

LILIENTHAL'S EXPERIMENTS ON FLYING.

THERE are many of us, no doubt, who are watching with great interest the experiments of Herr Otto Lilienthal in his "Fliegesport and Fliegepraxis." These

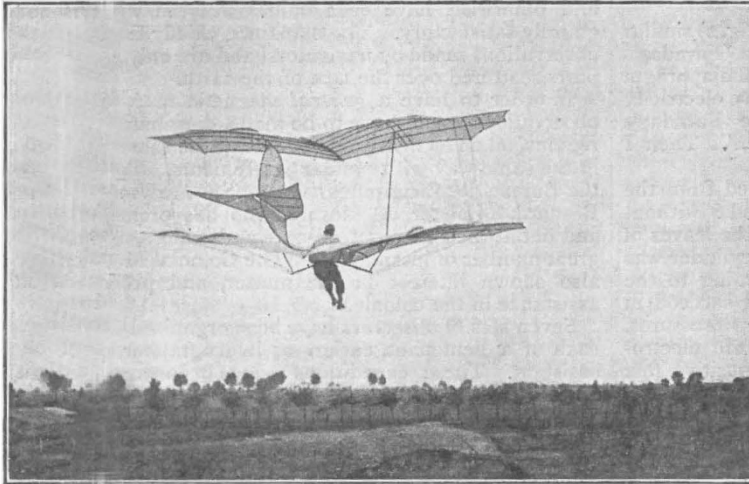


FIG. 1.

"Uebungen," which he is making from a hill thrown up in the neighbourhood of Berlin, have, from the very beginning, been rewarded with a distinct success; and it seems that, given time, he may present us, if not with a method of flying, then with an approximation to it, which perhaps at some later date may be more fully developed.

His experiments have, up to the present, shown that, by means of such an apparatus as he employs, fairly long flights may be indulged in with perfect safety, provided the operator does not attempt to do too much

on this subject, and it was then mentioned that falls must be expected in the preliminary trials, until the operator becomes accustomed to the many new conditions which make themselves apparent at every step, before they can be mastered instinctively.

Similar difficulties have, for instance, to be contended with when learning to ride a bicycle. The beginner is at first unable to keep his equilibrium, and so wobbles here and there with the loss of much power, until he eventually finds himself on the ground. This is simply because he is doing something unusual, and is not accustomed to the new conditions. An adept rider, on the other hand, never thinks of the possibility of falling, and quite unconsciously keeps his equilibrium without any exertion or loss of power on his part. So it is with this sailing machine, and it is only with practice that the required head can be obtained and success assured.

In the above-mentioned article, the machine Lilienthal employed consisted of a wing-shaped framework of a slightly curved nature, the advantage of the curved form, both as regards the amount and direction of the resistance, having been previously proved. The tail consisted also of two plane surfaces, one being at right angles to that of the

horizontal framework, and lying in the direction of movement, and the other more generally in that horizontal plane, but capable of movement about a fixed point in it.

With the wind blowing at a moderate and more or less constant rate this machine has been found to be very satisfactory, and flights of comparatively long duration have been made with it.

Lilienthal's ambition, however (*Prometheus*, No. 322, p. 148), does not end here; but he looks further ahead than this, and wishes to be able to practise in such strong winds that he can be carried along with them. He, however, remarks that the size of the apparatus puts a certain limit to this; for if the spread of the wings be too large, then the whole arrangement becomes extremely awkward and hard to manage.

Up to the present, although he has practised in moderately rough weather, and had to perform fantastic feats in the air to keep his equilibrium, he has been fortunate in obtaining on nearly every occasion a safe landing. Experience has, however, convinced him that before trying to compete against strong winds in future, he must modify his machine to some extent, in order to make it easier to handle under these more trying circumstances.

To this end experiments were made with wings of various shapes; but these were given up, as it was found that the employment of a new principle, suddenly discovered, gave the required results with satisfaction that was scarcely dreamt of. The idea consisted in using, instead of one large framework covered

with some light material, two smaller ones, placed parallel one above the other. These, of course, would, when sailing through the air, have a similar lifting effect; but, besides affording a simple means of increasing the sail-

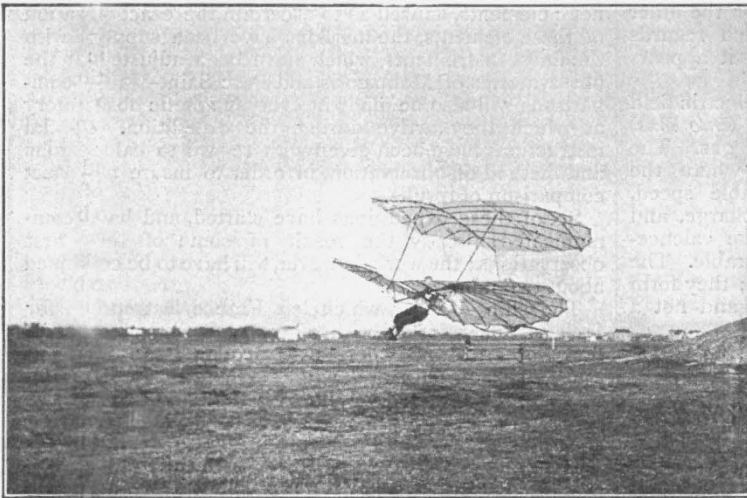


FIG. 2.

at the beginning, but contents himself with mastering the first elements of sustaining his equilibrium.

