Observations on the medical aspect of

Flight

by

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Being posted in charge of Royal Air Force Station on the East Coast of England for some months, I decided, having excellent material to work upon, to discover the effects of ordinary, straight flying at low altitudes, on cadets at the commencement of their experiences, and on observers and pilots who had been flying for some time. After experimenting, I found that the breath-holding and balancing tests, in use at the Hampstead Medical Board, gave results so indefinite as to be of little value, as the effects on the respiratory mechanism and stability of balance were much less marked than on the cardio-vascular system, and so I ultimately confined myself to the following procedure.

Before a flight I took the maximum and minimum blood pressures of the aviator by the Sphygmomanometer and auscultation at the brachial artery, and the pulse rate and character. I then put him through measured exercise by Flack's method (one foot is placed upon a chair, and the body raised to the standing position on the chair, five times, once every 3 seconds), noting the alteration in the pulse rate, and counting the time taken while he stood, for recovery to the normal rate for the individual. The regularity and character were also noted.

He then went up for his flight, and immediately on leaving the aeroplane after landing, and not having walked more than fifty yards, I put him through the same examination. The differences noted must therefore be due to the effects of the flight. The blood pressures I found high in these subjects, probably owing to the vigorous system of training and hard work in vogue, the fact that these figures represent the auditory index of the

systolic pressure, and that a few of the cadets were probably suffering from war stress. On comparing these pressures with others taken under circumstances of a more quiescent nature, this must be kept in mind. Before discussing the results obtained in these examinations, I propose to make some observations on a few points regarding flying stress. What is the damaging agent? I would divide this into three, viz.

A. Tension of the nervous system.
B. Rarified air and oxygen want.
C. Cold, and other factors increasing or modifying the strain.

The first is by far the most important factor. The tension of the higher centres and central nervous system, during a flight, is always acute, and, although, it increases and lessens according to circumstances, it is practically unrelieved until landing. The causes of the tension are many, but the main are:-

1. Divided attention. While rushing through the air at anything from 65 to 150, or more, miles per hour, the pilot has to watch the air speed and revolution indicators. In taking off he must have sufficient speed for climbing, and be careful to run accurately against the wind. An error in judgment in these may lead to disaster. When up, the engine sound is always in his hearing mind. An aeroplane is a flying engine, and if the engine stops, the machine must be put nose down to keep up the speed. If sufficient height is available, a good landing against the wind is most often possible, if not, a crash is most likely, especially if climbing, as the speed is less then and stalling takes place, and a subsequent nose dive to earth.

So the engine sound is one of the constant cares of pilot and observer too.

He has also to watch the compass, switch and throttle. The direction of the wind is another important matter, more especially as taking off and landing must be accomplished accurately against it. It is difficult to gauge the wind's direction from the air, as, of course, the aeroplane moves with the wind, and the direction must be found from earth. It is generally noted from a flag or smoke on the aerodrome. The direction of the wind, therefore, is another factor always in the pilot's mind. Then he has to watch other machines, sometimes quite a worry, and although there is generally plenty of room, collisions are not unknown. Rectifying bumps, (sudden falling of the aeroplane in wind pockets, from 10 to maybe 200 feet), is another care, especially in gusty weather, and at certain times of the day and year, and over certain places.

2. <u>The noise of the engine</u>.is apt to get on one's nerves, and certainly causes dullness of hearing for some time after a long flight.

3. <u>Strain on the Stimulus - judgment - action co-ordination.</u> By this I mean, that an aviator, getting a stimulus from sight, hearing, touch etc., judges quickly, and co-ordinates his muscles to perform the act necessary. The judgment in aviation never probably gives up this work, that is, the action never becomes reflex, and so the higher centres are in a tense active state during the entire period of flight.

4. Anxieties. These often cause increased tension, and the amount depends on what we call temperament, as well as on other factors.

Temperament. An even temperament is probably the best for an aviator. He will be less brilliant, but the most useful in the end. His stimulus - judgment - action co-ordination may be slow in developing, but latterly if it does so, he is likely to be most reliable. The most stolid, stable nervous systems are often the slowest in response to stimuli at first, and become rapid by practice. One of the best pilots I have known was, I learned, the last of his lot to fly solo[1*], taking more time to develop than others. He is quick, precise, accurate and reliable in all he does in the air now, and has won the Air Force Cross.

A Volatile temperament. This is useful if the emotional stimulus does not take possession of him. If it does he is unfit to fly. If not, he is likely to be more brilliant at times, particularly in fighting, but will not be able to fly as long at a time as the man of even temperament, because his tension will be greater. And here it may be noted that flying keenness is often felt by those of a volatile temperament, and more so than by those of the more stable nature. They become "full out" for flying, as they call it. They seem to have at this time a "will to fly", riding, as it were, on a strong, healthy, surging, nervous vigour. Flight is carried out on a wave of enthusiasm, (often with unnecessary stunting[2*]), with a maximum of

[1*] Fly the aeroplane himself + alone.

[2*] Irregular movements in flight only necessary when fighting.

success, and practically no consciousness of any difficulty or danger.. The nerve force overcomes imagination. The higher mental faculties are submerged for the time being, and his nervous vitality is spent in a manner favourable to himself and his work.

When not "full out"*, he is generally more thoughtful and imaginative. He feels himself more under the control of his higher centres, and therefore not so accurate in decision. His judgment lingers. He is more anxious, and the strain and tension are consequently much greater. (I have some further notes to make on temperament later on.)

Psychopaths. Should not be allowed to fly. Most of them, sooner or later, desire themselves to give it up.

5. Strain on the muscle sense, vestibules and equilibrium co-ordination.

Muscle sense must be normal, and vestibular stability present, in all pilots. I have seen good pilots deficient in muscle sense, but they all made indifferent landings, and two of them crashed badly. Muscle sense is very important, probably more important than vestibular stability. A pilot can only, by himself, tell his position relative to earth, when passing through a cloud say, by his muscle sense. "By the feel of the machine", he calls it. The vestibule does not give one an indication of the position of the body. Someone tried the experiment of bandaging his eyes while flying, and calling out the position of the aeroplane and type of movement to the pilot. He was most

* Expression used by aviators to denote great keenness for flying.

inaccurate in his judgments. Nevertheless, if the muscle sense is acute, one learns to have some idea of how one's body lies when the eyes are shut. The strain on the equilibrium co-ordinating nervous mechanism is a very severe one.

6. The cerebral cortex, which acts as commander in chief of motor movements and receives sensory impressions, also suffers some strain. This tension of the central nervous system is, as indicated, at first a conscious one and remains so more or less. It is possible, in the best type of pilots, that the higher centres are ~~more or less~~ relieved during most of the flight, or, in other words, that the tension becomes subconscious and is reduced to a minimum, but it is never entirely absent.

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B. Rarified air and oxygen want. At this point with reference to high altitude flying, I will merely note what Major (now Lt.Col.) Birley writes in his report on the medical aspects of High Flying, (Air Med. Invest. Com. Report No.2). Here he notes that the symptoms at high altitudes (15,000 to 21,000 or more), are:

While in the air.

- Dyspnoea, and often Cheyne - Stokes breathing.
- Muscular weakness. Perhaps the aviators are unable to stand up.
- Impaired Judgment. Hallucinations.
- Syncope. (50% of cases occur below 10,000 feet, and are, therefore, not due to oxygen want. Some faint owing to the fall in barometric pressure, and this comes on gradually like falling asleep.
- Overfilling of the bladder.

After Landing.

Frontal headache.

Fatigue.

Rapid Pulse.

High Blood pressure. This, if flying stress has occurred, is often very low, may be 90 m.m. of Hg., or so. After resting, it increases more than the diastolic, and so the pulse pressure is high.

Remote Effects.

Irritable heart mechanism.

Large pulse pressure (systolic pressure raised).

Bad cases show diminished maximum and minimum blood pressures.

Enlargement of right side of heart.

Dyspnoea. Exercise lowers the blood pressure may be.

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C. Cold. This, acting both from a physical standpoint, such as interfering with the peripheral circulation and the action of the skin, with consequent effects on the body generally, and also by interfering with ordinary muscular movement, and by adding to the general discomfort of high altitude flying, has its effect also on the central nervous system.

All these, therefore, constitute a very definite 'damaging agent'.

The other factors, increasing or modifying the strain, to be taken into consideration, are:-

1. The type of the aeroplane. The strain on an aviator is much greater when flying a scout or single seater. These have a much more powerful engine in comparison with their size, and possess, therefore, greater capacity of speed and movement, and "must be flown all the time", to quote the

pilot. He has no company, and often is alone for hours at high altitudes. In the larger type, with more than one engine, flight is much more steady, as the machine must be gently dealt with. It is not so fragile, there is more room and comfort, and the strain, for the observers at any rate, is at a minimum.

2. Company. This has a good effect in diminishing the nervous tension, especially in cadet observers.

3. Work. An observer, if busy with an Aldis lamp, wireless work, sketching or the like, suffers less tension. The work is never accomplished with as much celerity and accuracy as it is on the ground.

4. Weather conditions. Of great importance. The increased strain of flying in bad weather conditions is most marked. Gusty winds, especially if strong, fog and mist are the worst evils. Flying is decidedly dangerous then, as landing is a matter which may become wellnigh impossible without a crash.

5. Centrifugal force. If banking, say at ~~at~~ 70 miles an hour, in a circle of fairly short radius, as is often done while descending, the wings may be almost vertical with the ground, and yet the aviator is sitting naturally in his seat with no tendency to fall out or to either side of the fuselage. Centrifugal Force must affect the cerebral circulation. Stunting of all kinds brings not only centrifugal force into play, but increases the strain of flying in many other ways.

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Effects of Flying. Here it is best to give the symptoms I have noticed of the effects of flight on the nervous system of aviators.

Just down from a flight, especially at the beginning of his flying career, a cadet may be very talkative and show some want of inhibition and realisation, with inability to fix his attention on anything. For instance, he may be walking into the revolving propeller and have to be pulled back, or, if in examination he is asked to put his right foot on a chair, he will often put his left up. These symptoms pass off soon, and are not noticeable after an aviator has been up twice, as a rule. Excitement, frontal headache, dullness of hearing, sickness and stiffness, are common symptoms. Painful muscular stiffness, especially of the quadricips extensor, is often complained of. Fatigue is a most marked symptom if the flight has been of any length. An hour on a war machine, such as a scout or a two-seated bomber, is a good flight. Five hours of unrelieved flying is a heavy strain.

While in the Air. Sickness and vomiting are fairly common, especially in the early life of an aviator. It may occur from straight flying, but it is most common in stunting and bumps, as mentioned later on. It is analogous to sea sickness, and in the great majority of cases, passes off in a short time. In my experience it is as easy for the system to become accustomed to tumbling in the air, as it is to tumbling on the sea. Giddiness is common from the same cause, and may be present without any

nausea.

Lt.Col. Birley says vomiting is very rare indeed when flying at high altitudes. (Air Med.Invest.Com.Report, No.2).

Hallucinations, Illusions, delusions, etc. These generally occur when a pilot is beginning to show signs of flying stress. One complained to me of the illusion of seeing some boats on the sea swelling into a large fleet, and, on coming to the aerodrome, saw the huts there collapsing, the walls falling out. He landed all right, and I examined him and found definite signs of stress. After a month's rest he was all right again.

