While one may in this way pick out special mental characteristics essential for the successful aviator and exclude anyone specially deficient in any one of them from air service, one must at the same time recognise that there is an infinite variety in the temperaments and mental constitutions of men, and that therefore no hard-and-fast line can be drawn. Just as there are many types of aeroplanes, each more or less useful for a particular purpose and in each of which the designer has had to compromise between the lift and the drift or the speed and the climb, so the pilot of cool judgment, though somewhat slow and deliberate in action, is suited for one service, while the quick, high-spirited, though somewhat emotional, erratic type may be chosen for another, such as the fighting scout. In both cases they may be a compromise in comparison with the ideal pilot.

Aviation requires, above all things, a strong, tough nervous system that can withstand all the stresses and strains, both mental and physical, in the air, that controls well the vital organs, reacts to external conditions quickly and accurately, and is not affected detrimentally by emotional disturbances. Just as one uses the term "physique" to the general development of the body and one speaks of good or bad "physique," so I would suggest the expression "nerve physique" to describe the general tone of the nervous system. There is a general consensus of opinion that a good "nerve physique" is found in young men who have led an outdoor life. Outdoor pursuits not only tend to develop such a nerve physique, but also offer in many ways the best training for aviation by developing their power of observation and quick response, as in the case of riding, shooting, hunting, and, though perhaps in a less degree, almost any sport.

The Fighting Spirit.

It has been suggested that the best type of fighting scout must possess the fighting spirit and be capable of developing the emotion of anger with his foe—in other words, must be able "to see red." With this I disagree. In conformity with what I have already said in regard to the emotions, it is my firm conviction that a pilot requires to be as free as possible from any emotional disturbance, whether of fear or anger, and that if he "sees red" his judgment is liable to be clouded and faulty. I must admit that this is to some extent an armchair opinion, but I have sat in a machine taking part in a scrap many times, and I think I have sufficient imagination to fill in the rest of the picture; and as it appears to me, the fighting scout requires the hunting instinct, with all the judgment, cunning, and zest to down his prey, rather than the fighting spirit of "seeing red." It is the man who goes forth in this spirit, aggressive but cool, that is most likely to carry through those nice turns and twists in the right direction and at the right moment that seal the fate of his adversary and render him the victory.

Alcohol and Tobacco.

Then there is the much-vexed question of alcohol and tobacco. From what I have already said it will be obvious that it is not only necessary for the pilot to possess a good nerve physique, but to keep it up to pitch, and any excess reacts deleteriously upon the nervous system more than on any other part of the body, more especially excesses in drugs such as alcohol and tobacco. Nothing will better contribute to the restriction of these than the ample provision of facilities for out-of-door sports. More especially I would plead for the provision of horse-riding, both for pilots and pupils under instruction. Horse-riding is one of the best physical exercises, and probably comes nearer to controlling an aeroplane than any other ground occupation. I would suggest that every aerodrome should have its stables as well as its hangars, and what better place than an aerodrome for polo? Furthermore, there is a much greater inclination to indulgence as a means of combating conditions of stress or "staleness" from long service. In my opinion no one should be engaged in continual flying, whether as instructor, ferry pilot, or on active service, for more than three months without a complete rest of at least a couple of weeks.

WATER-SUPPLY OF KARACHI.—The President of the Karachi municipality states that ample supplies of water are now available and that the new wells provide a reserve of supply up to twice the consumption even of the period immediately preceding the monsoon.

SOME SIMPLE TESTS OF PHYSICAL EFFICIENCY.[1]

BY MARTIN FLACK, C.B.E., M.B., B.CH. OXON.,
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I WISH to bring to notice some quite simple tests which I believe will be of use in determining the physical efficiency of an individual. I am approaching this problem from the point of view of a physiologist, and the tests have been devised to show the physical condition, not particularly of any one system, but rather of the individual as a whole.

The procedure has been to select for examination, as far as possible, healthy controls. In this connexion officers of the R.A.F., who have made good and who have been chosen by their commanding officers for their efficiency in flying and in fighting, have been examined and standards have been set, provisionally of course, and may have to be altered. On the other hand, a number of officers who have broken down for some reason or other have also been examined, and the results obtained compared with these healthy controls.

