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Herr Lilienthal Tells of His Inquiries in the Realms of Aviatus in His Efforts to Produce a Flying Machine.

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BERLIN, May 25 .- (Correspondence of The Hee.)-The experience of the century and more which has elapsed wince the epochmaking invention of Montgolfier has taught us that the balloon is of practical service only when confined. The whitns of the winds are too capricious to afford a frustworthy basis of procedure, and notwithstanding the expedients which the progress of science has made it possible to apply, all attempts to control a free balloon or to guide if in any given direction have thus far been unavailing, and we seem to be no nearer to a satisfactory solution of the problem than were our predecessors of hundreds of years ago. The attention of investigators has been diverted, therefore, to flying machines like Prof. Wilner's, and air-ships like Mr. Maxim's.

The first recorded attempt to reduce the principle to practice was made at Paris in in the year 1673 by a locksmith named Bessier, who constructed an apparatus with which he was able to sustain himself in the the air. The wing of a bird is divided into

Iteration
Iteration do no harm to amuse myself with such pas-times, but warned me earnesty against put-ting any money into them. A special com-mission of experts, organized by the state, had, in fact, laid it down as a fundamen-tal principle, once for all, that it was im-possible for a man to fly. German so-cieties, for the promotion of aeronautics did not then exist, and those subsequently formed wave devoted almost entitlely to the formed were devoted almost entirely to the interests of ballooning. I have always re-garded the balloon and the exclusive atgarded the balloon and the exclusive at-tention which it so long attracted as a hindranee rather than a help to the devel-opment of the art of flight. If it had never been invented it is probable that more serious investigations would have been prose-cuted toward other sulutions of the prob-lem. Since the time of Montgolfier nearly all practical efforts have been directed to the improvement of the balloom. But it has nothing in common with the birds, and it that we must take as our model and ar. What we are seeking is the

> ems. "Many important questions, however, are atili to be determined. The simple knowl-edge that the arching of the wings imparts sustaining power is by no means a dis-covery of the art of flight."

means of free motion in the air in any di-rection. In this the balloon is of no aid;

there is no relation between the two sys-

LESSONS FROM THE OARSMAN.

In order to appreciate the guiding motive of Herr Lilienthal's researches it is necessary to say a word on the means of flight with which nature has provided the denizens of

START FROM TOP OF A HILL

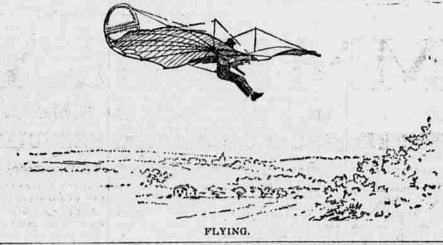
exemplar.

air during a brief flight, or, in other words, | three parts, corresponding to the shoulder-to descend gradually from an elevated | joint, the fore-arm and the hand fingers of point, with a gliding motion forward.

Another attempt was made in the year 1742 by the marquis de Bacqueville, a well known courtier of the time of Louis XV., who undertook, by the aid of a pair of wings which he had devised, to sail through the air from an elevated terrace of his hotel on the Quai des Theatins, on the left bank of the Seine, across the river to the garden of the Tuilleries. Crowds assembled to witness the experiment, which, if contemporary reports are to be trusted, would have succeeded if the marquis had not come into inglorious collision with a "wash-boat" or floating laundry, and broken his leg. In 1782, Montgolfier's invention of the balloon so captivated the imagination and engrossed the attention of all observers, that further researches into the phenomena of actual Gight were suspended for nearly a century. Herr Otto Lilienthal of Berlin, who has attained some celebrity as the "flying man," conducted a long series of experiments which have at length been rewarded with an encouraging measure of success. Herr Lilien-thal was born forty-six years ago in the antiquated little city of Anklam, near the Baltic coast of Pomerania, about sixty miles to the northwest of Stettin. A residence so near the sea afforded him in early life many an opportunity of prosecuting his favorite migrated with his younger brother, Gustay, his enthusiastic coadjutor in all his re searches in the domain of Aviatus, to Ber lin, where he established and is now con ducting a large manufactory of small steam engines, whose mechanical appliances furnish him with every facility for the con-struction of his flying apparatus. He resides, however, in the comparatively rural suburb of Lichterfelde, and his late experiments have been conducted chiefly in th ighboring localities of Steglitz and the Rhinower Bergen. He is an accomplished mathematician and a close observer of nature, and is besides endowed in large measure with that poetical instinct which nearly always constitutes one side of even the most practical German character.