Another, after flying on active service for 170 hours, said he had strange fears whenever he flew above 2000 feet. He became obsessed then with the idea that his machine was going to crumple up, etc. I put him on complete rest for a month, and he recovered, flying thereafter without any complaint. Seeing enemy aeroplanes is a common hallucination, and quite a few pilots have told me this occurred especially at high altitudes, after they had been up for a time.

Shortness of breath, and inability to hold the breath for long, (about 20 seconds), is nearly always confined to high flyers. Some trifling dyspnoea may be noticed after an hour's flying in cadets at low altitudes, but the respirations seldom rise beyond 20 -24, and, in fact, are mostly normal.

Mental depression and dullness may appear at any time, especially if tiredness is supervening.

Loss of confidence may suddenly trouble a pilot at any time. One has been known to call to his observer that he could not carry

on, and the observer has had to bring the machine down. Much more commonly, however, these lapses of confidence come as gentle warnings, and the pilot manages all right himself, and, on coming down, reports to the M.O., and is put on a spell of rest. To be tired of flying and sick of the look of a machine is quite common, if much flying has been in progress.

Sleepiness is one of the effects of high flying, as mentioned. As Birley says, it may be a form of syncope.

Judgment is impaired too, especially if flying high for a long time, or suffering from exhaustion. Indifferent landings and minor crashes indicate the necessity for rest. Here judgment has been impaired, and the central nervous system is showing signs of tiredness.

Irritability and restlessness are common in oncoming flying stress.

Fatigue is probably due to the intense nervous strain.

What occurs in the brain and systems during flight?

It is impossible, of course, to answer this fully, but one may give some reply. The brain is in constant action. The higher centres are taking impressions brought by the eyes, ears, tactile and muscle senses. Judgment is in constant action, and the cerebral cortex is both taking impulses and giving out orders. Muscular co-ordination is in a condition of great activity, and equilibrium co-ordination in a high state of strain. In addition to these, anxiety often plays its heavy

part in the higher centres.

In high flying and bad weather, stimuli, hurtful and often intense, are brought to bear on the brain. We find then in an aviator flying, intense cerebration. This means the necessity for great velocity of blood flow through the brain, and that is accomplished by vaso-constriction, and cardiac stimulation brought about by impulses to the medullary nuclei.

The cortex, cerebellum and higher centres are then in an acute state of action. These excited parts, acting with full force on the medulla, set a heavy task to this great nerve exchange. Both from the bulb and the higher centres the autonomic system is affected, and thus we have the whole nervous mechanism of the body in a state of high tension.

Let us consider what may now occur. The heart is acted upon through the cardio-motor centre. Probably near this centre arise the preganglionic fibres of the autonomic system, issuing down the 7th 9th 10th & 11th cranial nerves (Kirke). The augmentor and accelerator fibres of the heart arise from ganglia supplied by these. The depressor nerve from the heart runs up the vagus nerve to the bulb (cardio-inhibitory centre).

The cardio-motor centre is stimulated and the heart beats stronger and quicker. The vagus, always in action, sends inhibitory impulses by its depressor nerve etc. The vagus soon becomes exhausted, and the autonomic system is more or less uncontrolled in its action on the heart. Impulses to the vaso-dilator centre (doubtless in the bulb) on behalf of the strained heart, must then be urgent. The vagus, never quite knocked out, occasionally

puts in its message, but never during the strain quite regaining control.

The vaso-motor centre is stimulated and vaso-constriction occurs. The blood pressure rises. This causes great strain, and the left ventricle, being unable to empty itself, dilates and then beats strongly, bringing matters level, the young heart easily accommodating itself, so long as it is healthy and the strain is not too prolonged (Kirke).

Action and re-action are most complicated in the heart and blood vessels in response to the various stimuli. The heart's action is myogenic, as the foetal heart has no nerves, but it is regulated from the medulla by the ganglia and postganglionic fibres and by the vagus nerve. Under normal circumstances the centres for reflex action are in the central nervous system, but ganglia may assume this function, as in recovery of vaso-motor tone (Kirke). Thus the heart muscle becomes more or less at the mercy of that power, which, under natural circumstances, acts as a protector, but which, under the great strain, passes its own excitement on to the muscle, interferes with its normal mode of action, and increases its work. In addition to the cardio-vascular excitability, there is stimulation of the respiratory centre, but this, being of a tough nature is not much affected by the cerebral activity in flying at ordinary altitudes, but is, and very greatly too, by the rarified air of great heights, when the system is suffering from oxygen want.

The tone of the voluntary muscles of the body generally is increased. Weed has recently shown that muscle

rigidity arises from stimulation of the red nucleus by impulses through the cerebellum. (A. Rendle Short).

Stimulation of this red nucleus may account for the stiffness and painful muscles sometimes experienced by aviators after a flight, and depression may account for the weakness experienced by aviators at great altitudes (oxygen want and diminished velocity of cerebral circulation).

Regarding the great muscular weakness noted at heights, this may be due to lactic acid in the blood, as well as circulatory disturbance and lessened oxygen. There may not be sufficient oxygen to oxidise the lactic acid as it is formed.

Gastro-intestinal tract and ductless glands. There is no evidence of stimulation in these, but dilated stomach has been noted in many aviators suffering, or who have suffered, from flying stress; also atonic dyspepsia and hyperchlorhydria. Some one has advanced the theory, that adrenalin is first excreted in overabundance, and then in an amount too little for the needs of the system. This is quite possible, and fits in with the view of general stimulation and final depression In all probability there is a lessened output of adrenalin when the autonomic system becomes depressed. There must be a general physiological disturbance, and it would be interesting to know how far the ductless glands are affected, and what result this has on the system. Increased adrenalin output is probable during the great nervous tension, and this will increase the blood pressure. Loss of weight may occur, and

the cause may be due to gastro-intestinal disturbance, with diminished absorption and assimilation of food on the one hand, and an increased metabolism in the stimulative stage on the other.

Examination of 119 Pilots, Observers and Cadets.

Each test is tabulated as follows:-

Date. Name. Rank. Age. Hours flown and, if any, max. height and av. height. Breath held certain time, and reasons for giving up, (if case warrants this), period of service, remarks regarding wounds, illnesses, over-smoking, alcoholism, etc. Normal pulse, increase after measured exercise, time to recover to normal; maximum blood pressure, and minimum blood pressure. Any irregularity in force or rhythym is noted. After the flight the pulse is often given in beats in five second periods. The pulse figures are separated by horizontal lines, and the blood pressuresby vertical.

Observers and Cadets.

It will be noticed that, after a flight, the maximum blood pressure was increased in 63%, and the minimum blood pressure in 83%. The pulse rate was increased in 92% of cases, and the pulse recovery time, (after exercise) increased in 94%. Irregularity in rate was almost constantly found, and irregularity in force very frequently.

Pilots.

In experienced pilots the maximum blood pressure was found to be increased, after a flight, in 66% of cases. The diastolic pressure was raised in 84%, the pulse was increased in 75%, and was irregular in rate in 75%, and irregular in force in 50%. The rate recovery time (after exercise) was increased in 66%.

It will be noticed that, in many cadets after flying from eleven to fifteen hours, which meant twenty or more flights, the figures often show the difference in blood pressures to be more marked, the pulse to be more irregular, and the time of recovery of the pulse rate to the normal for the individual to be more prolonged, than those taken before and after the first flight. Also that the effects of flying are similar on pilots of long experience, observers of long experience, and on cadets who are commencing their duties in the air.

These facts suggest that there is little or no true compensatory resistance developed to withstand the effects of flight.

Lt.Col. Flack expresses the view, that the first breakdown in the bodily systems is probably in connection with the respiratory mechanism, which, becoming defective, reacts upon the cardio-vascular and nervous systems, thereby bringing out signs of cardio-vascular and nervous debility. He advised the use of oxygen, even at relatively low altitudes, to prevent the onset of deep breathing and dyspnoea, and also the secondary effects due to oxygen want. He put forward the suggestion that the strain upon the bulbar centres regulating respiration and circulation is particularly great, especially in high flyers, and that these centres, particularly the respiratory centre, become affected in such a manner that respiration is no longer normal, and there is an altered condition of excitablity in the cardio-motor centre. He used a manometer in the following way, in

order to test pilots, both as a pass test and as a means of recognising commencing flying stress. The pilot was told to blow the Hg. up the tube as far as he could, the degree of expiratory force being measured. Measurement was made of the time during which a subject can, after full expiration and inspiration, sustain by blowing, with the breath held, a column of Hg. 40 m.m. high. The behaviour of the pulse, during the sustaining of 40 m.m. of Hg. in expiration, was also observed. While sustaining the Hg., any suffusion of the face, subsequent breathlessness, and sensation before the breaking point were noted. He gave as a standard for flying officers:-

Holding the breath, 66 seconds.
Expiratory force, 110 m.m. Hg., with 80 m.m. as a minimum.
(Time sustaining, 52 sec., with 40 sec. as a minimum.
(40 m.m.Hg.

He thought that flying stress was shown, in the first place, by lessened power to sustain 40 m.m. of Hg. during the above time, and that, after stress was marked, the ability to hold the breath became affected also. For instance, among some of the cases he mentions, there are three with,

1. A History of shell concussion, and sick while flying in France.

In this case the results were, (Breath held 45 sec. / Expiratory force 130 m.m.Hg. / Time sustaining Hg. 38 sec.) Unfit for flying.

2. A History of enteric fever, dysentery, & flying tiredness.

In this case the results were, (Breath held 46 sec. / Expiratory force 70 m.m.Hg. / Time sustaining Hg. 35 sec.) Unfit for flying.

3. A History of long flying, and bad landings.

In this case the results were, (Breath held 63 sec. / Expiratory force 125 m.m.Hg. / Time sustaining Hg. 23 sec.) Unfit for flying.

It was noted that subjects suffering from anxiety neurosis passed the tests well, but that those with flying stress, and after dysentery and Malaria, failed to pass the tests. Counting the pulse while sustaining the Hg. with the breath held, affords an indication of the degree of stability of the cardio-motor centre. A steady, low rise in the pulse is regarded as good. A quick rise or sudden fall is regarded as bad.

	Normal Pulse.	Increase while sustaining Hg.	
For instance a.	72	96 - 108	maintained is good.
b.	72	132 or 144	unsatisfactory.
c.	84	144 - 72 - 60	is unsatisfactory and frequently found in officers in need of rest.

	Exp.force.	Time sustaining Hg.	Pulse.	Pulse response.	Remarks.
Case A.	100	35	84	- 144 - 132	unfit
Case B.	90	40	60	- 84 - 48	unfit
Case C.	100	50	72	- 84 - maintained	Fit.

(Air.Med.Invest. Committee Report, No.3.)

Further remarks on high flying.

There is no doubt about the intense and prolonged strain of high flying, the lessened pressure, the lack of oxygen and the extreme cold each handicapping the already overtaxed aviator. The effects are somewhat analagous to, but show definite differences from mountain sickness. In the former, as Lt.Col. Birley has pointed out, vomiting is rare, and in the latter it is the most obvious symptom (Kirke). Again adaptation is common in mountaineers, and is uncommon (Birley) in high flyers. Probably there is more acidosis (more H ion concentration in the blood, also co 2 and lactic acid) in mountaineers than in high

flyers while in high altitudes, but it is evident that acclimatisation is more likely in mountaineers, who dwell often in rarified air, than in aviators, who, after an hour or two in very high altitudes, return at once to earth. Adaptation in mountaineers takes place by increased pulmonary ventilation, and also increased haemoglobin content. (Kirke). This agrees with Flack's insistence on good respiratory capacity, as being essential to a high altitude flyer.

