A PAIR OF LIMBLESS, SNAKE-LIKE LAMBS.

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From the standpoint of the origin of new species or new kinds of animals, a most intensely interesting case is recorded from North Carolina. On the second of last February a lamb without indication of limbs appeared in a flock of sheep on the Tar River Stock Farm in Nash County near Wilson. This lamb is perfect in every other respect, having a well-formed head and body and a long tail, as may be seen by referring to the accompanying photograph of this peculiar sheep.

At first sight one may be led to think that this is merely a case of deformity, or in other words the lamb is a monster, such as occurs every day in one form or another among almost every class of animals. It is well known that young are often born with deformed limbs, and sometimes with their limbs severed from the body, but all such cases are very different from this, for the reasons below.

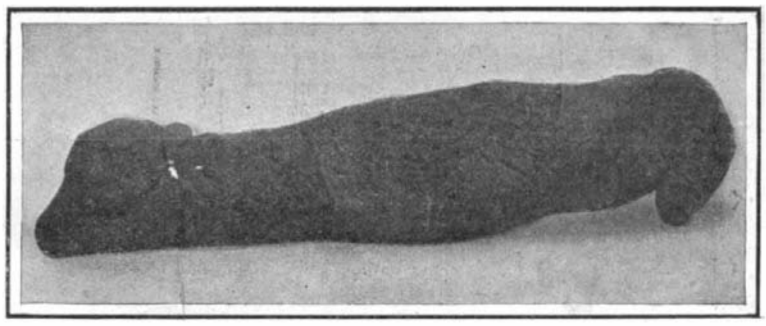
The first and most important reason is that during the latter part of April a second lamb was born on the same farm which was identically like the first, except that it was white instead of black. This one had the same father as the former legless freak but a different mother, both of its parents being white, while the first lamb had a black mother. Monsters or deformed young are usually weak and rarely live, while these lambs are healthy and very vigorous. The first one was fed on milk from a bottle for the first month or two, but is now able to feed on grass just as a normal lamb would.

Such cases as these are what have been termed "sports"; they appear suddenly among a given kind of animal, and breed true to their peculiar form. Darwin knew of a few such cases and recognized that they bred true to their peculiarities, and might even form new kinds of animals. The ones that Darwin recorded were the black japanned peacock, the turnspit dog, and the Ancon ram. The black japanned peacock is a certain peculiarly-marked pea-fowl which sometimes appears in the flocks in England. This "sport" pea-fowl, although smaller and generally whipped in fights with typical males, thrives and will crowd out the common type within a few generations, since it breeds true to its new characters.

The turnspit dog is the often-seen long-bodied and short-legged kind, which has become a race of dogs in such a manner as the black japanned peacock tends to establish itself.

The Ancon ram was a peculiar long-bodied sheep with short crooked legs born in Massachusetts about 1791. This sheep on account of its awkward shape was unable to climb the low stone fences which were so extensively used in New England. This was, therefore, a very valuable variety in case it should propagate true to its type, and so it did. When this ram was paired with common sheep, many of the offsprings were of the long-bodied, short-legged kind, and from this original father the Ancon race of sheep was produced. These sheep existed in New England for sixty or seventy years, and were then in some way allowed to "run out" or become extinct. Our legless lambs may be said to have carried this short-legged condition to the last degree and have discarded such appendages entirely, lying flat on the ground and being almost unable to move about except for some twisting motions. To the scientist and experimental breeder these lambs without legs are remarkably interesting. The newest and in many ways the most popular idea of to-day regarding the evolution of animals is based on such cases as this. Prof. Bateson in England and Prof. De Vries in Holland are the chief champions of this "Mutation Theory" of evolution, as it is termed. These prominent scientists believe that the various species in the world to-day have arisen from other existing or pre-existing species by sudden changes in form, or that is to say by "sports" or "mutants," such as this legless lamb. These "mutants" when they once appear breed perfectly true, and so establish new varieties or species of animals and plants. Prof. De Vries in his gardens in Amsterdam has succeeded in getting a number of entirely new plants, which establish themselves and continue to breed true from a single original kind, the evening primrose, which was introduced into Europe from America.

