

arrested and aggregated into comets and meteorites, which because of their density fall toward the center of the nebula, acquire a motion of revolution from the whirling gases and become the nuclei of planets and satellites. Thus is developed a solar system in which the planets, like the Pleiades, are surrounded by vast gaseous envelopes. Owing to their smaller mass these inchoate planets cool much more rapidly than the central body of the nebula. The resultant contraction shortens their periods of rotation and the tidal action between them and the great central body, supplementing the initial whirl of the nebula, ultimately produces a system in which the planets move in nearly circular orbits nearly in the same plane and in the same angular direction, which is also the direction of rotation of the sun and all the planets, and of the revolution and rotation of the satellites of all except the most distant planets, such as Uranus and Neptune.

To explain these facts Swedenborg, in 1734, imagined a "solar chaos" spinning round the sun with increasing speed until a ring separated and broke up into planets. Buffon, in 1745, conjectured that the planets were formed from a stream of matter carried off from the sun by a comet. Kant assumed a chaos of motionless dust, its conversion by the action of gravitation into a central body with rings of dust circling around it, and the subsequent consolidation of these dust rings into planets. But rotary motion cannot be produced *ab initio* by a central force. Hence Laplace (1776) like Swedenborg, gave his primordial nebula an initial rotary motion and assumed that it threw off rings from which the planets were formed. It is now believed that only small planets and meteors revolving about the sun could have been formed in this way. Saturn still presents an example of rings composed of small satellites which revolve more slowly with increasing distance from the planet.

Laplace would probably not have enunciated his hypothesis in the form which he gave it if he had known, as we do, that the satellites of Neptune and Uranus (and probably the satellites of Saturn which Pickering discovered in 1898) revolve about their primaries in a retrograde direction and in planes which deviate widely from the ecliptic. These exceptions to the general law of motion are easily explained by the supposition that the outer parts of the primordial nebula were so extremely tenuous that the immigrating planet did not develop sufficient volume to be greatly affected by tidal action. It is not inconceivable that the solar system possesses remote and undiscovered members moving in orbits as erratic as those of comets. These planets, as Laplace conjectured, probably joined the system after the condensation of the principal mass had almost freed interplanetary space of nebulous matter.

Chamberlin and Moulton have attempted to show that the difficulties of Laplace's hypothesis can be evaded by the assumption that the solar system was developed from a spiral nebula into which foreign bodies penetrated and condensed the nebulous matter about themselves. The attenuation or disappearance of nebulous matter near stars included in such nebulae (the nascent planets) can be actually observed in many cases.

In conclusion, we may draw a parallel between the theories which were generally accepted a few years ago and the views which have been opened to us by recent discoveries. The Newtonian law of gravitation, which until 1900 was regarded as the sole governor of the movements and the evolution of the material universe, leads to the continual aggregation of the heavenly bodies into greater masses, so that ultimately all the matter in the universe would be collected into comparatively few large suns, luminous or extinct, on which organic life would be impossible. But we see near our own sun a number of non-luminous bodies, the planets, and we are justified in assuming that other stars are attended by dark companions, by the presence of which alone can the peculiar oscillating movements of those stars be explained. We observe also that myriads of little meteorites or "shooting stars" fall to the earth from space.

The explanation of these discrepancies is given by radiation pressure and collisions between bodies. The collisions give rise to great whirlwinds about nebulous and gaseous nuclei. Cosmical dust, some of which may be aggregated into meteors and comets, is driven by radiation pressure into these whirlwinds where it unites with products of condensation of the surrounding gases to form planets and their satellites.

Thus the distributive action of radiation pressure balances the concentrating action of gravity. The nebulous cyclones merely determine the position of the dust expelled from distant suns by radiation pressure. If, as was once believed, the universe were limited to one great cluster of stars surrounded by infinite empty space, both the matter and the energy carried by radiation from the suns would be lost. On this theory all matter and all energy would have been dissipated and annihilated long ago.