But if a mountaineer becomes adapted to his work in rarified air, and evidence points to such being commonly the case, the evil effects of high altitude on an aviator must be due to the sudden changes in pressure (barometric and oxygen) that he is subjected to. Climbing is one of the most severe forms of physical exercise one can indulge in, and yet the respiratory mechanism and cardio-vascular systems of these men become adapted to the hard work in the rarified air. The chemical changes occurring in the blood during hard exercise, (H ion concentration, Co 2 and lactic acid, etc.) are likely to be more pronounced in mountaineers than in high flyers, especially for lactic acid, owing to the severe muscular activity, and therefore the chemical action on the bulb should be more excessively stimulative than in high flyers. But in the latter the effects of nervous tension must be added, and the sudden changes from one altitude to another.

Birley found the heart mechanism very irritable as a remote result of high flying. The standing pulse was nearly double the lying pulse. The maximum pressure he found increased, and the diastolic pressure normal, and therefore the pulse pressure

large.

In bad cases of flying stress, in high flyers, he found both the maximum and minimum blood pressures diminished, and sometimes enlargement of the right side of the heart, or enlargement of both sides, with palpitation. Exercise was found sometimes to lower the blood pressure instead of raising it.

General Review.

My view from the results of my examinations and experience, and from study of Col. Flack's and Lt.Col. Birley's papers, is that flying affects the system in the following way:-

1. Great stimulation and strain of the whole central nervous mechanism.

2. a. Spread of general impulses (irradiation) to the bulb.
   b. Special impulses to the
      Cardio motor centre.
      Respiratory centre.
      Vaso-constrictor centre.
   c. Chemical effects upon the same centres, especially in high altitude flying.

3. Inhibitory impulses to the bulb etc., more especially to the cardio-inhibitory centre, and vaso-dilator centre.

   (2 & 3) set a most severe strain on the medullary centres.

4. The strain and tension with excitement continuously affect the higher centres, central nervous system and autonomic system. This must have its influence upon those organs supplied, namely, (in addition to the heart, and blood vessels and respiratory mechanism), the voluntary and involuntary musculature of the body; some at least of the internal

ductless glands, such as the pituitary, thyroid and suprarenal, so that some increase during the excitement stage and decrease during the depression stage of the internal secretions is probable; and also the gastro-intestinal tract.

5. After a time, depending upon many circumstances, depression sets in. The central nervous system cannot rise to the occasion. If confidence is the last to go, (a most dangerous state for the aviator), flying will probably proceed, and if judgment fails, or the stimulus-judgment-action co-ordination is too slow, a serious crash may follow. And often the heart gives out, or the respiratory mechanism, or probably both, the blood pressures rise too high after a flight, and his response to Flack's tests or the exercise test is unsatisfactory, or his blood pressure falls low and does not react well to flight if he is a bad case, in the first instance.

One might divide a man's life as an aviator into three stages,

1. Stage of stimulation.
2. Stage of attempted adaptation.

   This may be prolonged with great care, flying not being indulged in more often than the aviator is fit for, and the amount can often be assessed by his own feelings. But it ought to be assessed by frequent medical examination of a strict and efficient kind, including the use of the Sphygmomanometer, Flack's manometer, the exercise tolerance test, and tactful psychological

investigation. There is no real adaptation, but probably a good deal of naturally discovered immunity, such as is present when feeling "full out" for flying, or engendered by only flying certain types of machine, by flying at low altitudes only, or only flying in good weather, and in such like ways.

3. Stage of depression. Here the whole central nervous system is depressed, and the great centres in the medulla are at first unstable, then ultimately fail to respond to stimuli well, and probably give forth a weak impulse. Secondary effects on the whole body follow.

I regard the heaviest strain, so far as the organs are concerned, from first to last, during low altitude and high altitude flying, as falling on the cardio-vascular system. The results obtained in the cadets shew that, as flying proceeds, that is from the 1st to the 20th flight (about 12 to 15 hours flying, as arranged in the Station I was attached to, so far as the cadets were concerned), the cardiac centre and vaso-constrictor centre showed increasing signs of strain. The blood pressure, especially the diastolic, was higher, the pulse was more irregular, especially after exercise, and the time to recover to normal was much increased. The higher centres were seldom affected so far as keenness was concerned, the men almost invariably expressing their enjoyment of the experience, and the desire to become efficient.

I used the Sphygmomanometer made by Hawksley. The band was level with the heart's apex, placed around the upper arm, the elbow

and forearm resting on a table, and the man sitting. The pressures were taken rapidly by auscultation at the brachial artery, practically no time elapsing between full pressure and release.

The systolic pressure is the figure indicated when the 1st scratch is heard, and therefore the auditory index of systolic pressure, and so a little higher than those taken when the pulse is first felt, as at Hampstead. The second part, murmurish, is allowed to pass, and the third part also, loud and clear. Thereafter the sound either (4th phase) suddenly becomes dull and almost inaudible, or gradually weakens. I regarded the diastolic pressure as being the sudden dulling or weakening between the 3rd and 4th phase.

The pressures are high, but, as mentioned above, the subjects were leading a most strenuous life in every way, and many had been on service for some time; and again, the auditory index was taken. The same method was adopted, of course, both before and after the flight, and all through the series of examinations. Naturally the blood pressures in these healthy boys are much lower after rest in a city, or after a short respite from the great strain, both nervous and physical, in the aviator's life when flying, more particularly when under training as a cadet. The heart then, and blood vessels are being continuously harassed by impulses of a conflicting character from the central nervous system. Ferry puts it that the aviator, while in the air, is constantly attempting to maintain a condition of circulatory equilibrium, which is, however, always elusively escaping from

control (Lancet).

Etienne & Lanny, in a series of xray examinations, found hypertrophy of the heart constantly present in aviators, after five months of flying. They said that the hypertrophy was proportional to the altitude, being more marked in high altitude flyers. They are of opinion that it persists, and put it down to a physiological adaptation to the constantly changing conditions during aviation. The systolic blood pressure rises, they say, after an aviator reaches 7500 feet, and falls after a flight. The fall may be as much as 20 m.m. Hg., when descent is from 15,000 feet. The diastolic pressure falls during a flight, and after a flight rises from 5 to 10 m.m. of Hg., if the descent has been rapid. They say that the hypertrophy may be due to rises in pressure, but that possibly repeated phases of sudden low pressure may also play a part. I have shown that low altitude flying has a profound effect in altering both systolic and diastolic pressures. It would therefore be permissible to put forth the hypothesis, that during the nervous tension stage the cardio-vascular system is put under a severe strain, that this strain is increased at high altitudes by lack of oxygen and its chemical effects on the medulla, intense cold and diminished pressure, and also increased tension of the higher centres, due to the more hazardous nature of the work and the greater difficulty of accomplishing it. Then also the respiratory system must be, as Lt.Col.Flack says, put under a most severe strain, and this will react also on the heart, adding more weight to the

already overburdened organ. This cardio-vascular strain may end in causing changes in the heart before the nervous mechanism gives out, but generally the evidence goes to show that the nervous element breaks down first, which is favourable to the aviator. *This must be looked for.*

There may be slight signs such as unwillingness to go up, some loss of confidence in the air, fear of mishap, bad landings, at first, followed by more definite signs of irritability and fits of despondency. If the blood pressures are taken then, before and after flight, a great difference will probably be found, with a high maximum pressure and generally a high diastolic too.

If flying is not stopped ~~then~~ the higher centres become dull and the airman apathetic. The medullary centres are depressed, the heart will not respond to exercise well, and the blood pressures become low, showing that the cardio-motor and vasc-constrictor centres are not reacting well to stimuli, and are sending forth weak impulses.

Flack's manometer is an extremely useful and simple means of judging the condition of the centres in the bulb. To my mind it is as much an indication of the state of the cardio-motor centre as of the respiratory centre. The two systems are intimately dependent on one another in flight, and not easily differentiated in testing. Lessened time of sustaining 40 m.m. of Hg. is to be regarded as a first sign of flying fatigue. Flack suggests tentatively the explanation that the first onset of flying fatigue is due, in many cases, to an altered tone of

the respiratory centre. Now the respiratory centre is known to be the toughest of all, and my results apparently show that the cardio-motor centre is the most sensitive and the first affected, and the vaso-motor centre probably next.
I have noticed alterations in the respirations after a fairly long flight, irregularity, and slight increase in frequency, but the condition of the cardio-vascular system was definitely and seriously upset by flying at low altitudes, i.e. up to 5000 feet, and occasionally higher. The respiratory centre is much affected at high altitudes, but I believe the cardio-vascular strain to be then even more, and I therefore suggest that flying affects the cardiac centre and heart more than the respiratory centre and respiratory mechanism.
Fainting at a high altitude occurs gradually. Birley says that there are instances in which the fall of barometric pressure is the main, and perhaps the only cause of syncope, and in such, that loss of consciousness usually comes on slowly, and persists for a relatively long time. It is a condition more like falling asleep. This condition is, to my mind, possibly due to diminished flow of blood through the brain, following on vaso-dilatation and collection of the blood in the veins in the splanchnic area (splanchnic pooling. Flack). This would suggest cardio-vascular depression, but it may, of course, be due to diminished barometric pressure. Flack lays great stress on firm abdominal muscles, and part of the examination at the Hampstead Board is planned to test these muscles, and by pressure on the splanchnic area to show

engorgement, if any, in the veins of the neck.

Flack & Bowdler (in Air Med.Invest.Report,March 1918) note that, in marked cases of flying stress, there are to be found frequently:-

A large pulse pressure;
A low diastolic pressure;
A soft abdominal wall;
A splashing stomach;
Engorged jugulars;
Muscular tremors;
A poor balance.

(one notes here the general loss of muscle tone, involuntary - voluntary, as well as weakened nervous impulses.)

They regard a pulse pressure of 25 m.m. as good. Measured, gentle exercise, should not increase the pulse rate more than 25, and the pulse rate should recover to the normal in 30 seconds. * As flying proceeds, it will be noticed in studying the figures obtained at my examinations, that the heart tends to become more irregular and the time of recovery to the normal after exercise to lengthen, and the diastolic pressure especially to rise. This suggests that the central nervous irritation tends to continue, and that adaptation, if any at all, only occurs very slowly. Each system, of course, shows its own degree of resistance, and doubtless every man learns what means are best for him to adopt, in order to protect his system from strain, as mentioned above. But the examination of pilots of long flying experience proves, that the effects of flight, although of course limited and different in each individual, are very similar in all men who fly, whether pilots of experience or cadets with little. I am in favour of using the Sphygmomanometer on every man taking to flying. The recording of his maximum and minimum pressure, his pulse rate and condition, his exercise tolerance, how long

* These figures are, in my opinion, too small, more latitude should be permitted.

he can hold his breath, his expiratory force, and last but not least, the time he can sustain 40 m.m. of Hg. by Flack's manometer, is necessary for his protection. If these figures are taken fairly often, more especially before and after a flight, any profound effect on his system is at once noted. I personally like the blood pressures and exercise tolerance tests, as I think that the heart is affected primarily, and signs of tiredness will at once be apparent, if the figures are compared with his own normal numbers. It should be a care to take these figures, if possible, on the field, not too soon after a meal or exercise, so that the comparison after a flight may be taken under similar conditions, and that the effects of the flight alone are noted in the difference. I took this fact into consideration when obtaining these figures. Regarding the expiratory force test, i.e., that of blowing a column of Hg. up Flack's U tube, I think, with Lt.Col.Birley, that ability here has some 'knack' about it, and may be developed with practice. But the sustaining of 40 m.m. of Hg. against time, is a test of great value, both in discovering the first signs of flying tiredness, and in noting improvement in this condition and in cerebral concussion. It is also valuable in sifting out, at times, those cases temperamentally unfit, and others, for careful supervision. It is best used after resting for a little, as unsatisfactory figures are common soon after flying.

