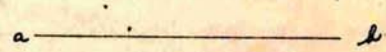
DETAILED SPECIFICATIONS
Written by JACOB BRODBECK of an
airship made by him and with which he suc-
cessfully navigated the air in San Antonio, New York
City and Chicago in about 1865. One of his associates who aided
in financing him was the late DR. FERDINAND HERFF, SR. of San Antonio.

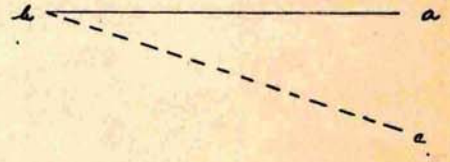
Close observation of the birds assured me that they flew on the same principle as the united working of the kite and parachute. Let us try this experiment.

Figure 1



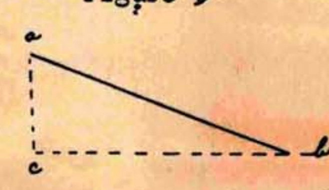
If a force in b (figure 1) acted toward ba, a level horizontal surface would move continuosly in a straight line in the direction of ba, provided no other force acted in any other direction. The point is that the force of gravity pulls toward the center of the earth and the friction of the air offers the other resistance. Let us say, a plane moves in a vacuum with a velocity of 45′; then at the same time the downward force tends to increase the movement to the center of the earth. This motion must be opposed or stopped, which only can be done by the friction of the air. To ascertain this properly, the place and direction of its effect, take a parachute and when it has reached a velocity which corresponds in proportion to its weight and area the friction of the air will cause a decrease in acceleration and an even tempered motion. The question is how great is the velocity of a parachute? This I proved through experiment and found that a parachute whose weight is ½ lb. per sq. ft. falls 5 ft. per second. If the point b of (figure 2) of the surface ab endeavors to act toward a at 45′ per second; then the gravity of the earth pulls toward c at 5′ per second, and instead of pulling in the direction of ba it would be forced in the direction of bc. To oppose this fall of 5′ you must have c, a horizontal motion; therefore it is necessary for the surface to give such inclination to the horizon

Figure 2



so as to form the side ac (figure 3) which forms the abc. The force in b pulls the surface toward a and the gravity of the earth pulls the same from

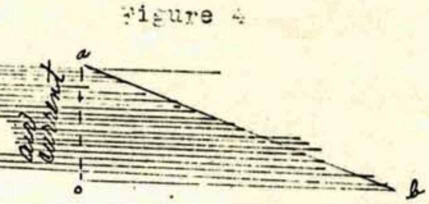
Figure 3



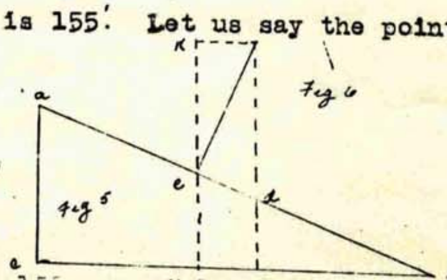
ac; therefore the united action of both of these tend to force b in the direction of bc which falls **parallel to** the **horison.** If there is given an increase in acceleration of the **surface** the **decrease in** the inclination of the same (also ac) must be proportional and compare inversely in greatness.

Let us determine the place and **direction** of the effect of the surface by producing a current **of air** on the same. It is evident in figure 4 that the **part** of the **current** inclosed in abc exerts a **pressure** on the lower side of the surface, and a part of the current strikes the **upper** half because of the adhesion of single particles of air between abc with surrounding air which is **striving to escape; therefore a decrease** in air **in this space. The air surrounding this surface would endeaver to equal the unequality of density; the air underneath the surface tends to force ab** higher and the **greatness of the pressure must be proportional to the decrease** in the **volume of** the **air between abc.**

Figure 4



How great a **pressure does the air** between abc exert **upon** the **surface?** It is true **that it is independent of the decrease** in air between abc. **Let us take a surface of 24025 sq. ft., the side of which amounts to 24025 sq. ft. which is 155'. Let us say the point** b(figure 5C of the **surface** be moves toward f **at** 45 per **second**, and the distance from f to e is **5'** so the distance ac of a 155' long plane would be as (45 5) : 5 155 : H (bf fe) : fe bc : ac 17117 **equals** the **area of a current** in **sq. ft.**; the height of ac 17117 **and the width of the plane which equals** to 17117 x 155 2653, 135 sq. ft. The **accleration of a current** of 2653135 sq. ft. **equals 45 ; so the pressure produced amounts to 45 x 0,002,288 x 2,653,153 =** 12292.5 lbs. **Let us examine the action of this pressure** on ab **(Figure 6). We find** that **the one on bc falls intimately** in a



perpendicular line; namely ef, which is 5 $\frac{bf}{9} = \frac{45}{9}$; so the force of the pressure acts on the parallelogram in the direction of ek with nine times greater force as in the direction of el. Accordingly the greatness of pressure on ek amounts to $\frac{122925}{9+1} \times 9 = 1106325$ lbs.and the greatness of the same on el equals to $\frac{12292.5}{9+1} \times 1 = 1229.25$. An aeroplane with a surface of 24025 sq.ft.would be allowed to have a half of a pound weight per sq.ft. which equals $\frac{24025}{2} = 12012.15$.