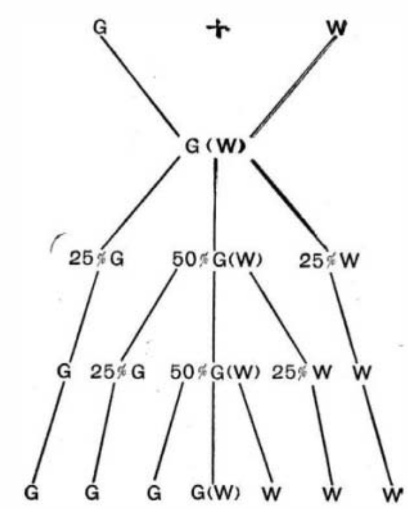
The most common cases of "sports" known to all are the albino forms, which suddenly occur among various animals. Many breeding experiments have been conducted with albino mice, to test the manner in which the albino condition is inherited. Albinos and many of these "sport" variations follow what is known as Mendel's law of inheritance, a law first discovered by an Austrian monk, Gregor Mendel, about forty years ago and then forgotten until it was rediscovered in 1900 by three different investigators. The manner in which the law acts may be best illustrated by a concrete case. When a gray mouse is paired with an albino white mouse, all of the young born of this pair will be gray in color like the gray parent, not at all lighter. If these gray offsprings from the gray and white parents are paired among themselves, one out of every four of their offsprings will be a pure albino like one of their grandparents, and the other three will be gray like the other grandparent and their own parents. In such a case the gray character is said to be more prepotent than the albino, or is dominant, while the white is recessive. According to Mendel's law, when an animal with a prepotent or dominant character is paired with one having a corresponding character, such as coat color, recessive or less prepotent, the first generation of the young will all show the dominant character only, though the recessive character is contained within them also, as is shown by what happens in the following generation. If the first generation be paired together, one in four of their offsprings will show the recessive character and the other three the dominant.



ONE OF A PAIR OF LIMBLESS LAMBS.

This is not the ordinary case of a monster, but of a new variety or "sport," which may be cited as evidence in favor of the new "mutation" theory of the origin of species.

The way in which Mendel's law acts is made clearer by the accompanying diagram. If we indicate the



gray mouse by G and the white one by W, then when these two are paired their offsprings will be $G(W)$. The W in parentheses indicates that this character, although contained in the mouse, does not show itself externally. Its presence is proven, however, when these $G(W)$ mice are interbred. One-fourth of their offsprings will be pure white mice, one-fourth pure grays, and one-half will be $G(W)$ again (see diagram).

If one of these "apodal sheep" be paired with an ordinary sheep, we may predict that all of the lambs will either be legless or else all have legs. Further, when these offsprings are paired together, one in four will be like one grandparent and three like the other. If the two legless sheep are paired together, all of their lambs will be expected to show the legless condition.

One thus appreciates the practical value of Mendel's law, since by its aid a stock raiser having a breed with two phases of any one character which he wishes to select may know exactly the number of generations required to obtain the pure form he desires, provided the phases of the character are dominant and recessive in their relations.

Zoologists are much interested in these new legless sheep, as they add one more to the very few mutations which are known to be occurring at the present time. A change of one species or form into another is not a common occurrence, and uncounted ages have been necessary to produce the various species of animals and plants that we know to-day. To find such a change when in its beginning gives an opportunity for experimentation along these lines, and may enable the biologist to come nearer the solution of the riddle how the diverse animal population of our planet has come about.

Such a remarkable "apodal sheep" has never before been recorded.

A SUCCESSFUL HYDROPLANE GLIDING BOAT.

We give herewith the design and details of a 15-foot hydroplane gliding boat—"Vida May IV."—which was designed and built by Stearns Brothers, of Bridgeport, Conn., during the fall of 1906, and was intended to be launched during the latter part of February of this year, but which, owing to the heavy ice, was not put overboard until after the middle of March.

