skeleton a live performer is placed. In this act there is no dissolving effect; by turning up the lights at the side of the stage any object desired and performers dressed as spirits are made to appear upon the stage, being reflected from the glass plate. The spectators simultaneously see their companion sitting at the table and the reflections of the ghosts apparently executing their movements about him.

From the scientific as well as scenic aspect, the exhibition is most interesting, and to one who knows how it is performed, the interest is vastly enhanced. To properly enjoy it, the stage position should be taken during one or both performances.

The Roentgen rays are utilized in the advertising matter also, although John Henry Pepper, of the old London Polytechnic, may lay some claim to discovering the full utilization of the rays actually used in the Cabaret du Neant.

A MINER'S TOOL AND CANDLESTICK.

For holding a miner's candle in place on his cap, or for attaching the candle to the walls of a mine, the device shown in the accompanying illustration has been devised, the same implement being also adapted to cut fuse, crimp cartridges and tamp blasts. The improvement has been patented by Adolph O. Sjoholm, of Negaunee, Mich. The device has a nearly circular handle, on a screw-threaded projection of which is mounted the cartridge crimper and fuse cutter, the rotative member of which lies clamped in folded position when not required for use. A sharpened point projects from one side adapted to be inserted in a crevice of the wall or in a timber to hold the candle, a thumb nut then locking the device in the desired position. A screw-theaded sleeve on the body of the device supports a hook adapted to be inserted in the miner's cap or hat, and the hook is held in position by engagement with a bent spring metal band which forms a socket to receive the candle. In the opposite end of the handle is a socket piece adapted to receive and hold a pin or peg of wood or other soft material to be used for tamping charges, the peg being swung back into the handle when not required for use. The whole device may be folded to take up but little space, when it may be conveniently carried in the pocket.

PRACTICAL EXPERIMENTS FOR THE DEVELOPMENT OF HUMAN FLIGHT.

BY OTTO LILIENTHAL.

Whoever has followed with attention the technical treatises on flying will have become convinced that human flight cannot be brought about by one single invention, but is proceeding toward its perfection by a gradual development; for only those trials have met with success which correspond with such a development. Formerly men sought to construct flying machines in a complete form, at once capable of solving

SJOHOLM'S MINER'S TOOL AND CANDLESTICK.

the problem, but gradually the conviction came that our physical and technical knowledge and our practical experiences were by far insufficient to overcome a mechanical task of such magnitude without more preliminaries.

Those proceeding on this basis therefore applied themselves, not to the problem of flying as a whole, but rather divided it into its elements, and sought first to bring a clear understanding into said elements which should form the basis of final success. For example, take the laws of atmospheric resistance, upon which all flying depends, and regarding which, until very recent years, the greatest uncertainty has existed; these have now been defined to such an extent that the different phases of flight can be treated mathematically. Besides which, the physical processes of natural flight of the creatures have become the subject of minute investigation, and have in most cases been satisfactorily explained. The nature of the wind, also, and its influence on flying bodies, have been carefully studied, thus enabling us to understand several peculiarities of the birds' flight hitherto unexplainable, so that one can apply the results thus obtained in perfecting human flight.

The theoretical apparatus needed for the technics of flying has been enriched so much by all these studies within the last few years that the elements of flying apparatus can now be calculated and constructed with sufficient accuracy. By means of this theoretical knowledge one is enabled to form and construct wing and sailing surfaces according as the intended effect renders it desirable.

But, with all this, we are not yet capable of constructing and using complete flying machines which answer all requirements. Being desirous of furthering with all speed the solution of the problem of flight, men have repeatedly formed projects in these last few years which represent complete air ships moved by dynamos; but the constructors are not aware of the difficulties which await us as soon as we approach the realizing of any ideas in flying.

From a raised starting point, particularly from the top of a flat hill, one can, after some practice, soar through the air, reaching the earth only after having gone a great distance.