Flying Temperament.

A word as to flying temperament. Flack says that this baffles assessment, at present, by medical means, while at the same time stating that good physique is of the greatest importance, especially in high flyers.

Birley, (in Air Med.Invest.Com.Report No.4), writes that flying temperament is intimately bound up with character, both hereditary and acquired. Flying demands and encourages a degree of individualism unknown in any other branch of the services. A successful pilot, suffering from stress of service, is not temperamentally unfit.

Men temperamentally unfit may, and often are, passed as fit medically, and then fail as aviators, disliking flying or being generally unsuccessful; or they may have physical signs of unfitness, showing trepidation and apprehension and loss of emotional control; or they may be termed, loosely, psychopaths, with possibly a neuropathic family or past history. They are never confident in the air, and may develop a pronounced anxiety neurosis. My own view is that a medical officer and a commanding officer very soon learn the temperamental excellences and deficiencies of those in their charge.

Given a good vigorous system, with healthy reflexes and a mind that does not dwell on possibilities of a morbid nature, and is taken up entirely with the work on hand, and, if confidence is imbued, a good pilot or observer will be gained, who may be expected, caeteris paribus, to stand the strain

as well as any.

Birley showed by his results, (in Air Med.Invest.Com.Report, No.4), that the temperamentally unfit aviator is unstable physically, and suggests that certain individuals are so constituted, that they react to strain by alteration of their physical state. He supposes that lack of inhibition in the higher nervous centres, paves the way for a spread of nervous impulses.

It is a most difficult matter, to my mind, to differentiate the good pilot from the indifferent by physique or general appearance. Flack thinks a good physique of the greatest importance, and there is no doubt that healthy organs and a healthy mind are essential to an aviator, who is to be a success from every point of view. I should imagine that in those who are temperamentally unfit for flying, it is reasonable to suppose that some defect exists in the central nervous system, either hereditary or caused by some previous injury or toxaemia. Then again the emotional factor must be taken into consideration. Excitement, imaginative thoughts of danger, the mental effect of dealing with a difficult situation, all set up a different degree of tension in each mind, and affect the physical systems controlled in a different manner. An acute nervous tension may react on the higher centres mainly, and very little on the heart for instance, which is what may occur in those we call psychopaths; and then again the tension may play on perhaps an unhealthy cardiac centre, or unhealthy cardiac nerves or muscle. It may

not be possible to differentiate these cases from the healthy, until actual trial searches out their weaknesses on the aerodrome. It is certain, also, that a sensitive and highly strung nervous system may be quite consistent with great success in flying. When such a one "feels like flying", he is not likely to undergo more strain to his nervous system, than is usual in those of a more stable type.

Soldier's heart.

Is there any analogy between the conditions in the nervous system in flying stress and soldier's heart?
Sir James Mackenzie, in a lecture on Soldier's heart, published in the "Lancet" of Jan. 22 - 1916, states that in"soldier's heart" there is:-

1. Exhaustion of the circulatory system, with breathlessness, sense of suffocation and praecordial pain, and a rapid pulse rate, increased on slight exercise.
2. Great vaso-motor instability, with pallor, flushing, giddiness and fainting.
3. In 90% of cases the central nervous system is also affected. Irritability, depression, and tendency to focus attention on the heart, and inability to concentrate the mind on anything.

It is just like a nervous exhaustion. There is marked disinclination for mental exertion in both. Both arise from strain and insomnia, or the shock of a bursting* H.E. shell. Both have mental distress, persisting long and passing slowly. In the one case the nervous system is probably itself the point of least resistance, and in the other the circulatory system has

* High Explosive.

also suffered, whether from toxaemia or strain in adolescence. Is the medulla injured here?

Are there more centres than we are at present cognisant of in the medulla?

If the main trouble is in the medulla in flying stress, do these centres merely become exhausted, and, while responding slowly and weakly to impulses, also emit only weak stimuli themselves?

Do the medullary centres exercise any nutritional influence upon the heart and vessel musculature, either directly, or by their influence through the autonomic system on the internal secretion of the ductless glands?

Doubtless injury to the medulla may cause alterations in the walls of the heart and blood vessels during strain, and these changes are assisted by the various toxaemias. I should put the predisposing causes of flying stress as, amongst others,

1. Malaria, typhoid fever, and all toxaemias.
2. Organically deficient, or undeveloped, central nervous system.
3. A strong sense of duty, a keen desire to succeed, patriotic fervour and sporting instinct.

Prevention and treatment of flying stress.

It is essential that every flying officer or airman, passed into the service, should undergo a searching examination of his nervous and physical state, and that the pass standard should be a high one. His heart and blood vessels must be healthy,

and his exercise tolerance good. He should have good pulmonary capacity, with his lungs beyond suspicion of disease.
All his organs must be sound. His reflexes should be normal, and his mind alert and active, responding quickly and accurately to those tests having a special application to his stimulus-judgment-action co-ordination. His muscle sense should be good, and his balance steady. His hearing in both ears must be acute, he must have full fields of vision in both eyes, a normal visual acuity, and true binocular vision.
His muscular co-ordination must not be upset by unexpected or expected noise, or other sudden stimulus. He must not suffer from such troubles as hay fever, asthma, or any disability which might seriously handicap him while in the air.
The tests in use at Hampstead, in the examination of cadets and others, are admirably suited to sifting out the deficient, and few pass as flying officers now, who are not fit for the work.

A word on the prevention of flying stress. The medical officer should be as friendly and intimate with all the flying officers as possible. He should encourage them to talk of their experiences, and treat as confidential those little tales of mental trouble entrusted to him. In this way he may often hear of slight symptoms of approaching tiredness. He should examine these men, particularly the pilots, frequently, both before and after flying, using, as indicated above, the blood pressure test, exercise tolerance and Flack's manometer. The last in the trial of sustaining 40 m.m. of Hg. by blowing against time

affords an indication (to my mind) of the strength and vigour of the respiratory centre, respiratory muscles, and general pulmonary capacity, but also of the condition of the heart. The movement of respiration has ceased, and therefore the aspirating action of the thorax in relieving the right side of the heart is in abeyance. The pulmonary circulation, therefore, and the right side of the heart, become congested, and it is more than probable that urgent calls are made to the medulla to ease matters, by inspiration, on the heart's account alone. It is to be regarded, therefore, as an excellent method of noting tiredness in even a low altitude flyer.

I used the blood pressures and exercise tolerance tests, and I think that an increase in either the maximum blood pressure of 30 m.m. Hg., or in the diastolic of 20 m.m. Hg., or if there is a great difference between the maximum and minimum blood pressures (50 to 60 m.m. Hg.) after a flight, that the aviator should be at once put on limited flying, and tested more frequently.

It is quite common to get indifferent results with Flack's manometer sustaining test just after a flight, and this is best used in the medical quarters after the aviator has had a rest for some hours, or even days, as mentioned above.

The sphygmomanometer and exercise tolerance tests give a better indication of the effect flying is having on the individual, when used on the aerodrome, than any other.

If the manometer sustaining test is poor after a day's rest, then the aviator should be put on ground duties for a month, or such like time,

dependent upon his general symptoms.

I examined my aviators regularly, and seldom had a case of real stress, because, whenever I had a large maximum pressure, pulse pressure, or minimum pressure for the individual concerned, and especially if the pulse was irregular after a flight, and took a long time to recover to the normal, I put the aviator on limited flying, or rest on ground duties, or on leave. Most of them, when shewing symptoms of tiredness, had no desire to fly, in fact were inclined to be irritable and depressed, and sick of the aerodrome and machines as well as of flying, and it was remarkable to notice what a difference a few days rest made on the condition of their minds. They often approached me for permission to go up, long before their ordered period of abstention from flying had passed.

After resting, if there has been any definite signs of stress, flying should be only gradually resumed. One case, (No.7 Pilot), happened to fly before I tested him. On the 3rd day, after 9 hours flying, (the first for six months, during which time he had been in hospital, (treatment for wound), and on leave), his maximum pressure was 148 and his minimum 92. On the next day he came to me, after flying twice, with the complaint that he did not feel well. On examining him, I found his pulse almost imperceptible, the volume being small and the tension high. The whole cardiac area was pulsating, and his respirations were slightly increased. The maximum pressure was 160, and the minimum 105. The pulse was slightly irregular, increased from 75 to 84 on exercise and recovered to 75 in 90 seconds.

Next morning his pressures were 138/85, and his pulse was 60 and regular. His exercise tolerance was 70-108-75 sec. Here the pilot had rushed into flying, expecting to take it up again with the vigour and spirit with which he had left off. Reducing this pilot's flying to one hour a day, with a very gradual increase, was all that was necessary. His pressures thereafter remained round about the lower figures.

Flying may not excite in the central nervous system that resistance to its strain which arises in other conditions affecting the human frame, but it does require training, and during this time of training the mind learns to protect the system from strain in many subtle ways.

Flying on war machines is to be regarded as a form of sport, and although not highly dangerous, at least as distinctly hazardous. It is a serious strain, especially for the pilot, on the central nervous system. In peace time flying daily should not be permitted to any aviator. Three or four times a week is quite sufficient, unless the pilot's flying life is to be limited to a very short time. In bad weather all flying should be suspended, unless under most urgent circumstances.

The treatment of flying stress, which ought to become rare, and be limited to flying tiredness, is rest, and, whenever possible, gentle open air exercise, gradually increasing. Fishing, bowls, cricket, riding and golf, at first, and then tennis and may be motor cycling are excellent. Absolute rest in bed is a mistake, unless the heart is in a serious condition,

a most unlikely occurrence now.

Regarding my personal experiences, I made many flights, which served to confirm what I have written above. I found also that even a comparatively short flight on a fragile machine, (such as a B.E.2.E), had more effect than a comparatively long one in a twin engine aeroplane, (such as the Kangaroo), which is steady and comfortable; that the strain is increased the higher the altitude, the longer the flight, and the worse the weather, and also with any irregularity in the proceedings, such as an unsatisfactory engine, stunting, or landing and taking off in unknown country. Flying by night did not seem to be more of a strain than by day, although landing then is always more precarious.

As for symptoms; some tachycardia, a feeling of fatigue and painful stiffness of the muscles, I observed; and, after being higher than usual, (10,000 feet for an hour or so), some restlessness during sleep the same night. I doubt if the strain of piloting, or even observing, in these light aeroplanes will ever lessen, rather will flying become less hazardous and more comfortable, and therefore less of a strain, by progressive inventing in mechanical science.

S. J. Moore.

OBSERVERS & CADETS.

Number. Date. Name. Rank. Age. Hours flying. Remarks. Pulse. Rate after scarce. Time to recover to normal. maximum blood pressure minimum do

1. July 14. M----W. FC* 22. 0. wounded 80-108-15 126/78

after 1st Flight 2000 35 min. 82 (slight irreg.) -102-30 132/85
29/8/18. 2nd test after 3 flights morning 5 a.m. 1 evening * 8576557-
Pulse = 100- in 75 sec = 66677567. Vol Good. 136/92
Then ¼ hr. after 1100 feet 20 min. 65666-100 = irreg. for
35 sec. then 87878 continued. 130/83.