the human frame. The two former, com-posed largely of bones and muscles and tendons, are comparatively heavy, and their rapid movement demands the expenditure of considerable physical force; the last consists almost entirely of "pen-feathers" or "pin-lons," which move to a certain extent automatically. In the larger birds-the "sailers" or the "soarers," which alone are to be considered here-the first two members, with their up-curved surfaces, furnish the sustaining power, and the last, being at the greatest distance from the shoulder, or axis of motion, the chief propulsion force. The construction of each member is peculiarly adapted to its special purpose, and it is this which Herr Lillenthal has endeavored to imitate.

An oarsman, on his forward stroke, opposes the blade of his oar almost perpendicularly to the resistance of the water; as he lifts it at the beginning of the backward stroke he "feathers" it, or brings it into a nearly horizontal position, so that its edge cuts the air. The pinlons of birds act in precisely



brella form universally adopted for the par-achute. Try to run with an open umbrella held above the head and slightly inclined backward and see what a lifting power it exerts. "I must confess," said Herr Lilienthal,

"that to my brother and myself, who hung our flat wings upon the wall twenty years ago, the obstinate adherence of nearly all experimenters to the aeroplane seems in comprehensible. "In my long intercourse with the air and the winds, in all their varying phases. I have learned that there is an extraordinary category of difficulties to be overcome. In my trials of wings moved by the feet, in my attempts to construct steam flying ma-chines, and in my experiments with me-chanical birds of every description I dis-covered how difficult it is to maintain a steady position in the air, independent of the caprices of the wind. I therefore, gave up for the time all efforts toward actual propulsion and applied myself to the dismprehensible

propulsion and applied myself to the dis-covery of the simplest form of wing that would enable me to sail steadily through the air on a gentle incline, and by practice to master the wind, that hereditary foe of all aeronaunts.

"I adhere firmly to my conviction that the wings must be slightly concave. That is the fundamental condition of success. The curve of a bird's wing is parabolic, but the simple parobola differs so little from the arc simple parobola differs so little from the arc of a circle that I adopted the latter curve as the more practicable, and the wings which I now use are in the main segments of a spherical surface. They are so con-structed that they can be folded together like the wings of a bat, and require very little storage room when not in use.

"It was only gradually that I arrived at the proper dimensions. One does not easily gain an adequate conception of the materi-ality of the air, and my apprehensions led me at first to make the wings too large. I me at first to make the wings too large. I found that the varying force of the at-mospheric currents, modified as they are by the undulations of the earth's surface, endangered my equilibrium in direct propor-tion to the spread of the wings. Those which I now employ are never more than iventy-three feet from the te tip, and I am twenty-three feet from tip to tip, and I am thus enabled by a simple change of posture so to alter the position of the center of gravity as to restore the equilibrium.

BALANCING PARADOXES. "There are limits also to the breadth of the wings, or their extension backwards. The operator must be able in a moment to transfer the center of gravity so far to the rear as to overcome the action of the alr, which might otherwise tend to throw forwards, and precipitate him to the earth. natural impulse is to stretch out the arms and legs in the direction of the fall, but it is one of the peculiarities of this mode of navigation that the movement must be in the contrary direction, or toward the upper side. The center of gravity is shifted to the one side or the other, forward or back-ward, and the pressure of the air, acting with greater force on the lighter and broader surface, soon restores the equilibrium. It is not easy to realize in practice at first, but after a short experience the movement becomes almost involuntary." It s exactly like "trimming" a boat; the weight must be thrown on the side which

