THE MEDICAL ASPECTS OF AEROPLANE ACCIDENTS.*

BY

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In the early days of flying there were necessarily many accidents, owing first to structural weaknesses in the aeroplanes and secondly to the fact that the pioneer pilots had to experiment and were mostly unacquainted with many of the factors governing aerial navigation. When man began to teach man, and as improvements in the construction of aeroplanes increased, so accidents diminished in number proportionately; but, on the other hand, many more took up flying, and the total of accidents was increased. The pre-war methods of teaching were slow and sure, and first solo flights were made in stages, and after prolonged tuition, thus tending almost to obviate accidents altogether. As the war advanced and the importance of aviation was recognized more pilots were needed and the methods of teaching had to be accelerated; after a few hours' dual-control instruction, pupils were sent off to do their first solo flights. Naturally many more accidents occurred, and as nowadays tuition is on faster and more powerful aeroplanes, so have the total number of accidents increased. Every accident teaches something new, and all should be investigated thoroughly, so that a preventable cause or error can be eliminated in the future. In this connexion the reports of the Public Safety and Accidents Investigation Committee of the Royal Aero Club are very instructive and should be studied.

The total number of accidents due to school work and experimental flying is greatly augmented by the number due to war flying, either the result of aerial duels or anti-aircraft fire from the ground.

An attempt has been made to classify accidents at this station covering a period of six months, and these are referred to as the "V" series. In a general review of accidents I have also drawn from fifteen months' experience whilst at another school, and these are referred to as the "E" series.

In the "V" series during six months 4,000 hours' flying were done, consisting of 9,000 flights, and during that time 58 aeroplanes were wrecked or crashed. The suggested definition of a crash is an aeroplane so damaged in a flying accident that it has to be deleted or sent into the workshops for repair or rebuilding. This is in contradistinction to the effects of a bad landing or get off where the ensuing damage is small and can be repaired by the flight mechanics. Fifty-eight crashes in 9,000 flights represents one crash in every 155 flights. In these 58 crashes 16 airmen were injured, which is equivalent to 28 injuries in every 100 crashes, or one pupil injured in every 560 flights.

From these figures one can see that school flying is fairly safe and compares favourably with other high velocity forms of transport.

From this list of 58 crashes the following table is compiled to show the frequency of crashes and injuries on early solo flights:

No. of Solo.	No. of Crashes.			No. of Solo.	No. of Crashes.		
	With Injury to Pilot.	Without Injury to Pilot.	Total.		With Injury to Pilot.	Without Injury to Pilot.	Total.
1st	1	8	9	8th	0	1	1
2nd	5	4	9	9th	0	2	2
3rd	1	3	4	10th	0	1	1
4th	0	3	3	12th	1	1	2
5th	1	2	3	After 10 hrs.	2	12	14
6th	0	1	1	Dual control	1	0	1
7th	3	5	8				
Total	...	...	...		15	43	58

* Abstract of an article published in the *Journal of the Royal Naval Medical Service*, January, 1918.

The table shows a greater frequency of crashes on the first and second solos, then a diminution from the third to the sixth inclusive, and a rapid rise again on the seventh. The inference suggested is that by the time the pupil arrives at his seventh solo he becomes over-confident and a little careless.

CAUSES OF AEROPLANE ACCIDENTS.

The causes of aeroplane accidents are: (1) defect in the aeroplane; (2) error in judgement in flying; (3) "loss of head"; (4) brain fatigue or lethargy; (5) fear; (6) physical illness; (7) unavoidable causes.

In an analysis of the 58 crashes in the V series the following table shows the frequency of these causes:

Cause.	Number of Crashes.		
	With Injury to Pilot.	Without Injury to Pilot.	Total.
1. Aeroplane defect:			
(a) Breakage	1	0	1
(b) Engine failure	—	—	—
2. Error of judgement	4	38	42
3. Loss of head	6	1	7
4. Brain fatigue	3	1	4
5. Fear	0	0	0
6. Physical illness	0	0	0
7. Unavoidable	1	3	4
Total	15	43	58

1. Defect in Aeroplane.

This implies mechanical failure of some part of the aeroplane, and can be subdivided into (a) breakage in the air, and (b) engine failure.

(a) *Breakage*.—In the early days of aviation breakage or giving way in the air of some vital part of the aeroplane—for example, the folding back of a wing—was fairly common, and was due to faulty design or weakness in construction. Happily, to a great extent this has been corrected, and at the present time very few accidents are due to this cause. In three years' experience with the R.N.A.S. I have not seen a machine actually break in the air. In one case in the E series an elevator control wire jammed and caused the aeroplane to nose-dive, with fatal results to both occupants.