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2. July 14. I----F.R. FC 20.0. wounded. shock. 84-120-15 132/80
Breath held 61 N.*
after 1st Flight 2000 46 min. 84-120-45 140/92 sick, no vomiting.
31/8/18 Two flights. 544545 irreg. Vol Good. 127/92
After 3 min. 70-104-120. cold weather.
4/9/18 3000 feet. 23. min. 70. irreg. in force -100-35 137/96

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3. July 14. I----F.L. F.C. 30. 0. France 1 5/12 years. 72-80-4 Breath held 60. N.
132/75
after 1st Flight 2000. 40 min. 64 slight irreg. -96-50 138/90
31/8/18. Before Flight 60reg, 122/88. After 2000 feet 30 min. = 52 reg. 126/96 Blood pressures.

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4. July 14. S----J.J. F.C. 31. 0. wound. France 2 8/12 years. 74-108-50
Breath held 68 N. 148/88
after 1st Flight 2500. 30 min. 80/96/30 140/82
31/8/18 Two min. after flight 54-72 (irreg. in force) 85 regular
4/9/18 1000 feet. 19. min. 62 (abrupt upstroke) - 84 = 12 144/98

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5. July 21. M----F.C. 29. 1 hr. 31. France 2½ years. Heart hypertrophied
74-120-30 148/78
after 1st Flight 2000. 40 min. 84-84-7 154/92
9/8/18. Bumpy day. 2300 ft. 20 min. 72 reg. sick taking off, alright after. Flew 20 min.
5/9/18 (40 min. after tea) 84-112-30 Reg. 152/84 (Before Flight)
(3000 feet. 85 min. 12 min. after landing = 72/108/65 Reg.
138/95.

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6. July 21. I----W.C. F.C. 20. 0. France 2. 76-132-30 148/78
after 1st Flight 3000. 30 84-110-20 138/92
Aug. 26. (7 hours flying) to date) Before 86-122-25 126/88 (Has been smoking)
After flight 76576657 (missed 1 beat).
After 3 min = 80-132-50 126/95

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* F.C. = Flight Cadet.

* Breath held 61 N. means — Breath held for 61 sec. the reasons for giving up were normal - i.e. no giddiness, headache re

* Pulse beats in 5 second periods.

B

No. Date. Name. Rank. Age. Hours flying. Remarks. Pulse rate – rate after exercise. Time recovering in secs. Max. + Min. Pressure

7. July 21. W----W.R. F.C. 24. O. France $\frac{8}{12}$ self-conscious.
74-96-15 128/77

after 1st Flight 2200. 25. 96-112-20 128/88
23/8/18. (Before flight 64-94-10 130/85
(After flight 5000 ft. 30 min. 84 irreg. 786876
In 5 min. = 72-122-45 still irreg. 133/90
weather cold.
5/9/18. Before flight = 80-108-50 Reg. 136/86.
After 2000 ft. 70 min. = 56656 irreg.then 84-112-
in 4 min. = 88 138/96.

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8. July 21. S----A.E. F.C. 26. O. France 1 $\frac{3}{12}$ Trench fever.
80-120-30 Reg. 132/78.
after 1st Flight 2000 ft 30 min. Pulse 80 irreg. -100-50 142/90.
6/9/18. Before. 74-110-25 Slightly irreg. then regular.
After 2000 ft. (twice) 677677 -104-45 then 6777677
After 3 min. = 56566577756 Irreg.
Pulse frequency in five second periods.

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9. July 21. S----R. F.C. 22. O. North Sea 2 years. C3. 72-108-20
138/83
after 1st Flight 2000 ft 60 min. 52-110-28 136/90.
Sept. 6. Before flight 60 reg. -130-50. S128.
After flight 65455 -118-25 in 90 sec. = 56. Irreg.
Upstroke abrupt.

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10. July 21. M----C.W. F.C.18. O. $\frac{5}{12}$ Home.* 6 teeth extracted recently.
84-108-30 128/70.
after 1st Flight 2500. 15 min. 108 slight irreg. -132-15 142/90
After 30 min. pulse still 108 & slightly irregular ~~ity~~.

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11. July 21. L----G.E. F.C.24. O. France 1 $\frac{6}{12}$ 74-118-40 130/82
after 1st Flight 4000. 15 min. 76-108-30 138/92

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12. July 21. K----L.W. F.C. 21. O. France 1. Year. 72-96-10 118/70
after 1st Flight 3000. 30 min. 76-108-40 118/72
26/8/18. Before flight 82 reg. -110-30 reg. 116/78
4 min.after landing = 62 irreg. missed 3 beats in 40
seconds = 56654545 (sitting)
After a further 3 min.(standing) = 72-90-80 regular
upstroke abrupt.
~~1~~123/82.
3/9/18. Before flight 60/94/30 Reg. 111/78.
After 3000 ft. 30 min. 70 slight irreg. -90-55 118/86

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* Home = Home Service
or
H.S.

C.

No.	Date.	Name.	Rank.	aft.	Hours flying.	Remarks.	Pulse rate after exercise. Time recovering.	Max. / Min. Pressures.
13.	July 21.	R----L.J.	F.C.	21.	0.	Sea 2½ yrs.	64-96-10	138/75
	after	1st F. 2100 ft.			30 min.	90 irreg.	-108-40	134/88
	9/8/18.	Before flight					84-118-60	128/82
		After flight				100 slight irreg.	118/95.	
		After a minute				84-116- in 3 mins.	90 slight. irreg.	
14.	July 21.	S----S.A.W.	F.C.	24	H.S.		74-120-15	143/84
		Heart irregular on holding breath 48 sec.						
	after	1st F. 2000.			40 min.	90 irregular	-118-40	170/100
	Aug. 23-18.	30 min. after tea.						
		Before flight					70-110-25	165/95
		After 1500 ft.			30 min.	88 irreg.		175/108
		After lapse of 5 min.					72-124 after a minute = 72 irreg. and missing 3 beats in ten seconds at times.	
15.	July 21.	M----C.S.	F.C.	19.	0.	Home, Influenza lately.	74-108-10	143/78
	after	1st F. 2500.			30.		88/106/20	160/84
	23/8/18	20 min. after tea and before flight					62-88-12	155/80.
		After 2500.			30 min.	50 slight. irreg.	-108-40 abrupt upstroke.	
							(454445)	172/88
	2/9/18	(Before flight.					60-110-30 Reg.	150/82 afternoon.
	3/9/18	(Next day after flight					70-120-30 Reg.	152/90 6.30 a.m.
		3000 ft.			20 min.			
16.	6/8/18.	L----Hal.	F.C.	20.	0.	Home 3/12	Irritable heart. 100-144-30	168/84.
	after	1st F. 2000.			30.	110 slight irreg.	-144 - in six minutes 108	160/95
		(on holding breath to 70 pulse slowed to 70 and then increased).						
17.	6/8/18.	B----A.J.	F.C.	18.	0.	H.S. 2/12	86-96-10	150/78
							72-108-45	160/90
	after	1st F. 2000.			30.		Pulse.	Pressures.
	2/10/18	(Flown 12 hrs) Before 1st flight of day					80	142/78
		After 35 min. flying				72 reg.	-110- in 3 Min. 84.	140/89.
18.	6/8/18.	W----H.	F.C.	27.	1.	France 7/12	84-132-50	142/84
		Slightly gassed.						
	after	1st F. 2000.			20.	100-132-	in 1 min. 108	150/92
	2/10/18	(Flown 12 hrs.) Before 1st flight of day					96 Reg.	158/90
		After 10 min. flight				108-120-90	(9,9,10,8)	162/92.

D

No. Date. Name. Rank. Age. Remarks. Pulse rate. — after exercise. Time to recover to normal.. max min. press

19. 6/8/18. M----S.O. F.C. 19 $\frac{6}{12}$ 0 H.S.1 $\frac{6}{12}$ 80-108-25 144/98

after 1st F. 2000. 20. 90 slight.irreg. -132-in 60 = 108
142/100

3/9/18. No flying for 4 days. Before 84-132-35 reg. 140/95
After 2000. 20. 78878-122-40 (87788) 150/106
in 1½ min. 676776.

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20. 6/8/18. S----H.V. F.C. 25. France 2 (base) 84-120-40 128/84
after 1st F. 2400. 20. 108*(S.I.) -132-60 145/92
3/9/18. (No flying 4 days) Before 96-144-40 Reg. 156/85
After 2000 ft.30 min. 789898-124-60 (89989) 146/98
(slight irreg) -120 (8878)
fairly regular

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21. 6/8/18. S----F.H. F.C. 21.0. France 2½ 62-110-15 140/80
after 1st F. 3000. 20. 76 (S.I.) -108-15 142/82.
30/8/18 After 2 flights 6564556 - in 2 min. -132-60 (S.I.)
132/94.

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22. 6/8/18. H----R.A. F.C. 18 $\frac{6}{12}$ 0 H.S. $\frac{3}{12}$ 86-120-40 142/68

after 1st F. 2800. 30. 8,9,10,8,9,9,10 (108)-132- in 8 min. =
100
145/72

2/10/18.(Flown 12 hrs.) 1st flight of day (96-115-75 127/86
After 3 flights,in all 60 min. (slightly irreg.

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23. 6/8/18. H---- O.F. F.C. 25. Flown 20 hrs. 62-130-35 128/78
After 5000 ft.20 min. 63-124-15 (slight irreg)
150/90

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24. 6/8/18. P----S.H. F.C. 25 1 H.S. $\frac{3}{12}$ 80-90-10 128/78

after 1st F. 2000. 20. 100(98778) -108-40 148/88
(Pulse 84 and S.I. after 12 min.)
2/10/18 (Flown 11 hours) After 1st flight of day 88(78778)-
110-60 (78877)
147/98.

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25. 6/8/18. L----W.G. F.C.18 $\frac{2}{12}$ 0 H.S. $\frac{3}{12}$ 80-120-30 150/80

after 1st Flight 2000. 20. 9,9,11,9,10,9,10,-144
In 15 min. = 108 145/90

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* S.I. = Slightly irregular.

E

No.	Date.	Name.	Rank.	Age.	Hours flying.	Maximum height.	Average height.	Pulse rate after exercise. Time recovering.	Blood pressures.
26.	8/8/18.	W----W.	Lt.	36 8/12	300,	15000,	2000.	60-72-10	120/82

(Officer in charge engines etc.)
After 3000 ft. 15 min. (5 min. after landing & swinging propeller twice 62-76-8 144/102

(After flight with
(Spin & many vertical banks - 72-80-8 Reg. 160/106
Complains of not feeling well. Headache before going up.

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27. 8/8/18. T----C.S. F.C. 18 6/12 0 H.S. 2/12 66-84-5 135/80
After 1st F. 3000 ft. 30 min. 60(546564) -108-in 75 sec = 70 (S.I.) 148/95
23/8/18. After flight 70-108-35 132/78.

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28. 8/8/18. S----N.M. F.C. 20. 0. H.S. 5/12 96-148-40 136/84
After 1st F. 2000. 20. P = 108 (S.I.) -150-45 145/85
23/8/18 After 2 flights (2500. 28 = 80-106-15
(1000. 35 = 54 (irreg.45454)-100-60 135/95

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29. 8/8/18. D----J.W. F.C.20. 0. France 10/12 slight wound 72-120-25 130/90
After 1st F. 2000. 25. 80-100-10 140/88
23/8/18. After flight 10000 ft. 45 min. P = 5565656 - after 4 min. = 768768, in 6 min. = 56556, and in 8 min. = 776677 = 70 (irreg. force & rhythm 70-106-45 132/92
Before this flight P.80 reg. 128/84.
Resp.14 and irregular & spasmodic at times.