ermost. "But is there not great danger?" I asked

'of a serious fall in such cases?" "No," replied Herr Lillenthal. "When there is no wind, the apparatus acts simply as a parachute. The pressure of the air is directly from benenth, and is equal on all parts of the under surface. I have more than once found myself in this position when I have utilized the speed attained in a gradual descent, in rising to a greater height, in order to soar over some obstacle like a tree, or a crowd of people. Under favorable circumstances it is easy to mount to a height even greater than that of the starting point, but the forward motion is thereby partially or wholly neutralized, and it may happen that one comes to a com-plete standstill in mid-air. In such cases It is only necessary to throw the center of gravity so far back that the air shall act more powerful on the forward surface, and

the gradual gliding descent is resumed. So in landing, I bend backward exactly as a crow does when alighting in a field, and reach the ground without the slightest shock. The worst that is likely to happen the same way. This is demonstrated by ob-the same way. This is demonstrated by ob-in any case is the breaking of the appar atus; there is little danger to life or limb.

the pressure of the air the fabric naturally assumes a form concave beneath and convex above, and is then raised by the wind to an angle cunsiderably above the horizontal plane.

NOVEL MOTIVE POWER.

Having demenstrated the practicability of sailing and searing. Herr Lilienthal has sought, in histerecent experiments, to remph a practical solution of the problems of actual flight. The first difficulty to be overcome was the discovery of a suitable motor, with-out which all efforts to fly would be hope-less. If we estimate the ordinary weight of the flying appearatus, we have a total burden of at least 200 pounds to be raised and sup-ported simply by aerial resistance. It is calculated that to overcome the attraction of gravity in such a case requires a force of at least one and one-quarter horse power, which no man is able to resist for more than a very short time, as, for example, in run-ning up an easy flight of stairs. This is the conclusive argument against "air veloci-pedes" and all contrivances to enable man to sustain himself in the air by his own ex-ertions. Having demenstrated the practicability of Auxiliary power is indispensable. With

Auxiliary power is indispensable. With such an apparatus as Herr Lilienthal's steam engines and electric motors are not readily available, but he conceived the in-genious idea of employing, as a motive force, the vapor of liquid carbonic acid, which, under ordinary atmospheric pressure, boils under ordinary atmospheric pressure. Dolls at a temperature far below that at which mercury freezes. Four years ago it was a mers chemical curiosity; now it has become an article of commerce, and is furnished in strong wrought iron fasks or tubes en-closed in a jacket of the same metal to guard against explosions, at the very moder-teneries of abaut 2 socia a pound. The caked ate price of about 8 cents a pound. The casked is much more costly than the jewel; the flasks are worth a dozen times as much as their contents. The engine devised by Herr Lilienthal required no fire, nor boller, nor team-chest; only a diminutive cylinder with the requisite valve arrangements, which may the requisite valve arrangements, which may be readily worked by hand, and a small res-ervoir of the liquid acid lying close beside it. The one first constructed was of two-horse power, with a receiver to contain enough carbonic acid to last for two hours. and was attached to the front of the flying apparatus. The whole contrivance, with the

city.

necessary machinery to impart motion to the wings, added less than twenty-five pounds to the weight, and this will probably be reduced in future by the use of some alloy of aluminum, instead of iron, in the manufacture of the heavier portions. The wings were also fitted with rotary pinions, constructed on the principles already fully indicated in this article, and capable of automatic action under the pressure of the air. The first experiments with this apparatus were rather too successful, at least in demonstrating the power of the engine. Un-fortunately the inventor had underestimated the energy of his motor, which acted with such unexpected vigor that the wings were broken and the modification thus shown to be necessary will require some time for their completion. It is only by a series of various parts of the machine can be determined. Herr Lilienthal confidently expects, however, eventually to solve the problem in this way. Herr Lilienthal's experiments have shown

to be practicable for man to sail or in the air. His future researches may prove that it is possible even to fly for a imited distance and under favorable VERNON. cumstances.) in:

UNTROD BY HUMAN FOOT.

The Everglades of Florida, Which Extend Ninety by a Hundred Miles.