(b) *Engine Failure*.—Engine failure *per se* may be a direct cause of an aeroplane accident—for example, if the engine fails just as the aeroplane is leaving the ground, and there is unsuitable landing ground, the pilot may not have sufficient height or air space to avoid obstacles in front. Or in landing the pilot may find in his glide downwards that he has undershot or overshot the mark and his engine will not "pick up" or respond to carry him on further to suitable landing ground.

On the other hand, engine failure may not be a direct cause but may be a strong contributory or indirect cause of an accident. In all cases if the engine fails in the air a forced landing is compulsory, but given a fair height—2,000 ft. or more—the pilot can usually select a good field for landing and arrange his descent accordingly. Of course, on approaching the field to land it may be found not quite so good as imagined from a greater height—for example, sloping ground, long grass, etc.—and thus the pilot may make an error of judgement on actually landing. This quite often occurs with a pupil, but rarely with an experienced aviator, who knows exactly how to "pancake" his machine. But even in the case of experienced aviators, engine failure just after leaving the ground is a strong contributory cause to the real cause of an accident—namely, an error of judgement in flying. Authorities cite as one of the commonest examples of aeroplane accidents engine failure just after leaving the ground, when the pilot tries to turn back to his original starting place loses height in the turning, and, in trying to prolong his glide, loses flying speed—stalls—and the aeroplane falls to the ground out of control. In the V series engine failure was the direct cause in one case, and was a contributory cause in two cases.

2. Error of Judgement.

Error of judgement in flying is the commonest cause of aeroplane accidents. This error may occur in getting off the ground, in the air, or on landing.

Of the 58 crashes in the V series this cause accounted for 42—4 in getting off the ground, and 38 on landing. Of the many examples of error of judgement in flying perhaps the commonest is when, on landing, the pupil misjudges his distance from the ground, and either "flattens out" too soon and "pancakes," with a possible crash depending on the height, or else "flattens out" too late, and strikes the ground at a varying angle, usually overturning and wrecking the machine. Other examples in the air are putting on too much "bank" with insufficient "rudder" or vice versa; climbing on a turn; and, as in engine failure, prolonging a "glide" so that the machine loses flying speed.

It is difficult to estimate and account for these errors of judgement. In some cases it may be due to under-instruction. In other cases, even after prolonged instruction, the pupil may still misjudge distances, and on examination one occasionally finds that his standard of vision is below normal; but, on the other hand, he may be found physically fit, with normal vision and good balancing power. In the latter cases it may be a question of delayed reaction time, especially the visual reaction time on which the aviator is so much dependent. Normally this reaction time takes $\frac{1}{10}$ or $\frac{1}{20}$ of a second. It may be delayed by fatigue, drugs, and excesses, but, on the other hand, in some individuals who are otherwise physically fit, it is found to be much slower than in others. Hence, in the selection of candidates for aviation the visual and other reaction times must be up to the normal standard. By the French medical authorities on aviation candidates are rejected if the reaction times are found to be of the delayed type.

3. Loss of Head.

Loss of head occurs fairly frequently in a greater or less degree, and accounts for a fair proportion of accidents—7 in the present V series. The pupil in his new occupation of flying for the first time has all his mental faculties on the alert, at extreme high tension; the sense of danger, although not asserting itself, is ever-present, but subconscious. Under the sudden strain of an emergency his power to reason and act synchronously may momentarily lapse, resulting in what is known as loss of head. In a critical position the pupil has to think, decide, and act quickly, but with loss of head the mental balance becomes upset: there is no mental inertia, but the wrong decision is taken and acted on. In flying, seconds and parts of a second count enormously, and may mean all the difference between safety and danger. After actual loss of head there is seldom time to correct the error made. As examples of loss of head in the air the pupil in an emergency may move the throttle the wrong way, may keep his engine full on when he should throttle down, or may switch off his engine at a moment when he requires all the flying speed possible. Loss of head is very much allied to the two following causes.