This boat has attained a speed of 21.6 miles per hour, which is extremely good, considering her weight and power, for a boat of the gliding type.

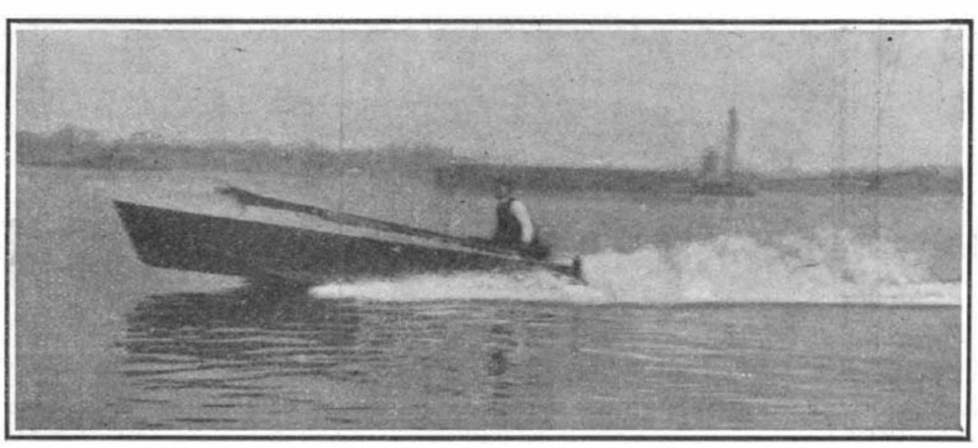
Although built on the gliding principle, the boat is considerably heavier than the European gliders, as it was built to stand a good sea, which is shown by the style of the bow and forebody chosen. Its weight is about 500 pounds, while some of the light gliders recently constructed weigh only 100 pounds. The engine used is also of a heavier type, being a 2-cycle, 2-cylinder, 14-horse-power Cushman marine motor which weighs 350 pounds.

As a comparison, this same engine was in use during last season in a displacement boat, "Vida May III.," of exceedingly fine lines, this displacement boat attaining a speed of 18 miles per hour.

The gliding boat, being heavier in construction, is quite substantial, which is a very necessary point, as a gliding boat is subjected to the severest stresses that any model can stand. One instance is a gliding boat running into a head sea where it pounds. Unless something is done to resist this pounding, as was the case when the designers adopted the form of bow and forebody which is here shown, such a boat is worthless in a sea.

Another instance is a gliding boat running at an angle to a head sea. The sea then strikes under its weather bow, and unless the hull were designed to resist the impact of the waves, they would wrench or twist it out of shape.

In the design of a gliding boat the weight of the structure has been found to be a very detrimental factor as regards speed, for the resistance varies almost directly as the weight. The angle which the planes make with the water line when running is also of great importance, as this angle determines the lifting and retarding forces and the resistance. The retarding force is directly proportional to the angle of inclination of the planes with the water line when the area and speed of the planes remain constant.



A 15-FOOT HYDROPLANE BOAT WHICH MADE 21.6 MILES AN HOUR WITH 14 HORSE-POWER.

The lifting force acting on the planes tending to lift the boat at right angles to the water line, has been found to equal

$$(AV^2C \text{ sine of angle}) \times \text{cosine of angle.}$$

In this formula A = area of planes, V = speed in knots, C = a constant of about 4.

In determining the area of the planes, it has been found that the area of plane necessary to give the right amount of bearing surface at certain speeds is obtained from the formula

$$A = \frac{W}{V^2C \text{ sine of angle} \times \text{cosine of angle}}$$

in which W = weight on plane, V = speed in knots, C = constant as before.

By this formula it can be plainly seen that the area of the plane varies directly as the weight, and inversely as the square of the speed.

A gliding boat when at speed is acting against different conditions than is a displacement boat. For instance, the boat has but little lateral area, and when traveling fast with a beam wind, it is easily blown off its course unless designed to resist the force of the wind.

Another condition realized is when the boat is running at full speed, at which time the downward pressure between the bottom of the boat and the surface of the water is shifted aft toward the stern.