In a previous article (*NATURE*, vol. li. p. 177), a short account was given of Herr Lilienthal's earlier experiments

area without adding to the breadth of the machine, they would decrease very considerably the difficulties, referred to above, with respect to the management of the centre of gravity.

On this principle, Otto Lilienthal constructed his new double-apparatus (Fig. 1), the appearance of which will be noticed from the accompanying illustrations. Each separate surface has an area of nine square metres; thus he is able to employ the very large carrying surface of eighteen square metres with a breadth of only five and a half metres. The upper surface, which is placed at a distance of about three-quarters of a wing-breadth above the lower, proves in no way a disturbing factor in the machine, as might at first be supposed, but develops simply a vertical lifting force. It may be remarked that this double-surface machine is managed in exactly the same way as the single-framed one.

From Fig. 2 it is easy to obtain a good idea of the arrangement adopted, by which the upper surface is fixed rigidly to the lower one by means of two rigid stays, the whole surface being held in position by means of thin wires.

With this new apparatus, Otto Lilienthal has already found that a step in the right direction has been made. The energetic movement of the centre of gravity, and the consequent more safe management of the apparatus, has led him to practise in winds blowing at times over ten metres per second. "These experiments," he says, "have given the most interesting results that I have arrived at since I began." With a wind velocity of six to seven metres per second, the sailing surface of eighteen square metres carried him against the wind in nearly a horizontal direction from the top of the hill, without even having to run at the start, as is generally necessary. More interesting still, is it to learn that, with stronger winds, he allows himself to be simply lifted by the wind from the hill-top, and sail slowly against it. Fig. 3 is such a case in point. The same illustration also shows how strong at times may be the side-motion, the operator having to considerably alter the position of his centre of gravity to retain his equilibrium.

As experiments have shown, the sailing path is directed strongly upwards by increasing wind force, and this fact causes him sometimes to be higher in the air than he was at his original starting-point. In this position his apparatus has occasionally come to a standstill; and this leads him to make the following interesting statement: "At these times I feel very certain that, if I leaned a little to one side, and so described a circle, and further partook of the motion of the lifting air around me, I should sustain my position. The wind itself tends to direct this motion; but then it must be remembered that my chief object in the air is to overcome this tendency of turning to the left or right, because I know that behind and under me lies the hill from which I have started, and with which I would come in rough contact if I allowed myself to attempt this circle sailing. I have, however, made up my mind, by means of either a stronger wind or by flapping the wings, to get higher up and further away from the hill, so that, sailing round in circles, I can follow the strong uplifting currents, and have sufficient air space under and about me to complete with safety a circle,

and, lastly, to come up against the wind again to land."

It may be remembered that Lilienthal has previously employed some mechanical aid, such as the flapping of the wings: an illustration of the apparatus so arranged was given in the article already referred to above (NATURE, vol. li. p. 178). Perhaps he will apply the same arrangement to the lower framework of his present apparatus, and thus accomplish the end he is wishing to attain.

One can quite understand that sailing against the wind is one thing, and with it another. In the latter case, since the framework is inclined slightly upwards in the direction of motion, the wind would meet the sailing surface from above and shoot the operator, arrow-like, to the ground if he were unable to come up again quick enough to the wind. That such circle sailing will be most probably successfully accomplished by Herr Lilienthal seems certain, but the first few attempts may prove, perhaps, rather rough.

The recent experience of Otto Lilienthal has thus shown that by means of his new apparatus a very close approximation to flying has been attained.

Should he, however, find that the accomplishment of

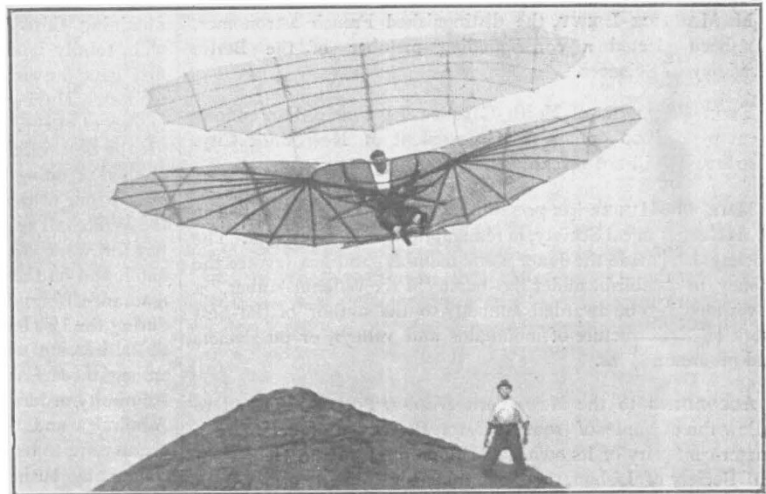


FIG. 3.

circling is not attended by any great difficulty, and there appears no reason why it should, then there seems no doubt that an important step will have been made, and the future development of this *Fliegesport* will depend nearly directly on the *Fliegepraxis*.

It is interesting to notice that in America this Lilienthal-method is about to be tested. We have in the British Isles already a follower in Percy S. Pilcher, of Glasgow University, but his experiments at Cardross, in Dumbartonshire, have not as yet proved very successful, owing to the wings of his apparatus being too much inclined. He is, however, busy with the construction of a new machine, which will have a sail-area of 300 square feet (= 27.6 square metres). The experience of Lilienthal has shown, however, that with such a large expanse this machine will only be able to be used in moderate winds with safety. If its construction be not already too far advanced, it would seem advisable to add the second or upper surface, since its presence has been shown to be attended by greater stability and easier management of the whole apparatus.

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