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30. 8/8/18. F----J.E. F.C. 18 1/12 0 H.S. 3/12 86-120-35 138/90
After 1st F. 2200. 30. 80-108- after 2 min. = 899889 (67766) 156/100
23/8/18 After flight 80-122-50
130/85. after 4000. 60. = 72-110-60 (S.I. 138/98.

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31. 8/8/18. W----J.E. F.C. 18 1/12 0 HS 3/12 80-120-25 145/58.
After 1st F. 2200 ft. 30 min. 94(788788)-138-30 145/84.

No. Date. Name. Rank. age. Hours flying. Remarks. Pulse rate after exercise time recovering. Blood pressures.

32. 8/8/18. S----J.R. F.C. 21. 0. HS $\frac{3}{12}$ 86-120-35 138/90

After 1st Flight 80 (irregular = 578885)-108-80 132/90

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33. 8/8/18. N----A.G. F.C. 18 $\frac{8}{12}$ 1 1000 H.S. $\frac{7}{12}$ 80-108-10 125/82

After 1st Flight 3000 30 90 (irreg.= 878566688) -140-80 (in a minute = 84 steady & regular) 138/92.

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34. 8/8/18. S----E.T. F.C.25. 300, 11,600. 3000 New Zealand Egypt 64-118-35 152/94

Flew last 3 months ago.

After flight 3500. 25. 64-100-40 (556555) $\frac{1}{1}$ 132/90

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35. 16/8/18 H----F.T. F.C. 20. 0. HS $\frac{3}{12}$ 76-120-35 132/85

After 1st flight 90 irregular -118- after 2 min = 88 128/88.

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36. 16/8/18. G----W.J. F.C. 19. 0. HS 1 $\frac{1}{12}$ 78-120-12 142/88

After 1st flight P = 72 irregular in force. After half an hour, exercise = 110 - after 4 min. = 84 125/78.

10/10/18. Flown 12 hours. Just down from flight 92 (irregular in force & rate) -120-65 Reg. 134/88

After another flight = 110 after 10 min.= 84-108 in a minute = 7867786. 135/94.

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37. 16/8/18. T---- F.C. 18. 0. H.S.1 $\frac{1}{12}$ 92-130-40 140/80

After 1st flight 1000. 20. 80(irreg.& abrupt) -138-after 3 min = 90 138/82

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38. 16/8/18. H----C. F.C. 20 $\frac{2}{12}$ 0 H.S.1 $\frac{6}{12}$ 72-130-20 158/88

After 1st flight. 58 slight.irreg. after exercise missed a beat in 5 sec. then missed two beats in 5 sec. Irreg.in rate & force. After 2 min. = 56 abrupt but regular.

10/10/18 Before flight 88. 140/80

After flight $\frac{1}{4}$ hour down = 108 after 6 min.= 88-116-25 reg. 140/88

No. Date. Name. Rank. Age. Hours flying. Remarks. Pulse rate. — after exercise. Time to recover. Blood pressure.

39. 16/8/18. D---- R.V. F.C. 28. 0. H.S. 3/12 74-98-15 124/88

After 1st Flight 64 (slight.irreg. & abrupt)-72-15
124/95

10/10/18 Crashed on a B F 2 E on Sept. 9. Commenced flying again two days later. Says he is now getting his confidence back.
Before flight P 96 161/98 (had flown morning of same day)
After flight P 120 -132- in a minute = 120 reg. abrupt.
163/91 (Perspiring freely)

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40. 16/8/18. H----R.C. F.C. 18 8/12 0 H.S. 3/12 88-118-45 124/84

After 1st Flight 78 (irreg.missed a beat) -118-35
144/92.

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41. 16/8/18. F----W.R. F.C. 18 4/12 0 H.S. 5/12 74-110-40 144/84

After 1st Flight 8000. 60 min. examined 2 min. after landing. Pain in ears before coming down. Ears normal in 5 min. 84 (S.I.) -130-90 150/92

10/10/18 (Flown 5 hours)
Just after flight 116-136-95 Reg.
150/94.

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42. 16/8/18. M---- C. F.C. 19. 0 H.S. 4/12 74-130-30 135/92

After 1st Flight. 84 (Reg. abrupt upstroke) -118-35
132/95

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43. 17/8/18. M----A.C. F.C. 19 6/12 0 R.N.A.S. 3 6/12 66-110-10
132/80

After 1st Flight 72-110-15 Regular
124/86

10/10/18 Flown 11 hours.
4 min. down from flight = 96-124- in 1½ min. = 120
135/95.

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44. 17/8/18. S----F.W. F.C. 19 5/12 0 H.S. 3/12 90-134-30
142/82

After 1st Flight 80 (S.I.) - 118-90
138/86

10/10/18. Flown 13 hours.
After flight before breakfast P = 110 on coming down
Ten minutes afterwards
78-122- after 2 min = 100 Reg.
126/89

No.	Date.	Name.	Rank.	Age.	Hours Flying.	Remarks.	Pulse Rate.	Rate after Exercise.	Time in sec. to recover to normal.	Max. & Min. Blood pressure.

45. 21/8/18. W———— W.V.F.C. 19 0 H.S. $\frac{10}{12}$ 90 - 134 - 25 122/82.
After 1st Flight 1500 25 P.106 (Si) (Slightly irregular)
(78989989)
In a minute 108
After 5 Minutes 84 - 106 -
In 2 Min. 104
140/98.

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46. F———— H.O.F.C. 18 $\frac{9}{12}$ 0 H.S. $\frac{7}{12}$ 80 - 118 - 30. 122/84.
21/8/18. After 1st $\frac{9}{12}$ Flight P = 886687867.
After 10 min. = 6788786 - 108
After 2 min. = 8977787998
129/95.

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47. 21/8/18. P———— A.M.F.C. 18 $\frac{6}{12}$ 0 H.S. $\frac{6}{12}$ 82 - 130 - 40
162/85
After 1st Flight P = 10,889
After 6 Min. = 788978 - 118
After 2 Min = 96 166/93.

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48. 21/8/18. S———— R.W.F.C. 18 $\frac{4}{12}$ 0 H.S. $\frac{4}{12}$ 70 - 122 - 35 130/80.
After 1st Flight
P = 8989999
After 40 Min. = 8787777 -118
- 40
138/90

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49. 21/8/18. S———— H.E.J. 18 $\frac{1}{12}$ F.C. 0. H.S. $\frac{3}{12}$ 72 - 110 - 30
124/84
After 1st Flight P = 60 Regular - 108 - 50 (SI) 118/72
After 2nd Flight P = 74
After 2 min. = 60 Regular.

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50. 22/8/18. S———— E.F. F.C. 18 $\frac{6}{12}$ 0 H.S. $\frac{3}{12}$ Anaemic.
Soft short blowing V.S. murmur apex and base
with accentuated second sound.
74 - 94 - 25. 122/75.
After 1st Flight 1500 25
P = 76887688 - 118 - in 1 Min=109
in 5 Min=88
135/92
After 2nd Flight in 10 min P = 96 - 118 - in 1 Min=96
(Reg.)

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51. 22/8/18. F———— W.H.F.C. 18 $\frac{9}{12}$ 0 H.S. $\frac{6}{12}$
Rough first sound,
Slightly accentuated.
Second sound at apex. 96 - 122 - 30. 118/78
After 1st Flight P = 10,9910,8910. 124/88
After 7 Min 9899810,9 - 126 -
After 3 Min 89910,998
After 2nd Flight. 10,10,10,9,9,10,8,10,10.

No. Date. Name. Rank. Age. Hours Flying. Remarks. Pulse Rate. — after exercise. Time to recover.

52. 22/8/18 W------H.G.F.C. $18\frac{2}{12}$ 0 H.S. $\frac{2}{12}$ 68 -100 - 20. 122/85. Blood Pressure.

After 1st Flight 72 (SI)
After 5 min = 455444 - 100 - 40 150/108

After 2nd Flight 72
After 5 min = 52 Regular.

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53. G-------L.F.C. $18\frac{5}{12}$ 0 H.S. $\frac{2}{12}$ 84 - 118 - 35 135/90

After 1st Flight 84 (reg) 128/92
After 11 min = 80 - 96 - 60 (reg.)
This cadet crashed badly on 17/10/18 and was commencing flying when I left. (Hospital and leave 3 Months).

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54. M-------A.G.F.C. 19 0 H.S. $\frac{3}{12}$

118 - 144 - 10 144/85
Breath held 85 Answer N. Pulse still 118 after holding breath
After 1st Flight P = 96 (Reg.) 140/98
After 5 min P, = 100 - 116
After 2 min = 106 (SI)
After 2nd Flight P = 120 and in 3 min = 94

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55. L---------R. Capt. 28. 200. 10000. 6000. France. $3\frac{1}{2}$ years.
Breath held 47 N.
64 - 96 - 30 130/82
After Flight P - 5566655565 - 84 - during 1st min rising to 98 and falling to 78.
After 3 min. (sitting) 60 (reg.) 122/84
1st sound rough and 2nd sound accentuated for 4 min. after flight.

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56. 17/9/18. B-------W.W. F.C. 20 0 France 2 years. Gassed.
Off Duty. $\frac{1}{12}$ Breath held 83 N.

56 - 84 - 12 (reg.) 128/88.
After 1st Flight 70 (reg.) -106 - 55. 142/94. (after about 10 min. down)

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57. S--------H. F.C. 20 $\frac{3}{4}$ Hr. 750 ft. R.N.A.S. 2 years.
Breath held 45 N. C P A nil.
74 - 112 - 80 (S.I. before reg. after exercise) 154/82
After 1st Flight Pulse (96 (89108910)
to (120 After 4 min. 84 - 118 -50 150/78.

J.

After having flown 13 hours.
8/11/18 After 1st flight for 4 days P 110. 140/92.
After 3 min. 100 - 132 - in 1 min =
10,9,9,10,9,10,10.

in 2 min =
8,9,10,10,9,9,8,9.

No. Name. Rank. age. Hours flying. Remarks.

58. W---------V.S.F.C. 18 0 H.S. $\frac{4}{12}$ C P A nil.
Pulse after exercise. Immediately. Blood pressure.
84 - 106 - 25 Reg. 128/79. Tension not well sustained.
After flight in twin engine machine)8,9,10,9.- 144
5000 ft. ½ hr. 4 min after landing) in 1 min. =100
130/82 (S.I)
slightly irregular.

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59. 18/9/18. J--------P.F.C. 24 0 H.S. $\frac{3}{12}$ 76 - 130 - 35

(S.I. after exercise
138/88. = 87877776777)

After Flight
84 (S.I) - 100 (for some seconds no pulse felt at wrist; asked if he felt all right, and he said, "Yes". Pulse came and went again for 5 or 6 seconds. In 50 seconds fairly good and about 80. After 6 minutes 76888778)

Having flown 13 hours.
After 1st Flight for 3 days P. 124, After 4 min 100 - 134
8/11/18. in 1 min. 9,10,9,8,10,9.
in 2 min. 9,8,9,9,10,8,8,9.
139/92 irregular in force and rythym.