Any slight force acting on the forebody at right angles to the direction of motion of the boat will then easily cause her to steer off.

When the boat is running very slowly, the action is reversed, or the downward pressure between the bottom of the boat and surface of water is shifted forward, which causes the stern to be swung easily when a force is applied. In this boat the rudder is placed on the forward plane, so as to take advantage of the foregoing conditions.

Gliding boats when at speed are practically on the surface, which causes the shaft line to come near the surface.

If the propeller is situated under the aft plane and not far below it, the engine will race as the plane nears the surface.

The cause, apparently, is as follows: The water line at full speed is very short on each plane; therefore the propeller draws a mixture of water and air from under the plane. This mass of water and air, since it has a less density than water, allows the engine to speed up, and the propeller shows very great slip.

By running the propeller a little aft of the stern in deeper water, this trouble is eliminated. Twelve to 14 horse-power is the smallest motor which should be used in a boat of this size to get good results. The weight of the motor should not be greater than 300 to 350 pounds complete. The dimensions of the propeller used on this boat with the 14-horse-power engine are 18 inches diameter and 30 inches pitch. The blades are oval shaped and 4½ inches wide.

For the benefit of those of our readers who would like to build a fast boat of this type, we print in the current SUPPLEMENT the drawings and full directions furnished by the Messrs. Stearns, who are the first Americans we know of to build a really successful hydroplane glider.

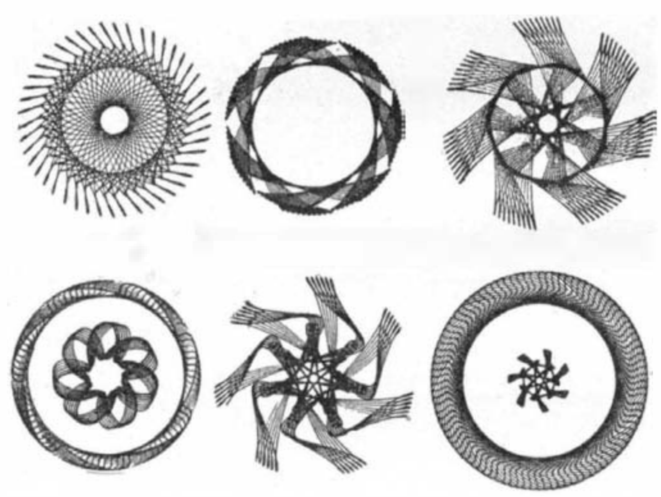
A MECHANICAL TOY WHICH DRAWS GEOMETRICAL DESIGNS.

A notable feature of the Advertisers' Show, recently held in Madison Square Garden, was the exhibition of a rose engine or geometric lathe, at work engraving the intricate tracery of geometric curves by which our paper currency is protected against fraudulent imitation. It was interesting to watch this complicated and expensive machine slowly cutting out with absolute perfection a most beautiful pattern, impossible of exact reproduction on any other machine, or even on the same machine, should the combination of gearing by which the design was produced be lost or forgotten.

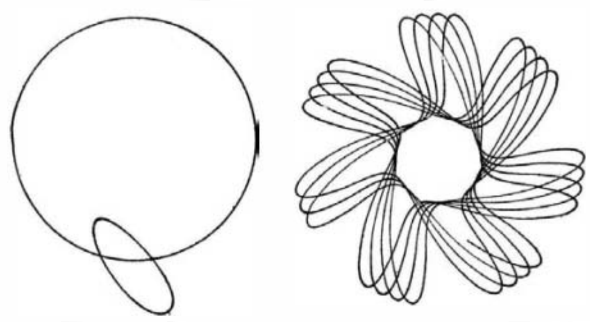
Turning away from this exhibition with profound respect for the genius who devised this masterpiece of mechanism, the spectator was confronted with a small toy, extremely simple, and almost crude in design, on which patterns fully as intricate as those of the geometrical lathe were traced in ink with wonderful perfection and celerity. A photograph of this toy with facsimiles of some of the work done by it are reproduced herewith. The device resembles, in a measure, the "Cycloidotrope," which was described about twenty years ago in the SCIENTIFIC AMERICAN (Vol. 53, No. 25); but the construction of the "wondergraph," as the new toy is called, is much simpler and it is capable of tracing a greater variety of patterns.

