The Planet Mars.

Professor Lockyer is of the opinion that human life on the planet Mars may be very much like human life on the earth. The light cannot be so bright, but the organs of sight may be so much more susceptible as to make the vision quite as good. The heat is probably less, as the polar snows certainly extend further, but by no means less in proportion to the lessened power of the solar rays. The professor agrees with others that several remarkable seas—including inland seas, some of them connected and some not connected by straits with still larger seas—are now definable in the southern hemisphere, in which, as in the case also with the earth, water seems to be much more widely spread than in the northern hemisphere. There is, for example, a southern sea exceedingly like the Baltic in shape; and there is another and still more remarkable sea, now defined by the observation of many astronomers—one near the equator, a long straggling arm, twisting almost in the shape of an S laid on its back, from east to west, at least 1,000 miles in length, and 100 miles in breadth.

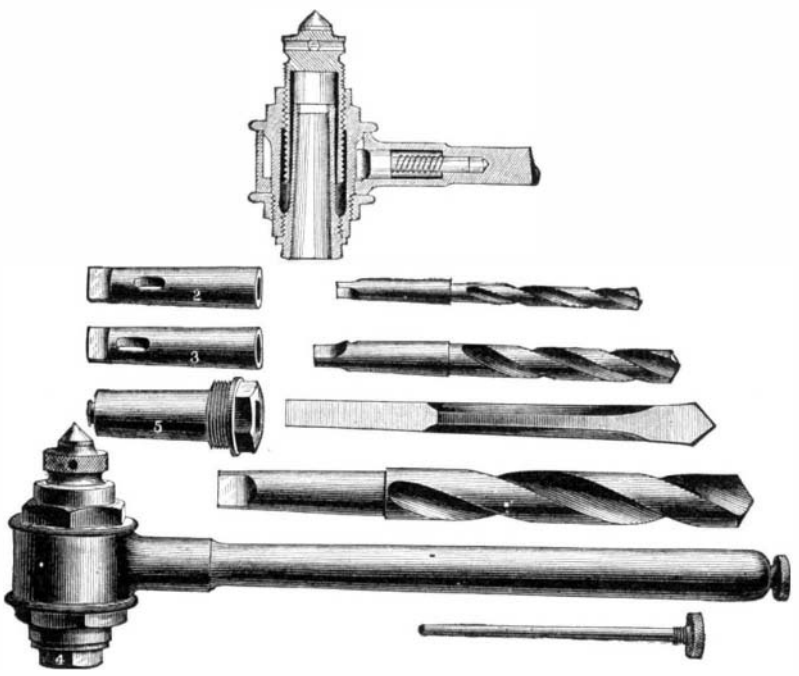
Does Invention Discourage Labor?

Burdette, of the Burlington *Hawkeye*, gravely remarks that it is a noticeable fact that the people in the prairie country of Iowa do more work than any other people in the West. This is because there is nothing about the top rail of a barbed wire fence that invites men to sit on it and talk politics while the grasshoppers get in the crops.

A NEW RATCHET DRILL.

The compact and useful tool shown in the accompanying engraving is made by the well known tool manufacturers, Messrs. Pratt & Whitney, of Hartford, Conn. This ratchet drill is contrived so that it will receive either twist drills or common drills. The handle is drop-forged of tough wrought iron; the spindle, of steel, has substantial ratchet teeth cut in its periphery, engaging with a pawl in the handle, which covers both pawl and ratchet, and protects them from dirt. The steel feed screw is of large diameter and hollow; being hardened, it is not liable to injury in ordinary use. This arrangement gives the drill large capacity in small compass, the length from the top of the feed screw to the bottom of the drill collet being only five inches. By transferring the collet and feed screw, as arranged for right hand drilling, to the opposite ends of the spindle, the ratchet may be used for left hand drilling. This feature will be appreciated by practical men.

Each drill is provided with four sockets for adapting it to the various sizes of twist drills, and to the ordinary drill having a square shank. The larger sockets are held in the spindle by a screw thread; the smaller sockets are fitted to the larger ones, and may be forced out by turning the feed screw until it bears upon their inner end. The feed rod, when not in use, is placed in the handle and held by a screw thread.



RENSHAW'S RATCHET DRILL.

The Origin of Comets.