I would like to emphasise that these tests are not designed to supplant the work of the clinician in any way, and when a man is reported as physically unfit on these tests it does not mean that the work of the physician is finished, but that it is beginning. If the subject does not come up to the standards on being overhauled by the applied physiologist, then the psychologist, neurologist, cardiologist, or general physician will find something is wrong with him. These tests give indications for such overhaul.

The chief point in connexion with these tests is the technique. This is important because, if adopted, it is essential that all the tests be carried out in the same way on all occasions, so that various medical officers may apply them to the same individual at different times. It has been suggested in regard to the care of officers in the R.A.F. that preventive treatment is best. If officers were periodically subjected to these tests by medical officers at different stations they would carry with them a certain definite amount of information as to their physical condition at the time of the various examinations.

Description of Tests.

The first test is the *response of the pulse to exercise.*

It is of importance the way this is done. I would point out that there is no limit to the number of times a man may be asked to stand upon a chair, but the technique here suggested is suitable to the examination of a large number of subjects. The test is that a man shall lift his body weight through a definite height five times in 15 seconds. The rate of increase in the pulse as a result of the exercise is noted and the rate of return to the normal, the pulse having been taken standing immediately before the exercise. In this way uniformity of observation is obtained. Hitherto, if ten medical officers were examining candidates, some might order the candidates to touch their toes four times: the enthusiastic man would do so in 5 seconds, the lethargic man in 20 seconds. The test as devised is an effort to set a level basis for all candidates. Preferably the sitting rate of the pulse is first taken. The pulse-rate is then taken standing. If the rate is unsteady it should be counted in periods of 5 seconds until a steady rate is obtained.

The candidate is then put through a regulated exercise, which should be carried out as follows: Standing before a chair, he places one foot upon the seat of the chair and steadily raises his whole body to the height of the seat five times in 15 seconds, one foot being retained on the chair throughout. The examiner should regulate the speed and rhythm in the following way: Standing beside the candidate, holding the wrist, with his fingers on the pulse, the examiner swings the arm forward and backward to indicate the time of raising and lowering the body.

The subject still standing, the examiner then counts the pulse in 5-second intervals, and notes the acceleration and the time taken to return to the previous rate. In a good subject the increase of rate is about 20 and the time of return to normal 15-25 seconds. If the time of return exceeds 30 seconds it is suggestive of cardio-vascular inefficiency.

The breath-holding test.—Test No. 2 is quite simple, and consists in getting the subject to hold his breath without any preliminary deep breaths.

[1] A synopsis of a paper read before the Epidemiology and State Medicine Section of the Royal Society of Medicine on Jan. 10th, 1919.

I would insist upon the actual lines on which the test is laid down being followed: A deep expiration followed by the filling of the lungs, clipping the nose, holding the breath as long as possible. The significance of the test should not be mentioned to the subject. He should just be told to breathe out and breathe in as far as possible and then to hold the breath. At the end of the test the question should be asked as to what are the sensations experienced by the subject during the holding of the breath.

The test was originally designed to show whether there was oxygen want, and I still believe the test does show the subject who would suffer from oxygen want. From my experience I found that people who were likely to suffer from "oxygen want" would give up after a very short time in holding the breath and would almost invariably return an abnormal answer. A normal answer would be that the subject "had to give up," "felt he would burst," an abnormal answer that the "blood rushed to the head," "things became blurred," &c. The test, however, has other significance. The man without resolution, for example, will give up early.

As originally shown by Dr. Leonard Hill and myself, if a man who had held his breath in this manner then takes a lungful of oxygen instead of a lungful of air, the time of holding the breath will be increased from 1½ to 2½ times as long. Therefore what one breaks down from is, in the first case, oxygen want, because when one breaks down in holding the breath on oxygen the symptoms are quite different, and are those due to CO_2 excess—headache, sweating, &c.