As may be seen in the illustration, the wondergraph comprises three wooden pulleys, about which an endless cord serves as a driving belt. The face of the larger pulley is used as a revolving table over which the pen operates, and is provided with a pair of spring catches that serve to clamp a piece of paper smoothly on the table. The driving pulley is fitted with a small crank handle, by means of which it may be easily turned. The third pulley is carried on an arm which is pivoted to the baseboard, so that the belt may be readily tightened by swinging the arm. A series of holes are formed in the face of this pulley to receive the downwardly-bent end of a rod, whose opposite end rests in one of the notches of a guide rack. The rod carries a pen, the point of which rests on the paper clamped on the revolving table. Now, when the crank is turned the paper is rotated under the pen, and at the same time the pen is oscillated by the small pulley, and this combination of movements results in the drawing of a novel design on the paper. The holes in the pen-oscillating pulley are arranged in a spiral series running from the center to the periphery. If the point of the rod is moved from one hole to another, the design will be changed to a very remarkable extent. Further variation is provided by setting the rod in different guide notches in the rack.

The exact curve described by the pen may be observed by holding the table stationary while turning the pen pulley. It will be noticed that the pen traces a loop or ovoid figure, which is the resultant of the revolving motion of the point of the rod and the sliding motion of the rod in the guide rack. In one of our illustrations we show a typical ovoid curve drawn in this manner. The motion of the paper under the pen is, of course, rotary, and is here represented by a circle. Adjacent to this illustration is a pattern drawn with the pen at the same adjustment, but without holding the table stationary, and represents the resultant of the ovoid curve superposed on the revolving circle.



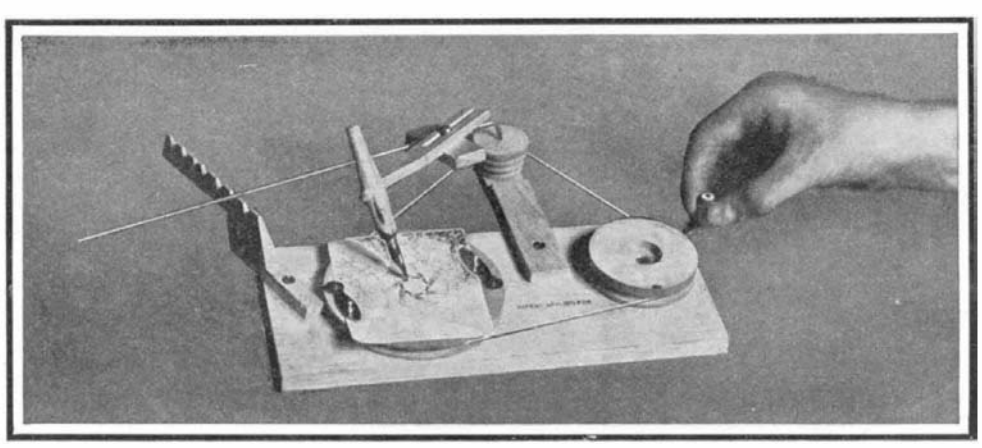
Some Patterns Produced by the Geometrical Toy, Showing the Wide Scope of Its Work.



Ovoid Shows Path of Pen. Circle Shows Rotation of Paper. **Design Produced by Combination of the Curves.**

Analysis of a Design.

It will be evident that the size of the pen pulley with relation to that of the table bears an important influence on the form of the design. That is, if the two pulleys are geared three to one, the figure will be a three-sided or three-lobed design. In order to permit varying the character of the figure, the peripheral face of the pen-oscillating pulley is tapered, and is formed with three grooves of different diameters.



A MECHANICAL TOY WHICH DRAWS GEOMETRICAL DESIGNS.

