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(Illustrated articles are marked with an asterisk.)

THE SCIENTIFIC AMERICAN SUPPLEMENT.
No. 5.
For the Week ending January 29, 1876.

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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: consequently 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 distinction: 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

naturalized among them: a process independent of the causes supposed mainly to govern heredity.

To illustrate the relationships of parents and offspring, Mr. Galton resorts again to a political comparison. The idea of such relationship being one of direct descent he holds to be quite untenable. From his point of view, the stirp of the child is to be considered as descended directly from a part of the stirps of each of its parents, while the personal structure of the child is an imperfect representation of his own stirp, and the personal structure of each of the parents is no more than an imperfect representation of each of their own stirps. The idea of filial relationship, which likens it to that which connects colonists to their parent nations, errs in making the relationship too close and strong. It resembles more that which connects the representative government of the colony with that of the parent nations. This is his first approximation. The second approximation consists in making allowance for the limited power of transmitting acquired peculiarities, that is, for the reaction of the personal structure upon the sexual elements and thereby upon the future stirp. This he allows for by supposing the governments of the parent states to have the power of nominating a certain proportion of the colonists.

INFERNAL MACHINES.

Recent European mails bring further details of the diabolical plot which accidentally culminated in the fearful dynamite explosion on the wharf of the steamer Mosel, in Bremerhaven. It seems that the igniting mechanism was a common clock, of strong construction, and with its works so arranged as to cause a thirty pound hammer to strike a blow every ten days. The dynamite was placed in four zinc boxes arranged one above the other, the clock and hammer being between the second and third. As to how the explosion was caused there is much difference of opinion, but it is probable that it was due to one of two causes: either the dynamite exuding out of its receptacles and being exploded by the concussion of dropping the box, or the premature fall of the hammer.

It is curious to mark how much mechanical ingenuity has been expended on these engines of destruction: ingenuity which, if devoted to honest ends, would have gained for its possessors far greater rewards than they ever might hope to obtain through the terrible crimes intended. Thomassen's apparatus, above described, is comparatively crude, notably so in view of the fact that he must have examined other devices before deciding upon its use. Take, for instance, the machine which, some three years ago, it was attempted to ship aboard one of the Messageries Maritime Company's vessels, at Bordeaux or Marseilles. As usual, a heavy insurance on worthless goods was the object of the plan. The principle of this arrangement was that of the needle gun. The needle was set in a bolt, which was acted on by a spring in a tube. In order to hold the bolt back, thus compressing the spring, a catch on the former engaged with a hammer-headed lever. The lever was also attached to springs, which tended to draw it away from the catch, but the operation of which was opposed by a large disk placed close against the lower part of the lever head and held in its place in front of the catch on the bolt. In the disk there was a notch deep enough for the lever head to drop into when that portion of the disk was suitably presented. The disk was rotated by a train of clockwork at a fixed speed, and its edge was spaced off so that two consecutive marks would come opposite a fixed point in exactly one day. Supposing, therefore, the disk to be marked in ten portions, and the machine to be required to explode in eight days, the lever would be set at the eighth mark from the notch. The clockwork started, the disk would revolve until, at the eighth day, the notch would come opposite the lever, and the latter would fall into it, so freeing the needle and exploding the cartridge. All of this mechanism was placed in a common packing box, and nitro-glycerin or other fearfully powerful explosive was used. Fortunately the scheme was discovered and frustrated in time.

The coal shell is another infernal device, the invention of which, the London *Times* intimates, may be attributed to some over-zealous supporter of Mr. Plimsoll's parliamentary endeavors to prevent the sacrifice of sailors' lives in rotten ships. Each shell was a hollow brass casting, resembling a moderate-sized lump of coal, and was simply filled with an explosive mixture. When coal was delivered to a vessel, it was intended (said the witness, who is supposed to have concocted the shell and the sensational story) to mix in a few of the shells, which, when carefully blacked, it would be impossible to distinguish. They would, with the coal, be shoveled into the furnaces, and instantly blow up, destroying the vessel, whose loss would probably subsequently be attributed to a boiler explosion.

Ingenuity of a much higher and hence more fiendish order has been brought to bear in the construction of "rats," which are of two species, one intended to operate on iron, the other on wooden ships. The iron ship rat consisted of a pig of iron, similar in appearance to that commonly used for kentledge or ship's ballast. Of course where several hundred of these pigs were carried next the keelson and on the floor of the ship, careful scrutiny of each would be altogether impossible. Into the block a hole was made, and in this a tubular boring tool, hollow and filled with acid, was placed. Above the tool a weighted lever was rigged, and so placed as to work to and fro horizontally in a space cut out of the top of the pig. The whole was carefully boxed in, and the surface of the iron restored. The rolling of the ship would cause the lever to sway back and forth, and so act on the tool as to carry it against the ship's side. A spring helped to push the tool, and the latter, aided by the acid, very slowly but surely made its way through the iron and opened a leak. The latter, being in a location very difficult to find or even to plug, unless closed in some way would cause the ship to fill and sink.