4. Brain Fatigue.

In contradistinction to loss of head, the pupil in brain fatigue reaches the stage where he has neither the power to reason, decide, or act. A state of mental inertia supervenes. This is due to repeated stimuli received by his brain in rapid succession in his flight—he feels alone; a succession of errors occur in the air; he feels he cannot manage to control the aeroplane; fear does not seize him, but the enormity of the whole thing appals him; he feels helpless, and a state of brain fatigue occurs in which he, in a stupor, awaits events and takes little part in the aeroplane's control. After a careful study of 100 of the first solo flight confessions of pupils, and of many pupils who have had crashes, I am convinced that brain fatigue is a cause of a fair proportion of accidents. Four occurred in the 58 of the V series. As a rule, in brain fatigue the pupil fails to flatten out, and the aeroplane strikes the ground at its gliding angle and becomes wrecked. On questioning a suspected case of brain fatigue immediately after his flight, one finds usually that there is very little recollection of what happened during the flight; memory seems to become partially stunned. It is difficult to make a diagnosis of those liable to brain fatigue. As a rule, if it occurs, the pupil, even should he escape injury, soon gives up flying. He is not of the temperament suitable for flying. As a preventive, the pupil's first few solo flights should always be of short duration.

5. Fear.

Fear, at least in a degree sufficient to disturb one's flying, is rarely experienced in the air on the first few solo flights, whatever the sensations may be before going up or in the intervals between flying. The mind is far too much occupied and concentrated on details of flying, watching the various instruments that record air speed, height, levels, and engine's revolutions, and in judging position and direction in the air relative to the ground. From an analysis of the confessions of the first solo flights of 100 pupils and of my own, it is curious to note that very few experience fear in the air, at least not in a degree sufficient to disturb flying. Many confess to a sense of danger lurking somewhere at the back of the head, but say that it rarely if ever asserts itself. In the V series no crash occurred through fear.

6. Physical Illness.

In the series of crashes under consideration none was attributable to physical illness. At an air station medical inspection of the pilots and pupils at regular intervals reveals any organic disease that might lead to loss of consciousness in the air.

Flying on an empty stomach may cause faintness in the air. In schools flying commences at dawn, and all pupils are provided with a good meal of cocoa, tea, bread-and-butter. Similarly on long flights pilots are provided with tabloid forms of nourishment. The effects of cold and fatigue may produce faintness or stupor in the air. There are many instances on record of pilots fainting in the air either through being wounded or from high altitude effects. Some have been known to recover consciousness before reaching the ground and to make successful landings. Two pupils in the E series suffered from attacks of malaria in the air, and both were made to discontinue flying. Another pupil in E series, although slow to learn, was making fair progress, but one day he was noticed to descend rather steeply; he made no attempt to flatten out, the aeroplane struck the ground at its gliding angle, and the pilot was thrown out, clear of the machine, a distance of 66 ft., and escaped with only a slight sprain of one ankle. A few days later in the wardroom this pupil was seized with a series of typical epileptic fits. On inquiry a history of epilepsy for the previous five years was elicited. This was undoubtedly a case of an epileptic fit-taking place in the air.

7. Unavoidable Causes.

From time to time unavoidable accidents arise. Every precaution is taken at a flying school to prevent collisions in the air or on the ground. Set signals are made with regard to the direction of circuits and landing areas for different flights. The terrain in certain areas may be unsuitable and conceal obstacles; again, in some aeroplanes the view of the sky or ground in certain positions may be limited. These conditions may cause unavoidable accidents. In the V series four accidents were unavoidable. Two were due to bad terrain with obstacles concealed in the grass; in the case of the other two a collision took place in the air.

TYPE OF ACCIDENTS.

The term "type of accident" has been suggested to describe the part of the flight in which the cause of the accident was initiated. It is possible to make an arbitrary division of a flight into three parts: First, the getting off the ground into the air up to 50 or 100 feet; second, in the air, with the various turns, figures of eight, climb, spirals, etc.; and, third, the landing, which includes the descent from the time the throttle is closed to the time the aeroplane is brought to a standstill on the ground.

The following table gives an analysis of the types in the V series:

Type of Accident.	No. of Crashes.		
	With Injury to Pilot.	Without Injury to Pilot.	Total.
1. In getting off	4	6	10
2. In the air	2	0	2
3. In landing	9	37	46
Total	15	43	58

Some of the errors which the pupil may make in getting off are raising the aeroplane's tail too high, slewing to one side, or getting off with one wing down. In the air a pupil may lose flying speed or stall, or may sideslip or spin. The commonest

type of accident is in landing—the pupil's *bête noire*. He may either flatten out too soon, lose flying speed some feet from the ground, and the machine "pancake," or else he may be too late in attempting to flatten out, and the aeroplane strikes the ground at an angle, turns over, and is wrecked.

SCHEME FOR FIRST AID AT AN AIR STATION.