Since the pulley is mounted on a pivoted arm, it may be moved to loosen the belt, and the latter may then be shifted from one groove to another, thus changing the gear or the ratio of rotation between the pulley and the revolving table. The best results are obtained when the diameter of the table is not a perfect multiple of the diameter of the pulley, for then the pen, after describing, say, a seven-lobed figure, will not come back to the starting point, but will continue the design at a slight displacement with respect to the original figure. If the operation is sufficiently prolonged, a continuous circular pattern may be formed, as shown in most of the designs here reproduced. The scope of the device is increased by providing a means for adjusting the pen to any angle with the rod, or extending it to any desired distance from the rod; and still another variation is afforded by pivoting the guide rack to the baseboard, so that by swinging the rack to various angles the designs may be further modified. It will be evident that the toy, crude as it may seem, embodies sufficient elements to produce a countless number of combinations, and hence it should prove of endless amusement to children, as the changes produced by slight variations of adjustment are kaleidoscopic in character. Furthermore, a toy of this kind is bound to be instructive to any one.

The Portland Cement Industry.

In the United States the cement industry has prospered to a degree that would seem to justify indulgence in the alleged American propensity to boast. Taking into consideration the brief period that has elapsed since America was entitled to be called a cement-producing country, the record of the industry stands without a parallel. One has merely to recall the fact that 82,000 barrels of Portland cement comprised the output in 1880, and to be told that the estimate for 1906 has been placed at the enormous total of 42,000,000 barrels or more, to be convinced that the development of the industry in this country has been truly marvelous. Certain it is that both the production and use of cement are constantly increasing, and not solely because of great enterprises like the construction of the Panama Canal, the reclamation of deserts, and the rebuilding of cities, but because there is growing appreciation and understanding of the value of cement. The last has operated to give the cement trade a tremendous impetus in the United States. Not only does America easily take first place among the cement-producing and using countries in the world, but so unprecedented is the demand for cement and so thoroughly established is the industry, that no one can safely predict its future magnitude. A potent factor in all this has been the gradual decline in the cost of manufacture and the selling price as compared with the situation of the early nineties. The wide distribution of the industry has been another important consideration. It has afforded the people generally an opportunity to become familiar with the many virtues of cement and concrete construction, and it is now extensively used in communities in which a barrel of cement would have been a novelty a short time ago.

To reflect upon the development of the past few years is to become convinced that, after all, this country has merely crossed the threshold in the evolution of the cement industry. Cement in factory construction may be said to have fairly begun. In the matter of dwellings and kindred structures the field has scarcely been touched. Granting that there can be no further saving effected in the cost of production, no increased competition in manufacture, and that progress in structural methods is about to cease, even so, under present conditions, the use of cement must increase far beyond the present output.

To sum up the situation briefly, America has first and foremost a large home demand. Cement is sold at a reasonable price within the reach of all classes of consumers, but at a price which allows a fair profit to the manufacturer. The consumption of cement is constantly expanding, but the establishment of new factories precludes the probability of exorbitant prices. Viewed from every standpoint the cement industry in this country appears to be on a substantial and wholesome basis.—Robert W. Lesley in the Engineering and Mining Journal.

Platinum $34 an Ounce.

The year 1905 saw a phenomenal rise in the price of platinum and a greatly increased production in the United States. The annual report of the United States Geological Survey on the production of platinum, prepared this year by Mr. F. W. Horton, contains details of exceptional interest. It shows that early in March, 1905, the price of ingot platinum advanced from $19.50 an ounce to $21 an ounce, surpassing gold in value. On April 1, 1905, the price fell to $20.50 and remained firm at this quotation until February 1, 1906, when it jumped to $25 an ounce, where it remained until September 1, 1906, when it leaped to the unprecedented value of $34 an ounce. Mr. Horton's report also shows that the production of platinum in the United States increased from 200 ounces in 1904 to 318 ounces in 1905. This report is published as an advance chapter of the annual volume, "Mineral Resources of the United States, 1905," and is distributed free of charge, on application to the United States Geological Survey.