For this purpose I have hitherto employed a sailing apparatus very like the outspread pinions of a soaring bird. It consists of a wooden frame covered with shirting (cotton twill). The frame is taken hold of by the hands, the arms resting between cushions, thus supporting the body. The legs remain free for running and jumping. The steering in the air is brought about by changing the center of gravity. This apparatus I had constructed with supporting surfaces of ten to twenty square meters. The larger sailing surfaces move in an incline of one to eight, so that one is enabled to fly eight times as far as the starting hill is high. The steering is facilitated by the rudder, which is firmly fastened behind in a horizontal and vertical position. The machines weigh, according to their size, from fifteen to twenty-five kilogrammes (thirty-three to fifty-five lbs.) In order to practice flying with these sailing surfaces one first takes short jumps on a somewhat inclined surface till he has accustomed himself to be borne by the air. Finally he is able to sail over inclined surfaces as far as he wishes. The supporting capacity of the air is felt, particularly if there is a

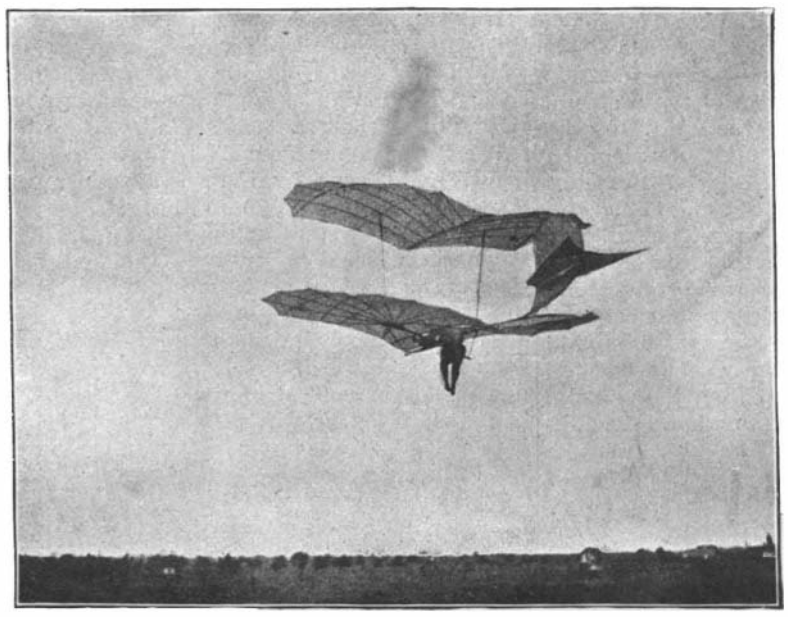

Fig. 1.

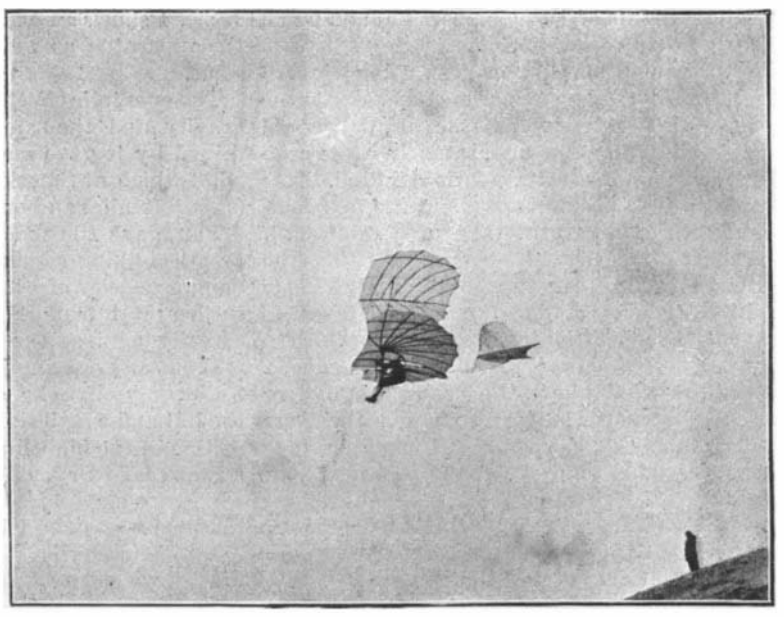

Fig. 2.