The sick-bay or dressing station should be in full view of the aerodrome, with a look-out man supplied with field glasses always on duty during flying hours. Should the dressing station not be situated on the aerodrome, the former should be connected by telephone to the look-out man, whose position commands a good view of the flying area. Immediately a crash or false landing occurs, the look-out man telephones to the sick-bay notifying the steward the exact site of its occurrence. A map of the aerodrome, numbered in quadrants, can be conveniently arranged in the sick-bay. The look-out man then leaves his post and proceeds to the scene of accident, taking the wheeled hand stretcher, on which is carried a first aid dressing bag and an emergency tool kit case. The latter consists of an oblong box containing the following:

1. Two crowbars.
2. Two strong wire cutters.
3. Saw.
4. A long stout knife.
5. A hammer.
6. Strong cloth cutting scissors.
7. A fire extinguisher.

The above set of implements is very necessary, as in some crashes where the pilot is pinned under the wreckage it may be difficult to reach him. An injured aviator should never be dragged out of a crash unless in the case of fire, but rather the wrecked machine should be cut away from him. In many cases this prevents simple fractures from being converted into compound ones. The steward on being notified of an accident dispatches the ambulance, which stands always in readiness by the sick-bay, to the scene of the accident. The ambulance should be provided with twin wheels aft in order to facilitate movements on soft earth, etc. Two sick berth attendants go with the ambulance, and with them is a bag containing the following articles:

1. Morphine solution and two Willey's hypodermic syringes.
2. A bottle of chloroform and face mask.
3. Brandy.
4. A bottle of sterilized water.
5. Six first-aid field dressings and slings.
6. Picric acid dressings.
7. A tourniquet, cloth cutting scissors, and a knife.

These articles can easily be packed into a small bag 10 in. by 8 in. by 3 in. The surgeon on duty is on the aerodrome during flying hours, and proceeds to the scene of the accident by car or foot. If the accident is at a distance, a mile or more, it is better to go by aeroplane. I have now gone by air to over thirty forced landings and accidents at a distance, and am convinced of the utility of this method in arriving quickly and not otherwise tired and out of breath after a long run. In discovering the site of forced landings and accidents at a distance from the aerodrome much depends on the condition of the country around. Should this be flat country, these accidents are fairly easily discovered, but in some flying schools the surrounding land may be uneven, intersected with dykes and high-hedged roads. Thus it may be extremely difficult for the search party to find the wreck. Officers and flight mechanics sent to the scene of accident should be trained in first aid with special reference to aeroplane accidents. Flying pupils should not be allowed to come near or help, except in exceptional circumstances.

Often the crash is so severe that the wreckage has to be cut away from the injured aviator. In other cases the machine is upside down, with the pilot held head downwards by his safety belt. The latter must be cut and the pilot slid gently out. The emergency tools are used to cut wires, remove wreckage, and lever away the heavy parts—for example, the engine—and thus easily to reach the injured person. The aeroplane seat cushion is taken from the machine and placed under the injured pilot's head, while his body rests on a flying coat spread out on the ground. A rapid examination is carried out to determine the injuries received. If the injured person is conscious and in much pain morphine should be injected and he should be conveyed quickly to the dressing station, where clothes can be cut away, injuries examined, and

treated accordingly. If unconscious, some cutting away of clothing can be done on the field, injuries examined, and perhaps a dislocation reduced or a fracture accurately diagnosed during the unconscious period. In cases of fire, unless the pilot is thrown clear, the extinguishers must be used; but if there is any wind blowing they are of little use, as an aeroplane on fire is destroyed completely within a few minutes. The pilot's leather clothing for a time usually protects the body, but the face and lower limbs rarely escape. As the pain is so severe, and this applies to other injuries apart from those caused by fire, it is better to give chloroform on the field, and this is kept up on the way back to the dressing station. Morphine should also be given, but it takes some time to act.

SOME FACTORS RELATIVE TO AEROPLANE ACCIDENTS.

The injuries sustained are akin to most high velocity accidents, but are usually more severe as greater speed is used in aviation. They are composed of—

1. Injuries due to crushing, where some part of the pilot's body gets crushed between parts of the wrecked aeroplane. Crushing injuries are very severe in nature and mostly fatal in the propeller type of aeroplane (engine behind).
2. Injuries due to collision with the ground, as when the pilot is thrown out, or hits the ground with his head in turning over in and with the aeroplane.
3. Injuries due to impact with different parts of the aeroplane, as when the head is violently jerked forward and strikes the edge of the nacelle on the aeroplane's impact with the ground. Flying debris, such as broken struts and wires, may cause local impact injuries.
4. Injuries from fire.
5. Drowning and immersion effects in seaplane work.
6. Suspension effects, as when the pilot is suspended head downwards in an overturned aeroplane and is unable to loosen his safety belt. In many crashes the sudden impact of the pilot's body on the safety belt causes abdominal injury.