The wooden rat was much more complex, and certainly more ingenious. In a box were placed, at a distance of five feet apart, two vertical cylinders. Between these was a horizontal cylinder having a piston working in it, the rod passing through a stuffing box. The other end of the rod worked a weighted ratchet drill. The vertical cylinders were each half filled with water, and each connected by a separate pipe with opposite ends of the horizontal cylinder. When the ship rolled, the water, alternately leaving and returning to the vertical cylinders, acted on the piston, the reciprocating motion of which was converted into rotary motion at the auger, which thus worked its way through the vessel's side. After the hole was made, the auger was freed from its fastening and dropped through into the water, so that it neither choked the hole, nor remained as evidence of how the same was produced. The box, even if discovered, would indicate nothing save to a mechanical eye. Both of the rats, of course, required that their originator or a confederate should adjust them to their work.

The use of infernal machines for wholesale destruction, in order to gain insurance, is of comparatively recent date, as the old and common employment of these devices was, and still is in a measure, to destroy individuals obnoxious to the perpetrator of the crime. In 1838, it will be remembered, Fieschi devised an ingenious arrangement of twenty-five gun barrels (perhaps the prototype of the modern mitrailleuse), which were discharged all at once at the object of his hatred, Louis Philippe, without accomplishing the purpose intended, however. The Orsini bombs, designed for the slaughter of Louis Napoleon and his family, were small iron shells made in halves and screwed together. The interior was filled with powder, and the outside completely studded with nipples and percussion caps, so that it would be impossible to throw down the bomb without some cap exploding the charge. These, when tried, killed several people; but the Emperor escaped unharmed.

The simplest infernal machine is that peculiar to the New York rascal, who occasionally dispatches it per express to politicians who have fallen from his good graces. The last recipient we can recall was Comptroller Green, of this city. The arrangement received by this gentleman, luckily without injury, was a small innocent-looking box having a sliding lid. The interior of the latter was lined with sand paper, against which the heads of several matches (of the parlor or explosive kind) were placed. On withdrawing the lid, the friction of the sand paper would ignite the matches and then the powder of a heavy cartridge in the box. The effect would be to blind or severely injure the opener; but in the case above mentioned, nefarious designs were suspected, and thorough soaking in water allowed of the box being safely examined.

We had prepared drawings of some of the ingenious machines which, as above described, have been applied to such diabolical uses, and contemplated publishing engravings of the same in connection with the foregoing article; but on second thought, it seemed to us wiser not to do so. Crimes, say those who have made the evils of mankind a study, are epidemic; and there are minds so delicately poised that but a mere touch is necessary to turn them in the direction of evil. Mr. James T. Fields has recently had a lengthy conversation with that incarnate infernal machine, the Boston boy murderer Pomeroy, who so mercilessly mutilated his little playfellows; and as a result of his interview, Mr. Fields traces the boy's mania for blood, in some measure, to the perusal of the sanguinary yellow covered literature of the dime novel type. Doubtless the writers and publishers of the murderous adventures would be as much shocked as any other good members of the community would be, could the effect of their work on badly balanced and illiterate minds be demonstrated to them beyond doubt. So therefore we, desiring above all else to avoid even the remotest probability of working evil, think best to deny our pages to the semblance of the means whereby crimes so horrible and atrocious have been committed, for the harm caused might vastly exceed the advantage of such knowledge as the pictures might impart.

SAFE SAVINGS.—AN IMPROVEMENT NEEDED.

Our English cousins are fast reducing the problem of how to live cheaply and save money to a science. They have invented coöperative societies of which the members can buy the necessaries as well as the comforts of life at greatly reduced rates, and have long since brought annuity schemes and similar facilities for putting by funds to a high degree of perfection. The latest invention of this kind is the Provident Knowledge Society, an incorporate association whose professed object "is to endeavor to make regular weekly saving a national habit, and so increase the facilities for saving that it shall be as easy for a man to put by a small sum as it is now for him to spend that sum in beer or spirits." A high aim certainly, and one cannot but feel curious to know will be the practical result.

