

Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT NO. 37 PARK ROW, NEW YORK.

O. D. MUNN.

A. E. BEACH.

TERMS.

One copy, one year, postage included.....\$3 20
One copy, six months, postage included..... 1 60

Club Rates.

Ten copies, one year, each \$2 70, postage included.....\$27 00
Over ten copies, same rate each, postage included..... 2 70

By the new law, postage is payable in advance by the publishers, and the subscriber then receives the paper free of charge.

Notices.—Persons subscribing will please to give their full names, and Post Office and State address, plainly written, and also state at which time they wish their subscriptions to commence, otherwise the paper will be sent from the receipt of the order. When requested, the numbers can be supplied from January 1st, when the volume commenced. In case of change in residence, state former address, as well as give the new one. No changes can be made unless the former address is given.

If any of our readers fail to receive their numbers regularly; if the direction is not plainly written; if premiums are not received; or if there is fault of any sort at this office, we will thank our friends to send us postal card complaints, and repeat the same, if need be, until the remedy is effected. Do not hesitate to complain. We desire to keep all matters between ourselves and patrons right and satisfactory.

VOLUME XXXIV., No. 5. [NEW SERIES.] Thirty-first Year.

NEW YORK, SATURDAY, JANUARY 29, 1876.

Contents.

(Illustrated articles are marked with an asterisk.)

Table listing various articles such as Air ship, the wreck of, 69; Air, temperature of, etc. (69); Alloy for models, 69; Alumina, fusible (41); Alum in machine (33); American meat in England, 72; Ammonia for nickel plating, 74; Aniline, discolored (73); Annealing cast iron (50); Answers to correspondents, 74; Band sawing machine*, 72; Beet cider, 72; Bichromated gelatin (25); Boilers, priming in (59); Boiler tubes, corroded (7); Bricks, Bath, 68; Brushes, artists', 74; Business and Personal, 74; Butter, oils from (28); Canal steaming, 68; Canary seed (48); Caraway seed (43); Castings, cleaning (58); Cement for roofs (72); Centennial exposition, the, 68; Chills (44); Coining*, 67; Comet, what is the tail of a, 67; Contagion in our schools, 68; Copal, dissolving gum (30); Copper edge tools (47); Crab, the Buddha*, 68; Ducks and terrapins, 68; Eau de Cologne (51); Engine, compression*, 66; Engines for boats, etc. (56); Engines, small, etc. (9); Fat, how to grow, 63; Fire, improved, 63; Fires, mysterious, 63; Force, the new, 63; Friction in shaft and hub (58); Frost on trees, effect of, 63; Gas apparatus, improved*, 63; Gas from steam boilers (11); Gold, weight of (49); Grinding machine*, 63; Gun, the 81-mm (31); Heating furnaces (64); Heating houses by steam (13); Heredity, new theory of, 64.

THE SCIENTIFIC AMERICAN SUPPLEMENT. No. 5.

For the Week ending January 29, 1876.

TABLE OF CONTENTS.

Table listing sections of the supplement: I. MECHANICS AND ENGINEERING; II. ELECTRICITY, LIGHT, HEAT, ETC.; III. THE CENTENNIAL INTERNATIONAL EXHIBITION; IV. PROCEEDINGS OF SOCIETIES; V. ASTRONOMY; VI. CHEMISTRY AND METALLURGY; VII. TECHNOLOGY; VIII. MEDICAL; IX. MISCELLANEOUS.

The SCIENTIFIC AMERICAN SUPPLEMENT is uniform in size with the SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, \$5.00 a year, postage paid, to subscribers. Single copies, 10 cents. Sold by all news dealers throughout the country.

COMBINED RATES.

The SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT will be sent together for one year, postage free to subscribers, on receipt of \$7.00.

Remit by postal order. Address MUNN & CO., PUBLISHERS, 37 Park Row, New York.

Single copies of SUPPLEMENT sent to any address on receipt of 10 cents.

A PRACTICAL dairyman sends the following about rendering winter churning easy: Strain the milk into pans and set them on a pot of boiling water on the stove. Heat the milk quite hot, but not so as to scald. Set away the pans, and in 36 hours thick cream will have formed. At each skimming stir the cream well together, and, when enough for a churning has accumulated, take care, in cold weather, to have the chill taken off the cream; then scald the churn, put in the cream, and churn gently; and if the butter does not come in less than ten minutes, you may judge that your cream is too cold.

STEAM ON THE HIGHWAYS—TEN THOUSAND DOLLARS REWARD.