The injuries sustained vary a good deal, and depend on the type and power of the aeroplane and the cause and type of accident. An experience of three years attached to the Royal Naval Air Service impresses me more and more with the element of luck which befalls pilots in crashes. The present-day school aeroplane is much stronger in construction and more powerfully engined than in earlier days, thus providing for a greater margin of error on the pupil's part. The propeller type of school machine (for example, the Maurice-Farman) is considered very safe. It can be landed slowly, and has a powerful engine to cover errors. In a crash it has a strong under-carriage and a great deal of woodwork to absorb the shock before actual injury occurs to the pilot. On the other hand in a nose dive in this type of machine the engine, being behind, is likely to crush the pilot severely, and this usually proves fatal. In tractor machines the engine in front takes most of the shock in a crash, but the observer's seat just behind the engine usually gets telescoped or crumpled sideways. The pilot's seat, which is behind these, usually escapes crushing effects. If the pilot receives injury, this occurs either from his being thrown out or from his head being violently jerked forward and hitting the nacelle edge, windscreen, or instrument board. Should the safety belt hold, the sudden impact of the pilot's abdomen and lower part of chest against it may cause internal injuries. Nowadays most nacelle edges are padded, and safety belts are stronger and broader.

Safety Belts.—With regard to the use of safety belts, endless discussion has taken place amongst aviators. My own opinion is that before leaving the ground all aviators should see that their safety belts are fastened and should be familiar with the method of their quick release. The belt should never be undone in the air. Thus the pilot, in the event of fainting, losing consciousness, or being wounded, or encountering gusty and bumpy weather or fog, has a safeguard to prevent him either being thrown out in the air or thrown forward on to his control lever (thus causing the aeroplane to nose-dive), or having his feet jerked off the rudder bar (thus losing steering power). I think all are agreed on the above, but the difficult question arises whether to release the belt near the end of a glide before landing. This I would advise in the propeller type of aeroplane, but in the tractor machines it remains an open question.

Certainly if the aeroplane catches fire in a crash little hope can be entertained of the pilot if he be strapped in. Safety for him depends on his being thrown out clear of the machine. A narrow belt is to be condemned. The

ideal safety belt should be broad and resilient, attached to the framework of the aeroplane and not to the pilot's seat, should be made to release easily and quickly, not at the centre of the pilot's body but at the side where it is attached to the aeroplane. This release should be effected by means of a small hand lever. It is advisable for all pilots to carry a stout knife in the outside pocket of their flying coat in order to cut the belt should they be held in upside down after a crash.

Safety Helmets.—These are of undoubted value in school work and should be worn by all pupils. They should fit properly and not be easily dislodged whilst flying. The modern ones are much lighter and less high in the crown than the earlier ones used. In a crash they certainly prevent scalp wounds from broken struts and wires and the side flaps protect the ears from injury. Over and over again I have seen pilots thrown out who owe their escape from more or less serious head wounds to their safety helmets.

On the other hand, in a turn over, the added height of the crown may catch the ground and wrench the head either forwards or backwards, causing fracture dislocation of the neck, or severe strain and possible rupture of the muscles of neck and back.

As pointed out by Fleet Surgeon Wells, an ideal safety helmet would take its support from the shoulders.

Goggles.—Most aviators wear goggles, but there are still some who prefer to fly without them. I know of one instructor who, after a year continuously instructing pupils and wearing no goggles, began to suffer from a form of conjunctivitis. I certainly think that goggles should always be worn. There is no doubt that flying without goggles is apt to set up a spasm in the eyes which in the long run is bound to do harm. Triplex or non-splintering material is now almost universally used instead of glass in the manufacture of aviation goggles. Thus rarely in a crash do we get any injury to the eyes. The nose-piece connecting the two lunettes should have no metal in its composition. I have seen some cases where wounds of the nose were caused by the metal connecting part of the lunettes.

Accidents under Dual Control.—Accidents under dual control are not common, as the instructor has usually time to correct in the air any of the pupil's errors in flying. One occurred in the V series, and was unavoidable owing to the character of the ground. In the E series three occurred. All dual control machines should be fitted with a mechanical device for throwing out of action quickly the pupil's control of the machine. I have seen three other crashes under dual control but without injury to either instructor or pupil.