In the exposition of his theory of the development of the solar system, Kant supposes the comets to be formed from the matter of the condensing solar nebula. By him they were regarded as planets, which, in some way, had been thrown out of their normally circular orbits. Laplace, on the other hand, in his exposition of the nebular hypothesis, took the ground that comets were formed from the matter which is scattered through the stellar spaces, and that in their origin they have no relation with the solar nebula. Have we, in the accumulation of facts since the days of Kant and Laplace, learned anything that may help us to decide between these theories? Such is the inquiry proposed by Prof. H. A. Newton, who, in a recent number of the *American Journal of Science and Arts*, considers: First, what peculiarities each of them requires in the shape and distribution of the cometic orbits; and, second, compares with the theories the facts that have been observed with regard to the paths of 247 comets. The cometic paths are represented by the writer in two graphic curves, and when the results of actual observations are put into the same form, it is at first found that the curve thus obtained differs from both the theoretical ones. However, as the known comets all have their perihelion (that part of their orbit nearest the sun) within the orbit of Mars, and are exposed to planetary disturbances, the author calculates the influence of these disturbances, and arrives at the conclusion that the curve corresponding to the actual cometary paths is thus brought into good agreement with the theoretical curve deduced from Laplace's hypothesis, whereas it does not agree so well with that deduced from Kant's. It would seem, then, that the origin of comets must be placed in interstellar space.

New View of Infection.

The theory that very small organisms, either vegetable or animal, are the cause of all infectious diseases is very generally accepted at the present day. It passes as established and almost mathematically proven, because this theory alone is able to explain for us a series of phenomena that would otherwise be totally inexplicable. Hence the alpha and omega of all precautions directed against infectious diseases and epidemics consist in combating and destroying these organisms.

C. Von Nägeli, a Bavarian investigator of some repute, makes a decided objection to this theory, and offers a new view, of great practical and hygienic importance. He retains the idea that the smallest organisms (*pilze*), fungi, are the cause of all infectious diseases, but he holds that only those germs are dangerous and calculated to infect which enter our organs of respiration with the air we breathe. This is the peculiarity of his theory.

He considers, on the other hand, that infection through the unbroken skin, or through the digestive organs by means of water or food, is impossible. It cannot be denied that there are important reasons advanced to substantiate this view. It is established that we often partake of great quantities of different kinds of fungi in our food without any injury.

It is sufficient to mention the high game (*haut goût*), Roquefort cheese, vinegar pickles, and many other kinds of food enjoyed by whole classes of people. Bad drinking water, so much decried as unsanitary, does not contain any products of decomposition other than those found in the above described foods. There are also examples in large territories, as in the Karat, where the people are accustomed throughout life to drink bad water exclusively, and yet infectious diseases are almost unknown among them.

If Von Nägeli's theory should prove true and find general acceptance, it would cause a total revolution in the principles of public regimen and sanitation, and in their practical application. Then it would be no longer necessary to trouble ourselves about the generation of products of decay in masses of liquid, as in sewers, canals, damp soil, river and spring waters. On the other side every means must be employed to prevent these fungi diffusing through the air as a result of the drying up of such decaying masses.

These are, in a few words, the foundation of Nägeli's new theory, and its immediate result. The theory will meet with much opposition, and we cannot say we are pleased with the prospects which its practical results offer, or threaten, we might say. So far as we are aware, the facts are so strongly against the use of putrid water, that the attempt to use it would be attended with too much danger to encourage it. As chroniclers of the latest theories, true or false, which affect so intimately the welfare of mankind, we feel bound to present its salient features, and recommend those who feel any special interest in the subject to procure the author's little book entitled "Die niederen Pilze in ihren Beziehung zu den Infectionskrankheiten."

Lake Superior Copper.

In the counties of Houghton, Keweenaw, Ontonagon, and Isle Royale, Michigan, 37 copper mines were in operation during 1878. The output exceeded by 20,000 tons the yield of any previous year. More than half the entire product came from the Hecla & Calumet mine. This mine employs regularly about 2,000 men, and each successive year shows a larger product. Last year it turned out 12,500 tons of refined copper, worth over $4,000,000. The mine was opened in 1868, and has already divided among its shareholders $14,650,000, retaining a surplus of $3,000,000.

How to Distinguish Diamonds.

M. Rabinet, of the French Academy of Sciences, gives the following test for distinguishing colorless gems from diamonds. If a person looks through a transparent stone at any small object, such as the point of a needle, or a little hole in a card, and sees two small points, or two small holes, the stone is not a diamond. All white colorless gems, with the exception of the diamond, make the object examined appear double; in other words, double refraction whenever exhibited by a stone, is conclusive proof that it is not a diamond.

Physical Consequences of Death.

While critically reviewing, in *Nature*, a very suggestive though decidedly speculative volume entitled "Paradoxical Philosophy" (a sequel to the "Unseen Universe," and evidently by the same authors), the learned university professor of experimental physics at Cambridge, England, Prof. J. Clerk Maxwell, takes occasion to discuss with characteristic acuteness the position of science with respect to the physical consequences of death. He says:

"No new discoveries can make the argument against the personal existence of man after death any stronger than it has appeared to be ever since men began to die, and no language can express it more forcibly than the words of the Psalmist: 'His breath goeth forth, he returneth to his earth; in that very day his thoughts perish.'