The State of Wisconsin has taken a very practical initiative in the important matter of promoting the use of steam power on the highways, by offering a reward of ten thousand dollars to the inventor of any successful machine, to be tested as stated below.

This reward appears to be intended simply as a token of the importance of the matter to the State—a sort of recognition, merely, of the great benefit that the discoverer will bestow upon Wisconsin, to say nothing of the advantages he will confer upon the world in general.

We subjoin the text of the law, which is now in vogue, having been passed at the last session of the Legislature. We may add that it is to the efforts of Mr. G. M. Marshall, of Big Spring, Wis., a member of the Legislature, that the passage of the law is due. Mr. Marshall is a most enterprising, intelligent, and practical man, and we could wish that many more of such gentlemen were chosen to represent the people in our various State legislatures. There is undoubtedly a vast work to be done, an astonishing economy to be gained, by the adaptation of steam to highway traffic, and we commend the subject to the serious study of our inventive readers.

We will make but one suggestion, which is that, in the study of plans for machinery for this purpose, the inventor should endeavor to provide a practical method of increasing or diminishing, at will, the leverage of his engine upon the vehicle, so that, without changing the speed of his engine, he may be able to reduce or increase the velocity of the vehicle thus enabling him to surmount bad places and heavy grades at a slow velocity, while running faster where the roadway is level and smooth.

The provisions of the law are so plain and simple, and the payment of the reward so certain, that we have no doubt there will be many competitors; while the general benefits of the competition will reach far beyond the particular object for which the reward is offered. The study which this competition induces will unquestionably lead to many new and useful collateral discoveries and inventions.

It will be observed that the successful inventors of this machine are not required to surrender any of their rights in respect to patents; but in addition to the pecuniary reward, they may enjoy the patent monopoly of their inventions in all the States of the Union, and in fact in all foreign States.

The following is the text of the law:

The People of the State of Wisconsin, represented in Senate and Assembly, do enact as follows:

Section 1. There is hereby appropriated the sum of ten thousand dollars, out of any money in the Treasury not otherwise appropriated, to be used as a bounty, and to be paid to any citizen of Wisconsin, who shall invent and, after five years' continued trial and use, shall produce a machine propelled by steam or other motive agent, the object of which is a substitute for the use of horses or other animals on the highways or farm.

Section 2. The test of successful use shall be that any machine or locomotive, entering the lists to compete for the prize or bounty, shall perform a journey of at least two hundred miles, on a common road or roads, in a continuous line north and south in this State, and propelled by its own internal power, at the average rate of at least five miles per hour, working time.

Section 3. The said locomotive must be of such construction and width as to conform with or run in the ordinary track of the common wagon or buggy now in use, and be able to run backward or turn out of the road to accommodate other vehicles in passing, and be able to ascend or descend a grade of at least two hundred feet to the mile.

Section 4. The Secretary of State is hereby empowered and authorized, when satisfactory proof that the above conditions have been complied with, to draw his warrant on the Treasury for the sum of ten thousand dollars, and pay the same to the inventor of the successful machine.

Section 5. This act shall take effect and be in force from and after its passage and publication.

GALTON'S NEW THEORY OF HEREDITY.

Next to the origin of life, and of far greater practical importance, the question of heredity is preëminently the great biological question of the day. How is it that, in the higher orders of plants and animals, the offspring resembles not only the parent, but often, and in a more remarkable degree, some remoter ancestor? How are characteristics of figure, temperament, mental and moral traits, etc., carried over from generation to generation? More mysteriously, how are the peculiarities of the grandparent transmitted to the grandchild, skipping the intermediate link? And how do acquired traits become hereditary?

Like the author of pangenesis, Mr. Galton adopts the hypothesis of organic units as the necessary basis of the science of heredity. This hypothesis almost necessarily implies: First, that each of the enormous number of quasi independent units, which make up each and every organism, must have a separate origin or germ. Second, that the stirp (by which term he designates the sum total of the determining elements of the newly fertilized ovum) contains a host of germs, much greater in number and variety than the organic units of the structure to be derived from them; so that comparatively few germs are developed. Third, that the germs which are not developed retain their vitality, propagate themselves while latent, and contribute to form the stirps of the offspring. Fourth, that organization wholly depends on the mutual affinities and repulsions of the separate germs, first in their stirpal, and subsequently during all the processes of development. For proofs of the reasonableness of these postulates, the reader is referred to the arguments of Mr. Darwin. By means of them, and what to him appear to be their necessary consequences, Mr. Galton explains why it is that none of the higher races admit of being long carried on by any system of unisexual parentage: conse-

quently the necessity of double parentage, and therefore of sex. This necessity in complex organizations is, he holds, the immediate consequence of a theory of organic units and germs.