The thin, gaseous, and cold parts of the nebulae constitute the regenerator of the machinery of the uni-

verse, in which the matter and energy wasted by the suns is received and utilized. Here the radiant heat of the suns is caught by immigrant dust particles and communicated to the separate gas molecules with which they collide. In consequence of this gain of heat the entire gaseous mass expands and becomes cooler. The most energetic molecules escape and are replaced by others from the denser interior of the nebula. In this way every ray is absorbed and its energy is carried to new suns in process of formation within or near the nebula while the dust is condensed upon immigrant bodies or fragments of the two suns whose collision gave birth to the nebula. Although, as Poynting has shown, the pressure of radiation is sufficient to keep asunder spherical masses 13 inch in diameter, having the density of the earth and a temperature of 15 deg. C. (59 deg. F.) material particles can cohere at the temperature of the nebulae (about -223 deg. C. or -370 deg. F.) at which the limit of size is reduced to 1/25 inch. Probably the initial aggregation of fine dust is effected less by gravity than by capillary forces due to the gases condensed upon the particles.

And in the nebulae available energy, also, can be accumulated, in defiance of the law of the continual increase of entropy.

As a result of these regenerative processes the gaseous envelope of the nebula is exhausted and the nebula converted into a star cluster or a group of planets revolving about one or more suns.

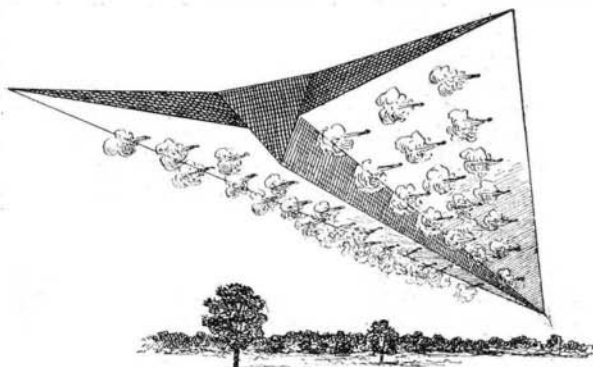
In the transformation of nebulae into suns and planets and in the production of new nebulae by collisions of solid bodies, luminous or not, an important part is played by the explosive compounds of hydrogen and helium with carbon and the metals. The laws of thermodynamics lead to the conclusion that these explosive compounds are found in the development of suns and destroyed in their collisions. The prodigious energy latent in these compounds represents the flywheels and governors of the mechanism of the universe and assures the eternal and uniform rhythm of alternation between nebulae and suns.

This harmonious and compensating co-operation of gravitation and radiation pressure, of equalization of temperature and concentration of heat, makes possible an ever-changing universe without beginning or end, on which life may continue forever.—Condensed from Chapters VI and VII of "Das Werden der Welten."

A NEW AEROPLANE.

By THEODORE GIBON.

SINCE Messrs. Wright brothers and Mr. Henry Farman have made their successful flights, the fact that aeroplane flight is possible cannot be disputed by



A TRIANGULAR MONOPLANE DRIVEN BY REACTIVE FORCE.

anybody any longer. It is time now to point out which improvements are needed to accomplish a more rapid development in the art of flying. Among the difficulties met with are the following:

1. The head resistance of the aeroplanes now experimented with is too large.

2. This already great head resistance is increased every time the equilibrium is lost.

3. In trying to regain the equilibrium by twisting the supporting surfaces and moving vertical and horizontal rudders (as the Wright brothers are said to do), or by moving a horizontal rudder (as Farman does), the head resistance every time becomes entirely too large and results in considerable loss of speed and a consequent loss of carrying capacity. These losses, then, are chiefly due to the constant and wide variation in the angle of attack.

In view of these facts, the question naturally occurs as to what is the proper course to follow to lead to better and perfect success. How can these obstacles be overcome in the best manner?

I believe that this can be, and eventually will be, accomplished as follows:

1. By reducing the head resistance by using an arrow-shaped monoplane with stationary supporting surfaces. This monoplane will be made up of triangles, no matter from what side it is viewed. It will be self-braced in every direction, which also gives the greatest strength to the structure in the simplest manner.