Another interesting point in this connexion is this: It is known that the power to hold the breath is greatly diminished at altitudes. Therefore a man who can hold his breath a long time at ground level without discomfort has greater room for diminution in his power to hold his breath than a man who can hold his breath a short time at ground level before discomfort occurs. An efficient man at altitudes is a deep breather, whereas the man who is inefficient is a panter. Figures in regard to holding the breath were worked out in the first instance on 40 successful pilots, all picked out by squadron commanders, or by the Admiralty, or the R.F.C. as being quite able. The time the breath is held averages about 69 seconds and the sensations experienced normal. The vital capacity averages at 3800 c.cm., with a minimum of 3400 c.cm. in efficient fliers. In a number who were sent up for medical boarding the breath was held for not more than 45 seconds, usually much under, and in most cases the answers recorded were not normal.

The deduction, then, is that the breath-holding test on an individual would be an idea as to whether he was likely to do well in the air. As the results appeared to show that poor breath-holders could not last in the air, the breath-holding test was adopted at the R.A.F. Commissions Board. In my opinion it is preventing people going into the Air Force who would not do well. The question of "oxygen want" is a matter for serious future research, and in peace-time one will be able to do such research on a more scientific basis.

The third test is a combination of the first two tests.

Having got the pulse response to exercise and the time of the breath holding test, then the time the breath can be held after exercise can be taken. In the unfit the breath-holding power comes right down, probably by 30 seconds. The fit man may possibly hold his breath almost as long as before, but will not have a fall of more than 20 seconds. The man out of condition gives a big fall in time after exercise.

The standard for admission for the ordinary breath-holding test was set at 45 seconds. Under 45 seconds should cause the subject to be looked upon with suspicion, and probably graded in regard to the height to which he should go.

The vital capacity of pilots —The minimum in the table of successful flying officers is 3400 c.cm.

I suggest that the use of a modified gas-meter is the best way of measuring vital capacity, and preferably one made by an English firm; this has the great advantage over the German model, from which it was copied, that its capacity cannot easily be overshot. Among officers who had broken down a great number of those tested were under the minimum of 3400 c.cm., but it was subsequently found that this was due to flying stress, some having a vital capacity of only 2800 c.cm.

Captain H. C. Bazett, M.C., R.A.F.M.S., has shown that in addition to these tests, if the respiration-rate is multiplied by the ventilation per minute and divided by the vital capacity, it is a very good indication of the power of a pilot to fly. A figure below 30 is good, a figure above 30 poor. A test like this will be of value for the selection of the high flier.

U tube tests.—The apparatus for the next test I wish to describe is a U tube manometer filled with mercury, with the scale moveable.

The test is a measure of the tone of the abdominal wall. The subject is asked to blow up steadily the mercury column as high as possible. The number of mm. Hg blown is recorded. If for any reason it is suspected that the subject is not trying, he is asked to try again with the scale of the manometer turned away. There should be but little difference from the previous reading, and in such a case encouragement may cause the subject easily to surpass his previous effort. He is then asked to try again while looking at the column. If he is not trying he will surpass his first effort, which he saw.

The sixth test is another test with the U tube manometer. This test is performed as follows:—

The subject is asked to empty the lungs, fill up, blow the mercury to the height of 40 mm. and hold it there, without breathing, for as long as possible. The nose should be clipped. A valuable adjunct to this test is the behaviour of the pulse during the time the mercury is being sustained. It is counted during each period of 5 seconds that the mercury is sustained. Starting at the 5th second in the normal individual there is generally a slow, steady rise in the rate of the pulse or a fairly marked rise which is sustained most of the time. For example, the pulse-rate may rise gradually from 72 to 96 or 108, according to the time the breath is held, or it may rise at once from 72 to 96 or 108 and be sustained there. A large rise in rate—e.g., from 72 to 132 or 144—is unsatisfactory. In cases of flying stress a characteristic response is for the pulse to jump up to a quick rate during the 5th to the 10th or 15th second and then to fall away in rate to normal or even below. Such a response is as follows:—

Normal at start, 84; 5th–10th second, 144 (sometimes almost impalpable); falling away (say 20–25 seconds) to 72 or even 60. Such cardiomotor instability is frequently associated with flying stress and is indicative of a need of rest. In any case the subject is generally not in a condition to be allowed to continue to fly. Other points in the examination should, however, be taken into consideration.

The averages obtained for these tests from some selected flying officers were:—

Expiratory force ... ... 112 mm. Hg.
Mercury held ... ... 52 sec.

It is suggested that they should all conform to the minimum standard, and preferably to the average standard.