Suppose, for example, a gardener takes the second bud of a plant and raises from it another plant, the second bud which is used in like manner, and so on consecutively. At each successive stage there is a chance of the dying out or omission of some one or more of the various species of germs in the stirp; and of course when they are gone, they are lost for ever. From time to time, this chance must fall unfavorably, causing deterioration of the race. If the loss be vital, the race will be extinguished at once: otherwise it will linger on until the accumulation of small losses becomes fatal. Exactly the same argument applies to every other unisexual process, all of which lead to deterioration and final extinction: subject, we should say, to the contingency of an origination de novo of organic units or their germs in the race. On the other hand, when there are two parents, the chance deficiency of any particular species of germ in the contribution from either parent will be likely to be supplied by the other, and the extinction of the family indefinitely postponed. And even if a few lines do run out, the remaining families fill up, only too easily, the gap.

From the rapidity of the visible changes in the substance of the newly fertilized ovum, it is inferred that the invisible germs in the stirp are in restless and eager pursuit of new positions of organic equilibrium, due, it may be supposed, to the unequal rates of development of some of the better nourished germs. Segregations occur as much as aggregations, repulsions concurring with affinities, doubtless, in producing them. The probable behavior of these germs under various conditions, Mr. Galton illustrates by analogy with political affairs. The successive segmentation of a cell is compared to the division of a political assemblage into parties, having thenceforward different attributes. Or the stirp may be compared to a nation, and the germs that achieve development to its foremost men, who succeed in becoming two nation's representatives.

The great dissimilarity frequently observed between brothers and sisters is similarly illustrated by a political metaphor. A uniform constituency will always have representatives of a uniform type; and this precisely corresponds with what occurs in animals of pure breed, whose offspring always resemble their parents and each other. On the other hand, when a constituency is very varied, trifling circumstances will change the balance of parties, and therefore, although there may be little real variation in the electoral body, the character of its political choice at successive elections may change abruptly. Similarly, in mongrel breeds, the greater the mixture, the greater the variety of the offspring. In like manner Mr. Galton explains why it is that the likenesses and differences of twins are more marked than those of ordinary brothers and sisters.

It is an essential condition in the theory of pangenesis that the developed portion of the stirp is the chief agent in maintaining the progeny of germs. Mr. Galton, on the contrary, holds that the developed part of the stirp is almost sterile, fertility residing in the non-developed residue, or rather in its progeny and representatives (whatever, or however numerous, they may be) at the time when the individual has reached adult life. In this way he explains why, although hereditary resemblance is the general rule, the offspring is frequently deficient in the very peculiarity for which the parent was exceptionally remarkable. "We can easily understand," Mr. Galton remarks, "that the dominant characteristics in the stirp will, on the whole, be faithfully represented by the structure of the person who is developed out of it; but if the personal structure be a faithful representative of the dominant germs, it must be an unfavorable representative of the germs generally, and therefore a fortiori of the undeveloped residue: nay, in extreme cases the person may be absolutely misrepresentative of the residue, the accidental richness of the sterile sample, in some particular valuable variety of germ, having drained the fertile residue of every germ of that variety." Instances of this sort frequently occur in the offspring of men of extraordinary genius, in which cases it is inferred that all the germs of genius were used up and rendered sterile in the structure of the parent, leaving the child exceptionally deficient. Another alleged result of the sterility of the developed elements of the stirp is the strong tendency to deterioration in the transmission of every exceptionally gifted race. By the same hypothesis, Mr. Galton explains the almost complete non-transmissions of acquired modifications through abruptly changing conditions, education, etc.

According to the theory of pangenesis, the germs or gemmules must freely circulate with the blood. On the strength of his experiments with rabbits, showing them to breed true after large transfusion of the blood of alien species, Mr. Galton holds that Darwin's theory demands too much: he is satisfied, however, that the segmentations of the stirp are not perfectly clean and precise, but that each structure includes many alien germs, whereby the progeny of all the contents of the residue of the stirp are distributed over the body, thus enabling the lower animals to replace lost limbs and the higher to restore wounded tissues.

Of the inheritance of non-congenital peculiarities, Mr. Galton is more than ordinarily sceptical. At most, "acquired modifications are barely if at all inherited, in the correct sense of that word." He accepts the supposition that they are faintly heritable, however, and accounts for such inheritance by a modification of pangenesis, to the effect that each cell may be supposed to throw off a few germs that find their way into the circulation, with a chance of occasionally finding their way to the sexual elements, and of becoming