The southern extremity of the peninsula of Florida is one huge marah known as the Evergiades, says the Pittsburg Dispatch. This impenetrable wilderness, or rather, jungle, is made up of about all of the large county of Dade, almost all of Monroe, the greater part of Dee, much of De Soto and most of Brevard. At the north end of this singular formation is Lake Okeechobee, into which the Klustiffmee and other rivers diswhich the Kissifimee and other rivers dis-charge their wat is and which are largely responsible for the vast swamp. This great stretch of tangle growth is in some places filnety miles which, extending from the Atantic across to the gulf, and from its south-ern extremity morthward is considerably over 100 miles, of There are great stretches of cypress swamps, wildernesses of vines, lake ets. of water, immense regions of moras with comparatively dry spots in this desert of untraversable and bewildering intermingling of a semi-tropical flora, with a fauna o alligators, snakes, bears, which is and other carnivora, while geese, ducks, sea birds and other aquatic fowl dot the water and myriads of the other feathered tribes make the som-ber cypriss forests vocal. The entire state of Florida is not much above the level of the sea and this dismal waste is scarcely alligators, snakes, Dea more than a few dozen feet higher than tide water. Throughout this everglade region no human being has ever fully penetrated, and there are lagoons that no human eye has there are lagoons that no human eye has ever seen that are much the same as those of preglacial lime. While there are large stretches on which sail or rowboats might be operated, there are hundreds of interven-ing miry bogs of ooze and slime of unknown depth that bar the way. There is no frost season here—no season when a frozen surface may be travers d—and so this dismal area for thousands of years has been given over to such a production as was in keeping with such an environment. But it is now contemplated to penetrate this great marsh with canal-like ditches, with a view of so lowering the general water line so as to bring this swampy mass into cultivation for the products peculiar to this zone, and for which the decaying vegetable matter of the ages is supposed to be admirably fitted. Little or nothing is known of the geological substructure of this peninsular termination but that an immense coral formation is its base is altogether probable. It is safe to predict that excavations through this ma-terial will reveal many skeletons of crea-tures that found death in the treacherously yielding surface. In a dry time this com-post bears up fairly well, but when continued rains are precipitated on it the entire area is inundated, when the softened ma-terial is incapable of sustaining any of the These everglades are interesting in this that they typify in a manner the early paleozoic conditions, when about all the earth was water and marsh. Of course there are no such creatures now as wallowed in the lagoons and crunched the roots of the aquatic vegetation in the earth's ear ier tim-, and yet in a small way the present fauna of the great Florida swamp is typical of their long ago ancestors. While the alliga-tor is nearly extinct in the regions of easy access, the saurians of the everglades have never been molested and have there attained a size and fierceness unknown to other parts of the state. Strange cries are sometimes heard coming from within the borders of this inaccessible domain, a churning of the water inaccessible domain, a churning of the water attests encounters between large and savage contestants, while the flight and terrified screaming of bittle gives evidence that the instincts of the everglade brute are still as sanguinary as they were before man had so evolved as to dominate over them and ex-terminate them from the earth.



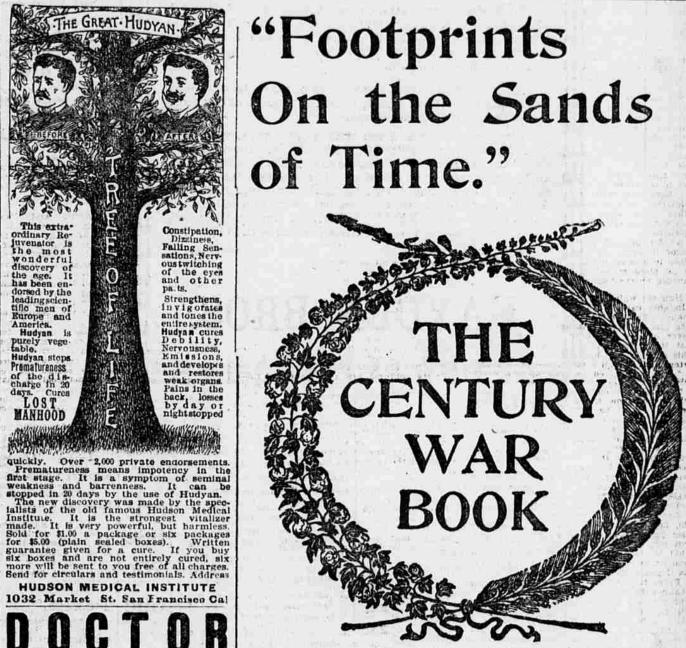
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DISCARDED FLAT WINGS.