Results of Tests in Successful Pilots.

Table I. gives a synopsis of results obtained from various sources.

TABLE I.

Subjects.	Number examined.	Breath held.	Vital capacity.	Supplemental air.	Expiratory force.	Sustaining 40 mm. Hg.
		sec	c.cm.	c.cm.	mm. Hg.	sec.
Fit instructors...	22	67*	4062	1620	112	52
Ditto	—	46†	3300	1000	80	43
Home Defence pilots	24	72	3940	1496	119	50
British candidates...	23	69	3823	1590	106	52
U.S. candidates	7	66	3814	1386	116·4	53·5
Delivery and test pilots ...	10	57	3620	1050	108	40
Pilots returned for rest ...	17	57	3897	1423	95	40
Pilots training for scouts ...	15	62	3820	1433	96	49
Pilots taken off flying through stress	27	49	3480	1134	74	25

* Average. † Minimum.
One or two suffering from stress are included among the Home Defence and test pilots.

Practically all the cases examined in hospital fell below the standard. There was one very interesting case, who came with a letter to the hospital and was examined. I told him he seemed very fit, and on reading the letter afterwards found he was still doing very good service in France and had not really come for treatment to the hospital, but for especial examination on account of his fitness and meritorious flying service. Another was a one-eyed man, whose only disability was that he was nearly blind in one eye. I could find nothing wrong by these tests. Many other instances could be given.

Results of Tests in Rejected Men.

Having found standards from the examination of successful pilots, I went to the Commissions Board and examined a number of rejects as the result of the routine examination there. The results are appended in Table II.

It will be seen that except one man, who was unfit on the vital capacity test, every man was rejected by the fatigue

TABLE II.

No.	Age.	Breath held.	Vital capacity.	Supplemental air.	Expiratory force.	Sustaining 40 mm. Hg.	Remarks.
		sec.	c cm.	c.cm.	mm. Hg.	sec.	
1	17 11/12	55	4200	1300	80	42	Rejected.
2	17 11/12	84	4300	1800	60	25	,,
3	18	53	3700	1700	55	32	,,
4	18	66	3800	1650	130	30	,,
5	17 11/12	53	2800	1000	60	25	,,
6	18	48	3600	1650	70	27	,,
7	17 11/12	44	3400	1600	120	35	,,
8	18	85	2750	900	100	28	,,
9	17 11/12	71	2400	1050	100	50	Unfit by V.C. standard.
10	19	50	3100	1000	60	20	Rejected.
11	19	63	—	—	60	40	,,
12	19	42	3800	—	40	33	,,
13	23	42	4200	—	60	25	,,
14	18 1/12	64	—	—	60	33	M.O. says fit, but does not like him. Referred by assessor.
15	22	61	4100	—	100	30	Assessor did not like the look of them.
16	23 2/12	63	4300	1800	60	35	
17	21 6/12	55	4100	1700	80	37	History of migraine; referred by assessor.
18	18 2/12	48	3800	1700	100	35	
Average		58	3650	1450	77	32	—

test. Some of these were people whom the medical officer was in doubt about and had sent them for examination, saying he had to pass them fit, but did not like the look of them, though he could see nothing wrong with them.

Importance of Using Tests in Combination.

I do not suggest that any one test should be taken in examining a candidate, but that they should be used in combination, and the instructions are that they should be used by the assessor for his guidance.

The results obtained by Lieutenant-Colonel J. L. Birley from pilots who had been fighting for several months and were being sent home for a rest support the results obtained by the U tube test. These pilots were fairly up to the average standard. On the other hand, cases who had been concussed were below average. One has here, therefore, a valuable test for the effect of crashes.

Lieutenant-Colonel Birley obtained from these found permanently unfit for flying the following results:—

Average expiratory force ... ... 76 mm. Hg.
Sustaining 40 mm. Hg. ... ... 28 sec.

As I have stated, it is the combination of the tests, however, that is important. The average standards are given in the following table:—

	Average standard.	Minimum standard.
Breath holding	69 sec.	..... 45 sec.
Vital capacity	3900 c.cm.	..... 3400 c.cm.
Expiratory force...	110 mm. Hg.	..... 80 mm. Hg.
Fatigue test (U tube)	52 sec.	..... 40 sec.
Pulse response to exercise—		
Increase per min.	12–24 beats	..... 36 beats
Return to normal	10–20 sec.	..... 30 sec.