We have indeed found that with an assumed acceleration and with an area which amounts to 1106325 lbs the upward action of the atmosphere causes a loss of 12012.5 = 11063.25 lbs. = 949.25 lbs. This apparent loss in capacity would through the action in abc (figure 4) produce a decrease in air; therefore it equals the stimulated air pressure. The greatness of the decrease in air is $\frac{24025 \times 188 \times 15}{949.25}$ equals $\frac{1}{546.29}$. This functionary experiment with different areas, accelerations and weights would give a large useful effect and as for me the applied apparatus were not perfect, so this obtained result must be determined by exact mathametics. We have in the foregoing shown that therewith by the means of a sufficient air current would press the surface higher. But just this force of air would not only convey the aeroplane further but would also step in the way of opposition. Does not the mechanic inform us of means of almost total cease in the direction of forward motion? On each budy no matter whether large or small and of a different frame, the air exerts a fixed resistance. Naturally an aeroplane can only be made with bodies of different sizes and of different frames. The resistance of air on bodies of equal dimensions but of different frames and sizes is dependent on the calculation of the resistance on the frame of different parts of the machine; so it is necessary before everything else to state the different forms of bodies. With the construction of the aeroplane or in other words to take advantage of the aeroplane let us ascertain the ratio of resistance on the different forms. These forms are cuneiform, pyramidal, conical, and cyclindrical. The foregoing Physicist have ascertained through experiment that on a half of a sphere that has been set in motion with the round side in motion ahead exerts 2½ times lesser resistance than if the half of the sphere with the other surface were ahead with equal velocity. I examined in which proportion the resistance is less on bodies of the same base when you have a cuneiform, conical, pyramidal and cyclinderal frames. I found that when the resistance acts on a level surface of a known velocity it equals to 1 so this is on a cuneiform body whose base equals the surface and whose axis equals $\frac{1}{2}$ of the base. The rudder amounts to 1;2 = $\frac{1}{2}$ on a pyramidal; the conical form under the same proportion equals 1:3 = 1/3; on a cylindrical equals 1:1. Let us take the resistance of the air on a level surface of a known velocity against the same as 90 lbs. : 1 = 90 lbs ....

so on a cylindrical = 90: 5/3 = 54 lbs ....

so on a cuneiform = 90: 2 = 45 lbs ....

so on a pyrimidal = 90: 3 = 30 lbs...

To prove the results theoretically, place the triangle of Fig. 7 so as to form of Figure 8 of the wedge of the axis ac = $\frac{1}{2}$ and bc = cd. da now ad equals dc so dac and bac equals $\frac{1}{2}$ right angles.

Figure 7

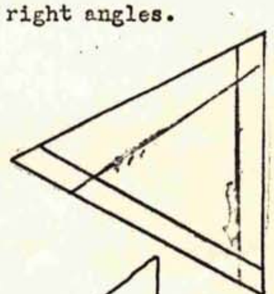
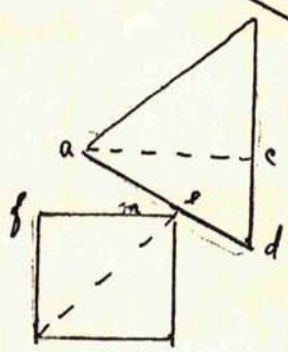
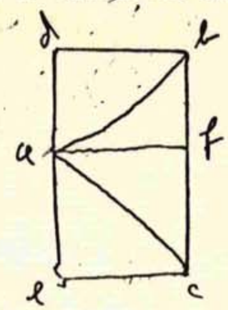