After many experiments with flat wings, or plain surfaces, Herr Lillenthal became convinced that it was the general parabolic curve of the wing which enabled the bird to sustain itself without apparent effort in the air, and even to soar without a motion of the wings against the wind, like the al batross, or seagull, or stork, and this may be regarded as the most important outcome Herr Lillenthal's investigations. Illus trations are not far to seek. The circular ascents of the carrier pigeon, as he rises when released to gain a general view of the landscape, and to take his bearings before starting on his homeward journey, de-pend upon this principle. He flies with the wind, but he sails or soars against it. It seems strange that the rationale of the phe seems strange that the rationale of the phe-nomena was not earlier recognized. The fins of many fishes and the webbed feet of many aquatic birds are strikingly analogous of construction; the sails of a ship assume



a similar form. Look at the lateen sail of an ordinary cat boat, for instance; it would be imposable to sail so near the wind if the instrument of propulsion were a rigid flat surface. It is the effort of the sail to get away from the wind which it gathers in its ample bosom which drives the boat forward almost in the very teeth of the breeze. An inflexible sail of sheet, here of the breeze. An inflexible sail of sheet iron for example would have no such effect. With the wind on the quarter, or even directly rationam, the boat might make some progress. but if the wind shifted a point or two for-ward its tendency would be to drive the

boat astern. "Now that we possess diagrams," said Herr Lilienthal to me. "which plainly fi-lustrate all these phenomena, it seems quite easy to explain the flight of birds, for every crow that flies over our heads offers a practical solution of the riddle. Re-cent researches into the laws of atmos-pheric resistance lead clearly to the deduc-tion that curved or arched surfaces are to be preferred to flat ones, but the original discovery was by no means as simple and boat astern. discovery was by no means as simple and saif-evident as it now appears. There are active videost as it now appears. There are attild prominent investigators who will not see that the arched or vaulted wing in-cludes the secret of the art of flight. As we came upon the track of this idea, my brother snil I, who were then young and whelly without means, used to spare from

news or gulls, which Herr Lillenthal regards as the most instructive exemplars of the art of flight.

There are other analogies between the wing and the oar.

SOME EXPERIMENTS.

To the conviction that concave or vaulted wings were essential to success, Herr Lilienthal was led not only by the examination of a great variety of natural wings and by theoretical deductions, but by actual experi-ment. The means adopted for this purpose were ingenious and simple. He fitted up an apparatus in the form of the "fly-fans" found on the dining tables of clubs and restaurants, with two long arms revolving horizontally, to the ends of which surfaces of different kinds and degrees of curvatures could be affixed in any required position. The motive power was furnished by a weight, and could be exactly measured. There was also an adjustment which enabled the observer to measure the lifting force of various surfaces, moving at different angles of inclina-tion through still air. By this means Herr Lilienthal was enabled to reach conclusions which were of great value to him in the con-struction of his flying machine; and the most struction of his hying machine; and the most important of them was that the most effect-ive form of wing was that whose convexity, as measured by the versed line of the arc, should be one-tweifth of the breadth of the wing, or, of the length of the chord connect-

ing the opposite edges. ing the opposite edges. The flying machine devised and now used by Herr Lillenthal is designed rather for sailing than flying, in the proper sense of the term; or, as he says, "for being carried steadily and without danger, under the least possible angle of descent, against a moderate wind, from an elevated point to the plain below." It is made entirely of closely woven muslin, washed with collodin to render it impervious to air, and stretched upon a ribbed frame of split willow, which to render it ampervius of split willow, which has been found to be the lightest and strongest material for this purpose. Its main elements are the arched wings, a ver-tical rudder shaped like a conventional paim

leaf, which acts like a vane in keeping the head always toward the wind, and a flat head always toward the wind, and a flat horizontal rudder to prevent sudden changes in the equilibrium. The operator so ad-justs the apparatus to his person that when in the air he will be scated upon a narrow suport near the front, and, with the wings folded behind him, makes a short run from some elevated point, always against the wind, and, when he has attained sufficient velocity, launches himself into the air by a apring or jump, at the same time spreading the wings, which are at once extended to their full breadth by atmospheric action, whereupon he sails majestically along like a gigantic sea guil. In this way Herr Lilienthal has accomplished flights of nearly 300 yards from the starting point. The same method is practiced by the storks and the larger birds of prey, when they take flight from the ground.

flight from the ground. HOW SUBSTANTIAL THE AIR IS!