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60. 17/9/18. D--------F.L.F.C. 18 $\frac{6}{12}$ 0 H.S. $\frac{3}{12}$ 62 - 110 -18.
136/83
4 min after 1st flight (Twin engine) 96 (S.I.)
After 8 min = 74 - 110 - in 2 min 84 148/90
On 15/10/18 before histenth flight 74 - 126 - 60 136/85
after his tenth flight 68 (S.I) -110 in a
minute 84 136/94

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61. 18/9/18. T--------V.C.F.C. 22 $\frac{8}{12}$ H.S. $\frac{3}{12}$ 52 - 86 - in a
min = 82
126/84.

8 min after 1st Flight (Twin engine)
7655 Irreg. After a further interval
72 - 108-72 Reg.
128/85.
After another flight some weeks afterwards 72 - 108 - 25 reg.
133/88.

K.

8/11/18 After 16 hours flying
After 1st flight for a week .
P. 106 after 4 min. 100 - 144 - in 40 sec.
= 8,9,8,9,8,9.
Slightly irreg. in force.
136/90 Respirations 20

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62. McM---------I.B.F.C. 21 0 East Africa 2½ years Milaria at 10 Dysentery. Breath held 80 - 102 - 20. Reg. 136/88. 56 N.
5 min. after 1st Flight 84 - 100 - 15. 140/84.
(Twin Engine)
Having flown 3 hours. Before flight 86 - 120 - 25 140/77
After Flight 108 (Reg.) - 124 -
in 2½ min.-7888978886888.
in 15 min.-96 and more reg.
8/11/18 Having flown 18 hours. 136/85
After three flights. 110 (S.I. in force and rate)
after 4 min 100 - 120 (Very irreg. in force and rate
Full of confidence as most are. during first 10 sec. after exercising then 120 (S.I.)
in 2½ min = 978999
Respirations 20.)

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63. H--------I. F.C. $23\frac{1}{12}$ 0 H.S.-$\frac{4}{12}$. 60 - 110 - 40 Reg. 140/84.
8 min. after 1st flight. 678668688. - 120 - 40 (then 68686777
138/84.

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64. R---------D.R. F.C. 19— H.S. 80 - 124 - 20 Reg. 160/85.
5 min after 1st flight. 94 after 8 min 72 - 120 - 55.
170/84.
Having flown 16 hours after flight P = 146 after 3 min
=110-160.
in 1 Min. = 10,9,10,10.
in 2 Min. = 9,10,9,10,9,11.
152/95 Respirations 26.

As full of confidence as the rest.

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65. L-------J.H. F.C. $18\frac{6}{12}$ 0 H.S. Just Joined up.
Pulse sitting 48. Standing 60-76-40
128/86. (S.I.)
10 min after 1st Flight. 72-100-105. 126/85.
Delayed test.

L

No. Date. Name. Rank. Age. Hours Flying. Remarks. Pulse rate - after exercise. Time to recover.

66. 23/9/18. A--------D.W. F.C. 26 0 H.S. $\frac{3}{12}$ 88 - 110 - 35 Reg. 165/94.
10 min after 1st Flight 72 166/99
22/10/18 After 8 hours flying
down from flight of 2500 53 min. 84 reg -120 - 30 157/98
1/11/18 After 14 hours flying P 100 after 4 min 92-110-
in 1 min 989888
In 2 min 878888
After two flights second in 3 min 78888878
lasting an hour 132/93
Sidcup Suit prespiring heavily.

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67. 24/9/18 K------A.F.C. 29 0 H.S. 1½ France 1 $\frac{3}{12}$ 72 - 110 - 50 reg. 120/92
4/10/18 After 3rd Flight 52 reg. -100 - 95. 128/93
22/10/18 After 5 hours flying
down from 2000 40 P 60 (S.I.) 111/80.
After 4 min 64 - 96 - in 1 min 7665
in 2 min 464564
Irreg. in force and rate.

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68. H--------I.T.F.C. 24 0 3 $\frac{4}{12}$ (France 1 $\frac{3}{12}$) 70 - 100 - 16 Reg.
Gassed 1917, not off duty. 156/95.
Typhoid 1914.
10 min. after 1st Flight P.96 164/104.
22/10/18 after having flown 8 hours
down from 3000 ft. 40 min. 84 irreg. after 4 min. 74-120
In 1 min.= 89988
In 2 min.= 67677767
153/97.

H.Rs.

69. W-------R. F.C. 20 2 6500 4000 H.S. 2 70-100-5 Reg.
1st Day's flying 24/9/18 no test taken. 128/85.
2nd Day's flying 3/10/18 1000 30 min. 88 Reg. 136/89.
22/10/18 Having flown 8 hours.
4 min after flight 84 after 4 min 76-116 in 1 Min.= 84
in 2 Min.= 76
134/90.

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70. 23/9/18. F-------R.S. F.C. 18 $\frac{1}{12}$ 0 H.S. $\frac{3}{12}$ 66-108-25. 146/76.
After 2nd day's flight 84 reg. 139/88.
22/10/18 Having flown 8½ hours. 108 upstroke abrupt.
After 3 min. 96-124 in 1 min.= 989
139/85. in 2 min.= 89888
in 4 min.= 98878
1/11/18 Having flown 14 hours. 98.
After two flights 124 - after 5 min 86-132-
in 20 Sec. = 108
in 60 Sec. = 6788688678.

140/92

M.

No. Name. Age. Hours flying. Remarks. Pulse rate. Rate after exercise. Time in sec. breath. Blood Pressure.

71. D-------L. 18$\frac{11}{12}$ 0 H.S. $\frac{3}{12}$ 84-110-30. 136/87.
Slightly irreg. Probably nervous.

4/10/18. After 2nd day's Flights (3) Sick and vomiting each time in a spin first time and while banking second and third.

Just down and feeling all right
70 irreg. and vol. small. 120/82.

22/10/18 Having flown 8 hours P.100 (irreg.789) -132 in 1 min. =9,10,8,9,10. in 2 min = 9899899

Just down from 2000 ft. ½ hour. 140/87

Has not been sick since above date

1/11/18 Having flown 14 hours.
After flight for 70 min. P. 576 After 3 min 96-132 in 10 sec. 68788878 Irregular

130/90

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72. W--------E.F.C. 24 0 France 3½ 62-86-15 Reg. 126/86
After flight P. 84 146/95
1/11/18 Having flown 11 hours
After 3 Flights to-day 122 After 4 min 100-140
In 20 sec. 8999899
in 1 min. 99989988987.
in 2½ min. 879788878
134/96

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73. F---------J.S. F.C. 21$\frac{10}{12}$ 0 H.S. $\frac{3}{12}$ 72-108-40 Reg. 140/84

First flights not tested
After having flown 6½ hours.
2000 feet. 1 hour P 878 in 3 min 84-122 in 1 min =787778
in 2 min =777887
in 4 min =888788
146/87

Hours flying. Maximum height. Aver. height. Remarks.

74. C-------G.S. 2/Lt. 23 30 9000 2500 S.W. Africa 1
East Africa 2
Breath held 50.N. Milaria 1916. 20 times since.
After 1st two flights for 2 months Dysentery 1915.
90-120- After 2 Min = Recovered.
89898899 136/92 Wounded slightly.
Off duty 2 days.

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75. 23/9/18 C------W.R. F.C. 18$\frac{5}{12}$ 0 H.S. $\frac{3}{12}$
84-110-45 Reg. 128/98 T.W.S.
Just down from 1st flight 74 irreg.
128/96

22/10/18 Having flown 8 hours.
2000 ft. 25 min.
5 min after landing. 96-138 in 1 min =9,10,899
in 2 min =8999899
in 3 min =999899899
in 6 min =6788688
144/93.

N

No.	Name.	Rank.	Age.	Hours Flying.	Remarks.	Pulse rate. Ratio after exercise. Time taken.
76.	B------H.J.R.	F.C.	18 5/12	0	H.S. 5/12	96-120-30 Reg. 160/88

Blood pressure

4/10/18 After 2nd day's flight P.132 after 5 min 96-120-75 160/97

22/10/18 Having flown 6 hours .
(7.a.m.) 5 min after flight 2000 30 P.110 irreg in rate and force. 128/92

After 5 min 100-140 in 1 min = 10,99989
in 2 min = 89999899

77.	7/10/18	E------R.F.C.	24 7/12	0	3 9/12		France 2 Accident 1915 off 3 months Septic poisoning. all right now. Breath held 91.

54-94-35 reg.
After 1st flight P. 5656566
After 2nd flight P. 45545 -106- in 1 min 767667
in 2 min 6566675 irregular
136/78

				H.Rs.			
78.	E-------A.	F.C.	26 8/12	10	5000	2000	11 years at sea. 120/82.

68-100-30 Reg.
After 1st flight 3500 20 min
P.120 after 3 min 108-124-50 (S.I.) (reg) 126/80.
After 2nd flight 3000 45 min. 96-110-20 126/85

79.	F------W.E.	R.C.	22 1/12	0	4 2/12	France 3 years. Breath held 98 N.

70-110-40 Reg. 139/95
Some mins. after 1st flight P.122 After 4 min 122 after 6 min 116-134 in 20 sec. 89 then 9,10,9,11,9,10,9,11,9.

136/94.

80.	W-----E.J.	F.C.	18 3/12	0	H.S. 3/12	Daily Smoking.	Cigarettes 20 (Players) 58-106-30. 136/82

After 1st flight P.110-134-65 (9,10,999,10) 123/83
After 2000 ft. 20 min. later same morning
84-124-25. 122/68.

81.	7/10/18. B--------A.L.	F.C.	21 5/12	½ hour	2000	H.S. 4/12

80-98-30 Reg. 144/86

After 1st Flight.

P. 108. After 4 min 100-118 in 1 min 987997
in 2 min 7986888
in 3 min 788978878
Headache. 146/95

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82. B-------H.R. F.C. 18 3/12 H.Rs. 1½ 5000 H.S. 4/12 82-120-25 Reg. 144/89. 156/96

After 1st Flight 86-128-65 (S.I.)

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83. B------R.J.F.C. 25 0 2 years France 1 10/12 Breath held 75 N.

84-122-55. 142/93
Some min after flight P.108
After 3 min 108 slight irreg. in rate and force
After other 4 min 108-124- in 1½ min= 9,10,89898999
126/90

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84. W--------C.T. F.C. 23 10/12 0 3 4/12 France 2 4/12 Breath held 62 N.

88 reg. -134-60 161/93.
After 1st Flight P.150. After 3 min.= 110 154/97.

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85. M------W.F. F.C. 26 7/12 0 H.S. 4/12 Cigarettes 20 (Goldflake)
Pipes 3.
A.mod.

74-108-50. 132/95.
Some mins. after flight P.108.
After 4 min. 108
after other 5 min 108-116- in 1 min 9899989
127/92

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86. D---------O.A. F.C. 26 6/12 0. H.S. 4/12 70-108-60 Reg.

After 1st flight 2000 20 min. Cig. 20. 147/94
78-106-50. 143/88.

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87. P-------G. F.C. 22 0 3 years. France 1 9/12 Breath held 56 N.
84-132-30. 128/78.
4 min after 1st flight 100-124- in 1 min 110
in 2 min 100 irreg.
upstroke abrupt.

132/82

P

No. Name Rank Age Hours flying Remarks

88. N------S. F.C. 28. 0. 2 6/12 France 1 2/12 Breath held 58N.
wounded abdomen and thigh. 8/12 off.

Pulse rate. Pulse after exercise. Time to recover to normal. Blood pressure.
88-110-35 144/94.

After flight on twin engine machine.
P.120. after 4 min. = 88-120- in 1 min 788788778
156/106

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89. D--------R.T. F.C. 24. H.Rs. 10 7000 2000 4 years.
France 3 Breath held 78N.