The association, it seems, works in two ways: First by advising people, either verbally or by letter, relative to forming schemes to encourage frugality, and second by issuing pamphlets, written in the simplest and plainest language, about various subjects of the same nature. Supposing, therefore, a workman can save a few pence a week, and has no idea how to do it, or what the result will be if he does, he sends a penny stamp to the society with his question, and back comes the necessary manual, telling him all he wants to know with official precision. There are pamphlets about life insurance, pawnbroking, saving banks, hints for working men, to general employees, and to servants, and suggestions how to start coöperative stores and penny banks, the details of which it is hardly necessary to go into, since in this country a very different condition of affairs in point of facilities for saving money, unfortunately perhaps, exists. We say unfortunately, because there is really among us no definite and absolutely certain system whereby a man, after he has put by his savings, can be assured that they will always be his. He has a choice, to be sure, of depositing his funds in a bank and leaving them there idle, but subject to check at sight, or of placing them in a savings' banks, gaining a certain interest, or of buying an endowment or annuity policy from an insurance company. We refer, of course, to very small amounts, and therefore such investments as good mortgages or government bonds are out of the question. The difficulty with all three plans abovementioned is their lack of absolute security. Banks, flourishing one year, may find cause to suspend the next; saving institutions (as did several of the largest recently in this city) may suddenly collapse and sweep away the hardly earned savings in an instant; and insurance companies are by no means exempt from a like fate. So that, after all, the working man, who here puts his money out of his possession for safe keeping, does so with the knowledge of incurring a risk.

It has frequently occurred to us that a plan might be perfected whereby the government could be made the repository of the public's savings, and perhaps a system of post office savings banks devised, imitating that now in vogue in England. There every post office is a legal recipient for deposits of any sum over one shilling; the account of each and every depositor is kept at the head office in London, and, immediately after he pays in a deposit, he receives post free a letter from the metropolis announcing the placing of the sum to his credit. When he wishes to draw all or a portion of his funds, he notifies his postmaster, who reports to London the amount called for, and the depositor again receives a free letter, advising him of the fact and inquiring whether all is right. This letter he carries to the postmaster who, in return therefor, pays him the money. This plan effectually precludes every possibility of fraud by intermediate agents, and the depositor has the security of his government for the safety of his cash. He is provided with a bank book, and in other respects deals with the post office as if it were an ordinary savings' bank. Two and a half per cent interest is allowed him on his deposit. In conjunction with this system, the government sells annuities, so that any person can, by depositing a small sum for a certain period, purchase an annuity for the rest of his life.

In one of the pamphlets published by the society above mentioned, the inquirer is told what, under the annuity plan, can be done for eight pence (16 cents) a week. For that sum, paid from the age of nineteen to sixty, any man may obtain, on government security, a pension of five shillings ($1.25) a week for the balance of his life. For four pence (8 cents), paid during the same period, he may buy a pension of 60 cents a week, and more or less in proportion. If the depositor who begins at nineteen dies before he attains the age of sixty, say at forty years of age, the money that he has laid by is returned to his heirs at law in absence of a will, or to any one he may designate; it amounts to £35, or $175. If he dies at fifty, about $260 would be returned, and so on So that the arrangement is entirely different from an endowment life policy by an insurance company, which might be forfeited through failure to pay premiums. This advantage more than compensates for the comparatively small returns which the investment at first sight appears to yield. There is beside, under this pension or annuity arrangement, a provision for drawing out money in case of illness.

It will be seen therefore that the depositor may either use the government as a temporary depositary for his savings or he may buy from it, for a very small weekly sum, a pension sufficient to keep him from want in his old age. There are several circumstances which militate against the adoption of a scheme of this kind here, but we imagine that ultimately the objections might be overcome. The principal one lies in the fact that our post office is a non-paying institution, and is a charge instead of a source of revenue to the country. The question then arises of whether the increased burden which the post office savings' bank department would add, to that already existing, would be compensated for by the benefits gained. Again, this being a country of magnificent distances over which to send a free letter for each deposit or withdrawal, it would be an expensive proceeding: and it would be necessary to designate several cities where accounts for adjoining sections of the country could be kept. There are various other considerations which might be mentioned, relatively to adopting the system here. In England, however, recent statistics show that about one person in every seventeen of the population takes advantage of the facilities thus afforded, a fact which fully demonstrates the value and popularity of the plan.

There is no mistaking that the circumstance of the recent collapse of the savings' banks in this city has, for a time at least, shaken public faith in institutions of that character, and indicated moreover how little people examine into the affairs of concerns to which they entrust their funds. Whether the safe English system be adopted here or not, certain it is that a safer plan for poor people's savings is badly needed; and in modifying the English or devising another or better plan, our political economists and financiers will find a useful opportunity for the exercise of their abilities.

BATHE weak eyes before retiring at night with a little sugar dissolved in warm water.