"No one," said Herr Lilienthal to me "can realize how substantial the air is until he feels its supporting power beneath him. It inspires confidence at once. If the wings

were flat the speed might be greater, but the sustaining power would be reduced and the descent would therefore be more rapid. With arched wings it is possible to sail against a moderate breeze at an angle of not more than six degrees to the hori-

The principle is recognized in the uni-

"I am far from supposing that my wings although they afford the means of sailing and even of soaring in the air, possess all the delicate and subtle qualities necessary to the perfection of the art of flight. But my researches show that it is well worth while to prosecute the invstigations further, and in the end, perhaps, to realize the beauideal of all modes of motion, and to turn to practical account. "To this end arched or vaulted wings are he first essential. They not only develop he first essential.

the greatest sustaining power, but, when properly constructed, they rather increase than retard the volocity of motion. other requisite is a moderate wind. An-lts lifting power so modifies the conditions o atmospheric resistance that the bird resem-bles a kite, which not only needs no string, but which can move freely even against the wind.

SAME WAY WITH KITES.

anologies and illustrations furnished by the different forms of kite are worth a moment's notice. The best kite is that which preserves as nearly as possible the bird form and presents the largest concave surface to the breeze. The common hexagonal kite, with its stiff cross pieces tied to-gether at the center, is the worst of all forms because its surface is thus kept nearly flat. A great improvement upon this is the "bow kite," with a semi-sircular top and a tapering point. If constructed with its bones beneath the skin instead of above it. chelonians and mollusks, like turtles and clams, it will be found to assume, under the pressure of the wind, very nearly the parabolic form of a bird's wing, and instead of tugging at the string at an angle of forty-five degrees to the horizon it will rise much higher and sail at a much closer angle to the It is to this arching or vaulting of wind. the sustaining surfaces that the Chinese and Japanese kites owe their remarkable ascensive power. The more nearly a kite ap-proaches to the form of a flying bird the bet-ter will be the result. Herr Lilienthal constructed one of an ingenious combination stiff willow rods with strong muslin, which floated almost horizontally directly overhead, and by shortening the forward stay while it was in this position he actually succeeded in making it fly against the wind so rapidly that he was unable to keep up with it and was obliged to let go the string. After proceeding for some sixty yards one of the

trailing strings became entangled in the shrubbery, and the equilibrium being thus disturbed, the kite fell to the ground. But the incident furnished a striking illustration of the correctness of Herr Lilienthal's de-It is an error to suppose that the flight of birds is rendered materially easier by their

corporeal structure. It has been imagined that their hollow bones and quills, filled with warm air, diminish their specific grav ity, but they bear a quite inconsiderable proportion to the general mass. Their features give them the appearance of greater size, and therefore of lighter weight, but when denuded of these a pound of bird looks no larger than a pound of beef.

Observations within the daily reach of overy one prove that the wind exercises a strong upward pressure upon all concave surfaces. Take the familiar example of linen hung upon a line to dry; a fresh breeze will keep it during most of the time in a position considerable shows the

in a position considerably above the hori-zontal, which presents so familiar a phenonionon as to need no description. Under

DeWitt's Witch (Hazel Salve cures piles.

Bey Solow, an African student at Williams ollege, returns home after graduating to come king of Bendoo.

MPERIAL

HAIR REGENERATOR

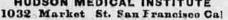
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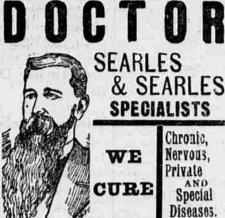
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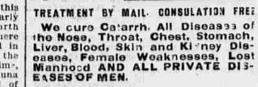
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