Fatal Accidents.—In two years of school work I have only seen three fatal accidents occur in roughly 200 crashes. Four deaths occurred, of which three were instantaneous and one after four days. All were due to multiple injuries.

ACUTE YELLOW ATROPHY IN SYPHILIS.

(A Preliminary Note.)

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DURING the past two months I have had the opportunity of studying in the *post-mortem* room no fewer than five typical cases of acute yellow atrophy, an experience which must be almost if not quite unique. Though numerous examples of subacute types of the disease have been recorded in recent years, and particularly in munition workers, typical cases of the classical icterus gravis are seen only at long intervals. According to Best¹ (1903) only some 500 cases of acute yellow atrophy were on record at that time.

In a personal experience of over 5,000 *post-mortem* examinations performed since 1898 I have only investigated one other case. The present series of five cases have all occurred in syphilitic subjects in the course of, or subsequent to, treatment by "salvarsan" preparations and mercury; and considering the number of cases of syphilis now being treated throughout the country, a searching

analysis of these fatal cases would appear to be urgently called for to determine, if possible, the relative parts played as etiological factors by the syphilitic toxin, arsenic, and possibly some other exciting agent.

I do not propose in this communication to describe the details of the observed cases, these being reserved for a later and fuller joint report, but would content myself at present with a brief summary of the essential facts.

In practically all the cases a full course of intravenous injections of salvarsan had been given, coupled with the usual intramuscular injections of mercury. Needless to say, in each case the diagnosis of syphilis was not only clear on clinical grounds, but was confirmed by a Wassermann test. These cases were not of undue severity, and indeed showed no special symptom of importance till a sudden onset of jaundice was noticed, without at first any special disturbance, the disease suggesting nothing more than an ordinary catarrhal jaundice.

At a varying period of from two to eight days, however, acute symptoms appeared with dramatic suddenness. They were ushered in by a period of wild excitement and increased icterus, with haematemeses. The patients rapidly passed into a condition of deep coma, and death occurred in the five cases at periods of one to four days from the onset of the acute symptoms.

The urine was markedly bile stained, and in each case showed tyrosin; in some leucin was also demonstrated. In four of the cases diminution in the size of the liver was demonstrated during life.

These cases, then, presented clinically the classical symptoms and signs of icterus gravis of a degree of acuteness which is seldom seen. The morbid anatomy and histology of these cases were equally striking and equally characteristic, the appearances being practically identical, and varying only in degree. To summarize the *post-mortem* results, there was in each case great diminution in the size of the liver, which varied in weight from 27 to 43 oz. Histologically there was the usual intense necrosis rather than a fatty degeneration of the liver parenchyma, the bile duct epithelium largely escaping; there had been, of course, no time for liver-cell regeneration, but a definite inflammatory reaction was present. Though "red" areas were macroscopically apparent in the liver, the condition has been so acute that in most cases the "yellow" areas preponderated. It is to be noted, however, that the naked-eye appearances give no adequate indication of the extensive changes found microscopically. In each case there has been widespread haemorrhages in the serous membranes with a special haemorrhagic infiltration of the lungs. The kidneys, in contrast with the liver, have shown an intense degree of fatty change, with, in some instances, definite signs of an inflammatory reaction. There has been constantly noted also a varying degree of intestinal catarrh.

Bacteriological examination has, in contrast to what has been hitherto found in similar cases, yielded some interesting results which may prove of prime importance in relation to the etiology of the condition. Cultures from the heart blood and lung have given copious growths of organisms apparently of the *coli*-typhoid group, with some definite cultural characteristic features and pathogenic properties (in two at least out of the three strains tested so far). I am unable to say more at present, as their cultural and biological reactions are still being investigated, and as the bacteriology of acute yellow atrophy has hitherto been so indefinite, one must be chary of attaching too much importance to their presence without some experimental evidence of an etiological relationship with the disease. One may be permitted, however, to review briefly the present opinions as to the causation of acute yellow atrophy, or rather acute necrosis as it should be called, and to note how the various hypotheses which have been advanced would apply to the present group of cases. In 1908² I endeavoured to summarize the current views at that time from a study of an acute case, and a series of subacute cases which I had personally observed, and particularly from a series of cases which had been observed in that year in Germany and America.

To quote from that paper, I stated

that there is much to be said in favour of the view that in the causation of acute yellow atrophy we have two factors at least at work. It may well be that the typical condition is