions of the kidney are: (1) The regulation of salt and water metabolism and the osmotic pressure of the blood. (2) The excretion of certain end-products of metabolism, especially from protein, and of other substances not required by the body. (3) The maintenance (with the help of other apparatus) of the acid-base equilibrium of the body. The first of these functions is represented clinically in the amount and specific gravity of the urine, and in the occurrence of oedema. With regard to the second function we have in the estimation of the non-protein nitrogen of the blood a delicate and important test, and one which is often most helpful in treatment and prognosis. It must be remembered that the normal kidney can, and will, excrete protein when required to do so—as, for instance, injected proteins, or haemoglobin when liberated from its normal position in the red cell.

The following classification of nephritis, based on that of Christian,¹ will be adopted in this paper.

1. Acute nephritis (oedematous, haemorrhagic, recurrent).
2. Subacute nephritis with oedema.
3. Chronic nephritis (a) with oedema; (b) without oedema; (c) vascular hypertension progressing into nephritis.

ACUTE NEPHRITIS.

Nearly every case of acute nephritis, whether oedematous or haemorrhagic, is a sequel of an acute infection, most commonly a throat infection, which it usually follows after an interval of ten to fourteen days. Scarletinal nephritis, which in all cases is a sequel of a streptococcal tonsillitis, is no exception.

There are two factors at work in the production of acute nephritis: (1) the specific factor which causes the renal damage; (2) the factor of functional overstrain which determines the amount of the damage. Animal experiment² is quite clear on this point, for whatever the poison used—some of the recent work has been done with scarlet fever streptococcus endotoxin³—the amount of damage done by a given dose depends on the functional strain thrown on the kidney; in other words, on the amount of protein and salt in the diet. This applies not only to rabbits, whose normal protein intake is low, but also to animals normally carnivorous. A further point which stands out from the experimental work^{4,5} is that fresh vegetables in the diet are not merely neutral in effect, but appear to have a positive influence in limiting the degree of renal damage.

The treatment of acute nephritis must therefore consist in the prevention of functional overstrain during the stage

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