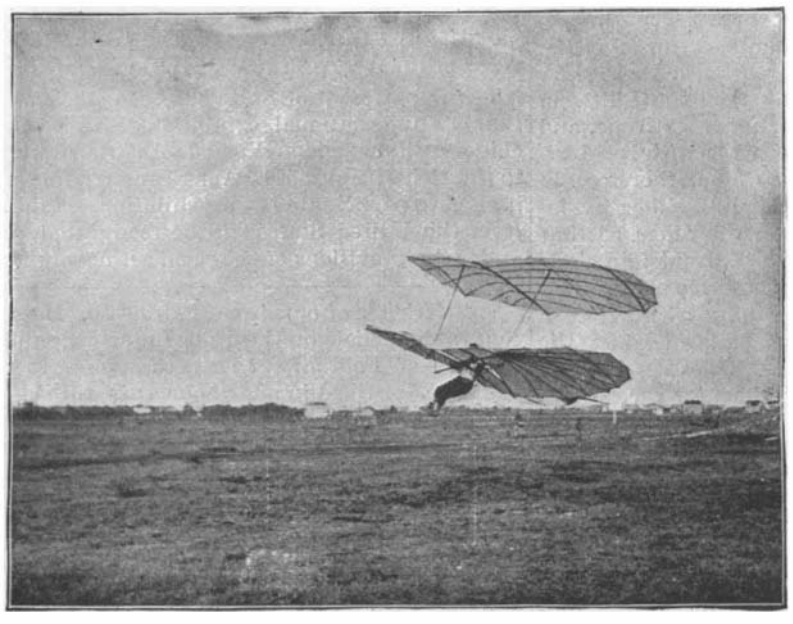

Fig. 3.

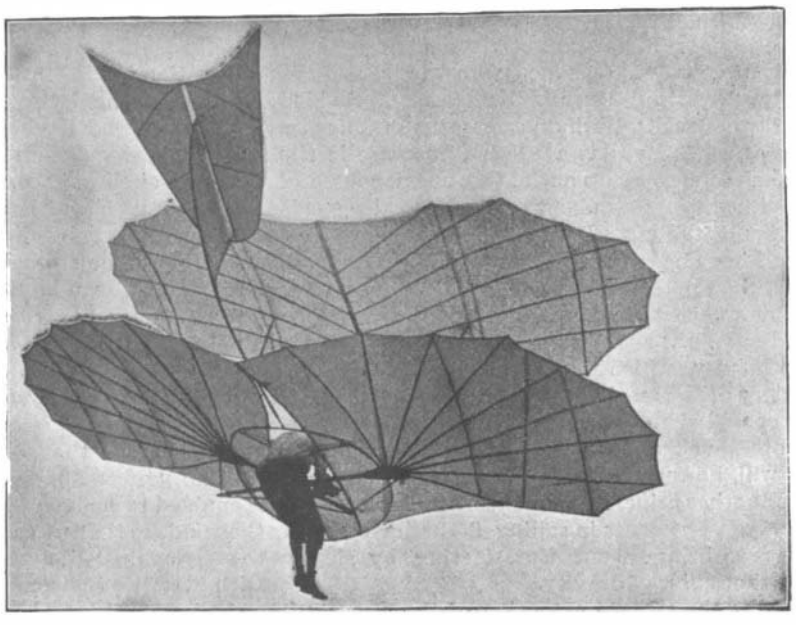

Fig. 4.

OTTO LILIENTHAL'S LATEST FLYING MACHINE.