72-106-10. 124/74.

After flight 1500 25 min. P.84 after 3 min 72-90-50 (S.I.)
Soft and tension not sustained.
108/68.
After 5 min more tension better and 767667

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90. P--------H.D. F.C. 25. 0. 4 6/12 Cigarettes 20.
Breath held 55 N.
Egypt.
Gallipoli.
Palestine, etc.
Trench Fever 3 days.

84-124-60 (a trifle irregular, as nervous).
127/78

After 1st flight on twin engine machine.
P.134 After 10 min. 76-96- in 1 min 88
in 2 min 76 (S.I.)
130/86.

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91. P--------T. F.C. 29 0 2 9/12 France 1 6/12 72-120-30.
143/84.

After 1st flight 88 after 4 min 84-118-50 reg.
128/88

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92. M--------L. F.C. 22. 0. 3 7/12 France 3 3/12 72-120-30
140/78.

After 1st flight P.124. Reg. After 3 min 106-132
in 1 min. 89989.
in 2 min. 99889
in 3 min. 899888
in 6 min. 999889.
130/83.

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93. W-------E.S. F.C. 20. 0 H.S. 4/12 Cig. 20.
84-134-35. 128/82.

After 1st flight on twin engine machine.
P.100 After 5 min 72-110-50- reg. 136/90.

Q

No.	Name.	Rank.	Age.	Hours Flying.	Remarks.

94. D---------T.G. F.C. 23. 0. 3 6/12 France 3 2/12.
Pulse rate.
84-112-25. 147/82. Blood pressure.
After flight Felt a little sick after coming from machine.
P.96. after 15 min 82-106 in 1 min 768797.
in 2 min 57767786.
148/96. in 3 min 767667766
Irregular in force & rhythym.

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95. H-----S. F.C. 26. 0 France 2 6/12 74-100-15 Reg.
124/85
After flight on B.E.2E. 3000 ft. 25 min.
6.a.m. 22/10/18. P.140 After 12 min. 88-100 in 1 min 89789988
128/85. in 2 min 897887.
Respirations 24

H.Rs.

96. M--------C.R. F.C. 2. 3/4 7000 2 11/12 Egypt 1 8/12
France 2/12
88-124-40 Reg. Milaria.
126/66.
After flight on twin engine machine.
P.100 after 5 min 84-120-50 (S.I.).
106/70 (Note low maximum pressure).

H.Rs.

97. M-------H.S. F.C. 21. 7 4000 1000 R.N.A.S. 2½
P.70-100-45. Reg. 110/74
After flight P.122 after 6 min 114.- 11,9,10,9,10,9,108978878
9788.
128/88.

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98. E--------O.R. F.C. 24 3/12 France 3. 84-124-10 (S.I.)
Trench Fever 3 times. 132/82
After flight P.126 after 5 min 1209138-25 (S.I.).
in 90 sec. = 9,10,11,10,9,11.
128/90. Respirations 22.

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99. W----------F. F.C. 18 10/12 Just joined up. 84-120-35.
150/84
After 1st flight P.156 after 5 min 128-160
in 40 Sec. 11,12,12,
in 90 sec. 10,11,12,13,11.
168/92. Respirations 24.

R.

No. Name. Rank.

100. McC--------F.C.

After 1st flight P.144 after 5 min 124-136-25.
138/84.

			age.	Hours. Flying.	maxm. height.	aver. height	Remarks.
101.	B---------Lt.		18 6/12	70	12000	1000	H.S. 6/12

Pulse rate rc Bloodpressures.

78-110-10 Reg. 126/83.
5 min after flight P.108 after 3 min 96-122-30.
in 60 = 8989.
142/85.

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102. U-------- F.C. 18 6/12 0 Just joined up. 78-114-25.

After 1st two flights. P.108 132/87
After 3 min 108-130. in 1 min. 899109.
in 2 min. 99910999.
150/88.

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103. B--------W.C. F.C. 26 0 Mercantile marine
72-118-65 Reg. torpedoed 2 years ago.
After 1st two flights P.120 146/92
After 5 min 90-120
in 1 Min 8987.
in 2 Min 7888878. 148/92

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104. W------P.A. F.C. 22 0 France 1 60-106-25 Reg.
Wounded thigh
2 years ago 131/92.
& discharged.

After 1st flight P.130
after 4 min=108-160-50. (Pulse, coeraae recovery).
in 2 min=9,10,9,10 Respirations=20, irreg.
Bloodpressure=152/100

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105. W---------T.A. F.C. 18 3/12 0 Just joined up. 80-110-35 Reg.

After 1st two flights P.120 after 6 min. 130/88.
80-120; in 40 sec.=9898
in 2 min.=687886877
Bloodpressures=128/93.

S

PILOTS

Number. Name & Rank. Age. Remarks. Hours flying. Max. Height. average height. Pulse Rate. Rate after exercise. Time to recover normal. Blood pressures.

1. C_____ Lt. E.V. 18 10/12 H.S. 49 hrs France 120 hours. 18000, 10000, 72-108-10 Reg. 140/85

After flight 1000 ft. 40 min. (58855 (missed 3 beats in 40 sec) 132/96
(- 98 - 45 (slight irreg) V.G.
(After 11 min. = 454445544.
(15 min = 54 and regular
(20 min = 50 and regular
Tendency to deep inspiration for 10 minutes after flight.

Hours flying. max. height. average height. Remarks.

2. B_____ C.Lt. 22 6/12 H.S. 25 hrs) 20000, 13000, Malaria Dysentery.
abroad 225 hrs)
60 - 104 - 14 Reg. 128/85
After 3 flights 1000ft. 25 } = 6786-98-72 (6776767) 136/92
4000ft. 30 } Minutes. irregular
2000ft. 12 }

Max. ht. av. ht. Pulse.

3. W_____ R.W.Lt. 18 8/12 H.S.) 15000, 4000 64 Reg. -110-35 117/78
80 hours)
France 20 hours.

29/8/18 After 2 flights 4000 ft. = 1 hour P.on coming down 878878 after 4 min. rest = 72 Reg.
After 5 min. (70-108-75
(125/84

2/9/18 After 5 flights 3 morning 5000 = 60 min. 2 evening 3000 ft = 1 hr.
Did not feel like flying the fifth flight.
6787-108- in 1 min. = 8898998
in 2 min. = 6776 slight irreg. 138/88

1/10/18 (Flown 100 hrs. in 2 months) 4 days rest. ½ hrs. flight this morning.
After flight afternoon.
92 (78887887) -120-55 (SI) = 7899778788 121/77
Tension low and not with sustained. Giddy going upstairs. Illusions in air.

14/10/18 (after 12 days rest) 72 to 84 (slight irreg.) -108- in 45 sec. 88
in 2 min. 88
(S.I.) 124/67
after 2000 ft. 20 min. 96 maintained for 4 min. 126/75

24/10/18 10 a.m. no flying 28 hrs. only 3 hours flying since 14th inst.
after flight 3000. 60 68-86-65 Reg. Vol. small.
127/77

T.

Number. Name. Rank. age. Flying. Max. ht. av. ht. Pulse.

4. W------ C.V.C. Lt. 25 6/12 H.S. 90 hrs. 20,500 3000 80-106-40 Reg.
France 20 hours 118/80
After flight 72-106-45 Reg. abrupt upstroke.
Deep inspiration & missed beat at same time.
122/86.

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5. Mc----- W.R.Serg.19 6/12 H.S.75 hours) 18400, 16500, crashed 9 months ago.
France 125 hours. 74-106-20 Reg. 132/84
(Flying morning same day for 3 hrs.)
After 2 flights 1000 ft. = 45 min. 80-112-20 Reg. 130/93
upstroke abrupt.

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6. A_____L.D.Serg.23 70 H.S. hours.
France 180, 17000,12000. Has had 3 crashes two three months ago, and one 18 months ago.
70-100-25 135/88 3 hours after flying.
Just after 2 flights 74-108-25 144/98.

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7. M_____R.G.Lt.19 7/12 (90 Home hours. 19000,10000, wounded 6 mos.ago.
(60 France First 9 hours flying since wound
Soon after flights, 90 (SI) BP 148/92 80-130-90 (then S I)
Just after 2 flights 1500 = ¾ hr. Diffuse cardiac pulsation
667 (SI) -84-90 vol.small. tension high and maintained 160/105
Reduced flying to 1 hour daily ordered.
Next morning after rising 60 reg.(standing)70-106-75 Reg.
138/85.

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8. F----- H.S.Segt.24. 250 hours. 21000,16000. Fainted in air at 14000
France 75 hrs. off 10 months from flying.
Holds breath 33. Bursting sensation.
3 hrs. after 3 flights = 84 (678786) -104-25 irreg. Regular for 10 sec.after exercise.
140/90
Just after 3 flights = 786565456 -72 irreg - in 45 sec. =
655666455 127/90
Some hypertrophy of heart.

Max. ht. av. ht. Remarks.

9. G---- W.C.Lt. 23. 150 hrs. 10000, 6000. Crashed badly
France 50 hrs. Hospital 6/12

(After 1st F. for 7/12 1000 ft. 20 min. as observer.
(4 minutes afterwards 565666-110-85 (SI) 120/78
Flown other 15 hours as pilot.
1½ hours after 3 flights 67677-108-85 112/78

Number. Name. Rank. age. Hrs.flying. max.ht. av.ht. Remarks.

10. W------H.W.Serg.28. 85 hrs.flying
Egypt. 10000 ft.6000 ft. 12 yrs.service
Malaria, Dysentery.
Crashed $\frac{9}{12}$ ago.

(After resting 3 days save for 12 min.flight
(12 hours ago = 6776777 (SI) -110-after 2 min.= 898998
vol.small 145/98
Crashed badly D H 6 17/10/18 went up as passenger 1 hour afterwards.
Test 29/10/18 = 72-120-96 128/86.
After 1 flight P = 108. After 2 flights = 90-108-65
136/96 Respirat.20

age. Hrs flying. max.ht. av.ht. Pulse &c.

11. B----M.J.M. Capt. 28. 1500 19000, 10000, 72-116-40
(France $\frac{8}{12}$) Remarks. 126/80 Blood pressures.
Neurasthenia a year ago.
Dilated stomach.
After flight before breakfast.
On twin engine Kangeroo P = 96. after 4 min. 90
in 10 seconds more 108
in 6 min. 88
Rate fell after deep inspiration
Slight.irreg. 7878688.
130/88

Hrs flying. max.ht. av.ht. Pulse &c. Blood pressures.

12. W----L.S. Lt.25 300. 12500, 5000. 60-90-30 Reg. 123/74
(France 250)
After flight before breakfast 88 & after 4 min.72-96-25 Reg.
114/76.

Hrs flying. max.ht. av.ht. Pulse &c. Blood pressures.

13. P----F.L.Lt.20. 200 15500, 5000. 72-84-12 Reg. 116/71
Egypt. Dysentery
Diphtheria.
After 1½ hours flying P = 100. After 4 min.84-110-75 (S.I.
116/75.

Hrs flying. max.ht. average height. Remarks.

14. G----A.H.Capt. 23. 900 hours) 18000 varies. 4 days crash at sea a year ago.
France 75) hours
Sea 100) hours.
After flight P - 108; in 5 min.= 84-124-in 3 min. = 8,10,9,8,8,10,9.
in 5 min. = 78 (S.I.)
upstroke abrupt.
126/90.