Figure 8



A body with axis ad moves against ac according to the law of the rebounding oblique push, and it was the pressure, the deficient angle equal to the downfalling angle, is in the direction of fe and the executed force is therefore $\frac{1}{2}$ of the side dc, and the same is the case of the exerted pressure on ab. Now ad = $\frac{bc}{2}$. So the exerted resistance on fe and ab and that on ac and ab equal to one half the resistance on bc of a pyramidal form, the air not only turned away on two but four sides. Through which a produced decrease of the analogical cubic area of a pyrámidal form, the air not only turned away on two but on four sides. Through which a produced decrease of the analogical cubic area of a pyramidical form equals a prism of equal base and height. The triangle abc of Figure 9 is equal to the rectangle $\frac{dbce}{2}$, even so the wedge whose base bc equals the side of the prism dbce, and with an axis af = the height bc of a prism, equals the prism dbce: 2. A pyramid whose base bc equals the side bc of a prism bdce and the axis af equal to the height bc of a prism; immediately prism dbce : 3. The decrease in the resistance of the air on a cylindrical body is proportional to that upon a cuneiform body, and as the



resistance upon a wedge is proprotional to a pyramid, we have 3: 2 = $2\frac{1}{2}$: H = 5/3. Further experiment taught me that the resistance of the air of different forms of Bodies was still more reduced when the ratio between the axis and base was enlarged and lengthened, and that the decrease in the resistance was doubled when the axis doubled the above assumed half of the base and also when the axis equal the base. The exact resistance of the air is therefore (on a level surface moving downward with a known velocity) is equal to the same upon a conical form whose axis equals the base, and equals this level surface equals to 113.2 = 1/5; upon a cuneiform shaped body = 1:$2\frac{1}{2}$.2 = 1/5; upon a wedge shaped body equals 1: 2.2 = $\frac{1}{4}$; upon a cylindracal equals 1:5/3.2 = 5/6/. Let us take the proportion of the axis to the base as a standard so that the decrease is universally known; in order to double the resistance the axis must be double the base, in order to triple it, the axis must be triple the base, in order to double it repeatedly, the axis must amount to the base doubled repeatedly.

Let us calculate the resistance which the air exerted upon my progmatic aeroplane, with an area of the wing equal to 22125 sq.cubic ft, and a weight of 12012.5 lbs,. and an acceleration that should be 45 per second. First, we have the principle resistance of the air on the inclined area of the wing in the direction of the motion executed, which as above was found by the calculation of the air pressure on the whole area to be 1229.25. A further resistance of the air resulted against the front side of the surface, which is on the average 3' thick and 155' long; therefore the quadrate area of the perpendicular base of the same equals 155 x $\frac{1}{4}$' = 38.75 sq. ft. This front side of the form has a wedge whose axis is twice as great as its base; hense, the air exerts on the same, as determined above, an eleven times smaller resistance as upon the perpendicular intersection of the same. This resistance carries a weight of 45 x 0.002288 x 38.75 = 22.5376975 lbs. The hollow beams which their connections whereon the propeller rests have a length of 53' and a height of 6''. Then the wedge shaped part whose axis is twice as large as its base resulted in a resistance of 45' x 0.11288 x 53/2: 8 = 30.82745 lbs. The aromatic wing of the plane had a base of 9' height and a width of 4'; the root of 4 x 9 is $\sqrt{36}$ equal to 6'. The length of the axis of 24' contains also an intersected base of the same equals 4:1. The resistance on the pyramidical form is equal, after the above determination, to $\frac{45 \times 0.002288 \times 36}{4.6} = 6.9798$.

The compilation of the resistance upon various parts of the aeroplane equals on the broad side of the wing 1229.25 lbs; the resistance upon the front side of the plane = 22.5976875 lbs; the resistance upon the

front side of the propeller	= 30.82765	"	"	"	"	"
" " " ship in general	= 6.9798	"	"	"	"	"
cables of the plane	= 89.34144	"	"	"	"	"
other small parts	= 50 lbs.	"	"	"	"	"
the plane altogether	= 1428.93775 lbs.					

Let us calculate the number of horsepowers necessary to surpass this resistance and to lift an aeroplane of the 33,000 lbs a foot per minute; this gives a constant resistance of 110 lbs. to lift up the constant resistance of the air on the whole plane of 1428.93775 lbs which requires a steam engine of 1428.9363775 = 13' horsepower.

To take advantage of my aeroplane one must have a steam engine which weighs no more than forty to fotrty-five thousand lbs. Mechanics declared that they could build a staam engine, made out of the materials used then, that weighed not more than 40,000 lbs. In regard the cast iron which is double the strength of the best blacksmith iron; so with the increased weight of 40000 lbs, a steam engine of 80 horse powers should be made out of cast iron which will produce an aeroplane which should give an acceleration of 100 miles per hour in a quiet atmosphere; so an aeroplane gains 30 miles when moving in the direction of the wind. The acceleration is now 100 plus 30 equals 130 miles per hour, and when it moves in the opposite direction 100-30 equals 70 miles per hour. But let us assume that an acceleration of from 30 to 80 can be reached, but such an acceleration has not yet been reached and will not be reached. So this alone is significant ground on which to say that the aeroplane deserves our attention. Should not every man, because of the importance of the object, give everything in his power to help me complete my experiment. Capitalist and business should be interested enoughto offer their aid of its completion.