Practical Value of the Tests.

I believe that every pilot could be overhauled by the breath-holding, expiratory force, and U tube tests and a station graded according to its efficiency. As a matter of fact, this has been done. At a certain fighting station the medical officer found that the average for all the pilots by these tests were—

Breath-holding ... ... 65 sec.
Expiratory force ... ... 103 mm. Hg.
Sustaining 40 mm. mercury ... ... 67 sec.

He picked out one officer as being badly off colour, a pilot with 250 hours' experience. The pilot soon after went for a flight, there was nothing wrong with the machine, but the pilot lost contr l, crashed, and was killed. His results for the three tests just previously were—

Breath-holding ... ... 33 sec.
Expiratory force ... ... 95 mm. Hg.
Sustaining 40 mm. Hg. ... ... 22 sec.

The medical officer had suggested that this officer should not be allowed to fly. This unfortunate incident so impressed the commanding officer that the medical officer was asked every week to grade the pilots. It soon became evident that the officers who were picked out by the commanding officer or senior flight officer for special duty were practically always those graded by the tests as extra fit. It would seem from this that the selection of pilots for special work by these tests if adopted would be of great value. The commanding officer eventually made a rule that if an officer did not come up to the standard of the tests he must not be placed in charge of a machine. The medical officer then gave him instructions for making himself fit, and he was told if he was still unfit by the tests in a fortnight he would go up for a board, and possibly be found unfit for flying. This was actually done in one or two cases. By this means the efficiency of the station was greatly increased.

I suggest that these tests would also be of value for measuring trench fatigue, industrial fatigue, and fatigue in women workers; also for the grading of people for positions of trust, such as special motor drivers and members of mine-rescue teams. With special standards set according to age, they would possibly also be of value to educational authorities in assessing how children are maintaining their physical efficiency.

THE TREATMENT OF VENEREAL DISEASE.

BY SIR ARCHDALL REID, M.B. EDIN.;
AND
P. HAMILTON BOYDEN, M.D. EDIN.,
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EVERY great war has been followed by an increase in venereal disease, so marked that on occasions it has amounted to a pestilence. Unless timely sanitary precautions are taken the greatest of all wars is unlikely to furnish an exception to the rule. We think it desirable, therefore, to give an account of an essay in preventive medicine which, as may be judged from the following, achieved considerable success.

One of us (A. R.) has been in medical charge of a rapidly changing body of men generally numbering about 2000. Up to the end of 1916 venereal disease was common among them in spite of numerous moral lectures and in spite of adequate provision of what is known as "early treatment"—that is, disinfection after the "contact" has returned to quarters. At the beginning of 1917 a new system was instituted. The men were instructed to disinfect themselves immediately after danger had been incurred—just as a surgeon would disinfect his hands. This procedure is what is known as prophylaxis. It differs from early treatment merely in that the man carries the disinfectant and uses it immediately. Each man who applied was given an ounce of solution of potassium permanganate (at first in a strength of 1 in 2000, later in a strength of 1 in 1000), a small swab of cotton-wool, and careful directions. Potassium permanganate was chosen merely because it happened to be the most accessible disinfectant. The rationale of the procedure was fully explained, so that on an emergency the man could purchase the materials from any chemist. During 1917 and 1918 about 20,000 men passed through the station, and among them precisely seven cases of venereal disease occurred, six of gonorrhœa and one of syphilis. Of the six cases of gonorrhœa, two only were contracted by men on leave, in each case from the man's own wife. Two of the others were drunk and took no precautions. The fifth man was infected the night he arrived, and he also, being unaware of the system, took no precautions. The sixth man practised early treatment an hour after intercourse. The man who acquired syphilis also carried no disinfectant, and used it (permanganate and calomel) two hours after intercourse. He had a long prepuce, and therefore a sensitive gland, and probably did not—probably could not—rub in the calomel vigorously.

The other of us (P. H B.) commenced prophylaxis against venereal disease in the Royal Navy in 1907. Some 18 months ago he took over medical charge of an establishment numbering