2. By doing away with all movable, twisting planes or movable rudders.

3. By doing away even with the air propeller and making direct use in the form of reactive force of the motor explosions.

4. By distributing the force of these explosions to the surrounding atmosphere by a suitable arrangement of pipes located in the supporting surfaces with nozzles on both the under and upper sides of these surfaces. These nozzles should be so arranged that the emitted gases should strike the atmosphere at an angle of 45 degrees with the horizontal, so as to produce forward motion as well as upward and downward push for automatic equilibrium. The equilibrium will be maintained automatically by suitable valves, and consequently the angle of attack will be kept as constant as possible. The valves can be made to act in response to a tilting of the monoplane of less than one degree.*

5. The steering, instead of being accomplished by rudders, will also be done by reactive force of explosions controlled by hand-operated valves.

Twistable, movable planes give too much head resistance when used for the purpose of steering. Besides, they are breakable and get uncontrollable, particularly at great speed.

6. The arrow-shaped, wedge-form monoplane will compress the surrounding air, so the reactive force will act on comparatively hard air.

7. Under forward motion of this monoplane, with outlets for the reactive force set at an angle of 45 degrees in the supporting surfaces, the reactive force strikes fresh, untouched atmospheric air all the time.

8. The faster the monoplane is flying, the more compressed the surrounding air becomes; and the more the air gets compressed, the better for the action of the reactive force, which will force the monoplane to go still faster and compress the air still more. This in turn results in greater speed and harder compressed air and so on, up to a certain limit, the speed getting faster and faster, and all this without the motive power being augmented in any way.

9. It is important to mention in this connection that, on the other hand, Langley's law is: "The weight remaining the same, the force requisite to sustain inclined planes in horizontal motion diminishes instead of increasing when the velocity is augmented."

10. So the necessity for experiments with reactive force and a monoplane of the arrow-shaped form with automatic balance is very great. With no hindrance to speed by movable and twisting planes and with the angle of attack kept constant, the speed will be enormous; and consequently, at great speed, the monoplane will carry more weight, with smaller area of supporting surfaces; while last, but not least, it will carry it with less motive power.

11. The experiments going on now with the double surface and box-kite form and other types of flying machines, even if they are successful to a certain extent, will nevertheless sooner or later prove conclusively that the only really successful aeroplane has to be of the type described in this article. Before too much money is wasted in the wrong direction, a committee ought to be appointed to investigate the plans closely and a fund ought to be furnished to experiment with the reactive-force-driven, automatically-balanced-and-steered, arrow-shaped, wedge-form monoplane.

12. If reactive force has not been managed very successfully in the past, it does not follow that this cannot be done in the future.

13. The opinion that reactive force cannot be made sufficiently powerful cannot be sustained in the absence of any evidence.

14. In conclusion, attention is called to the article in the *Aérophile* of November, 1907, pages 321 and 322, and also to the *Aérophile* of March 1, 1908, page 83, where M. René Lorin proves by his diagram that reactive force is a much more effective propelling medium for aeroplanes than the usual air propeller.

To Clean and Curl Plumes.—In 3 parts by weight of rain water, boil 50 to 60 parts of white soap and allow it to cool. The feathers, dipped in water, are spread on a table and washed with a linen rag, dipped in the above soap water, rinsed off with lukewarm water, well pressed out and folded between clean linen cloths, after they had been dried as nearly as possible, by striking with the open hand. Red-hot coals are then spread out and the plumes, in both parts, held high above them and turned over and over until they are dry and nicely curled. If we have white plumes to dry, we may sprinkle a little powdered sulphur on the coals and allow the fumes to pass through them, by which means they are rendered perfectly white.

* It would go too far to explain in this article how this can be done. Particulars can be found in—

United States Patent 730107, June 2, 1903,

United States Patent 825881, July 10, 1906,

British Patent 14003, June 19, 1906,

French Patent 367867, S. G. D. G., July 7, 1906,

and particularly in my descriptions and photographs of experiments which I made with the system of automatic balance. Particulars also in my letters of correspondence with authorities.