"Physiology may supply a continually increasing number of illustrations of the dependence of our actions, mental as well as bodily, on the condition of our material organs, but none of these can render any more certain those facts about death which our earliest ancestors knew as well as our latest posterity can ever learn them.

"Science has, indeed, made some progress in clearing away the haze of materialism which clung so long to men's notions about the soul, in spite of their dogmatic statements about its immateriality. No anatomist now looks forward to being able to demonstrate my soul by dissecting it out of my pineal gland, or to determine the quantity of it by the process of double weighing. The notion that the soul exerts force lingered longer. We find it even in the late Isaac Taylor's 'Physical Theory of a Future State.' It was admitted that one body might set another in motion; but it was asserted that in every case, if we only trace the chain of phenomena far enough back, we must come to a body set in motion by the direct action of a soul.

"It would be rash to assert that any experiments on living beings have as yet been conducted with such precision as to account for every foot-pound of work done by an animal in terms of the diminution of the intrinsic energy of the body and its contents; but the principle of the conservation of energy has acquired so much scientific weight during the last twenty years that no physiologist would feel any confidence in an experiment which showed a considerable difference between the work done by an animal and the balance of the account of energy received and spent.

"Science has thus compelled us to admit that that which distinguishes a living body from a dead one is neither a material thing, nor that more refined entity, a 'form of energy.' There are methods, however, by which the application of energy may be directed without interfering with its amount. Is the soul like the engine driver, who does not draw the train himself, but, by means of certain valves, directs the course of the steam so as to drive the engine forward or backward, or to stop it?

"The dynamical theory of a conservative material system shows us, however, that, in general, the present configuration and motion determines the whole course of the system, exceptions to this rule occurring only at the instants when the system passes through certain isolated and singular phases, at which a strictly infinitesimal force may determine the course of the system to any one of a finite number of equally possible paths, as the pointsman at a railway junction directs the train to one set of rails or another. Professor B. Stewart has expounded a theory of this kind in his book on 'The Conservation of Energy,' and MM. de St. Venant and Boussinesq have examined the corresponding phase of some purely mathematical problems.

"The science which rejoices in the name of 'Psychophysik' has made considerable progress in the study of the phenomena which accompany our sensations and voluntary motions. We are taught that many of the processes which we suppose entirely under the control of our own will are subject to the strictest laws of succession, with which we have no power of interfering; and we are shown how to verify the conclusions of the science by deducing from it methods of physical and mental training for ourselves and others.

"Thus science strips off, one after the other, the more or less gross materializations by which we endeavor to form an objective image of the soul, till men of science, speculating in their non-scientific intervals, like other men, on what science may possibly lead to, have prophesied that we shall soon have to confess that the soul is nothing else than a function of certain complex material systems.

"Men of science, however, are but men, and therefore occasionally contemplate their souls from within. Those who, like Du Bois-Reymond, cannot admit that sensation or consciousness can be a function of a material system, are led to the conception of a double mind:

"'On the one side the acting, inventing, unconscious, material mind, which puts the muscles into motion, and determines the world's history; this is nothing else but the mechanics of atoms, and is subject to the causal law; and, on the other side, the inactive, contemplative, remembering, fancying, conscious, immaterial mind, which feels pleasure and pain, love, and hate; this one lies outside of the me-

chanics of matter, and cares nothing for cause and effect.' We might ask Prof. Du Bois-Reymond which of these it is that does right or wrong, and knows that it is his act, and that he is responsible for it, but we must go on to the other view of the case, which Dr. Stoffkraft alludes to [in the volume under review].

" 'I feel myself compelled to believe,' says the learned Doctor, 'that all kinds of matter have their motions accompanied with certain simple sensations. In a word, all matter is, in some occult sense, alive.'

" This is what we may call the 'leveling up' policy, and it has been expounded with great clearness by Prof. Von Nägeli. He can draw no line across the chain of being, and say that sensation and consciousness do not extend below that line. He cannot doubt that every molecule possesses something related, though distantly, to sensation, 'since each one feels the presence, the particular condition, the peculiar forces of the other, and, accordingly, has the inclination to move, and under circumstances really begins to move—becomes alive as it were. . . . If, therefore, the molecules feel something which is related to sensation, then this must be pleasure if they can respond to attraction and repulsion, that is, follow their inclination or disinclination; it must be displeasure if they are forced to execute some opposite movement, and it must be neither pleasure nor displeasure if they remain at rest.'

" Prof. Von Nägeli must have forgotten his dynamics, or he would have remembered that the molecules, like the planets, move along like blessed gods. They cannot be disturbed from the path of their choice by the action of any forces, for they have a constant and perpetual will to render to every force precisely that amount of defiection which is due to it. Their condition must, therefore, be one of unmixed and unbroken pleasure.

" But even if a man were built up of thinking atoms, would the thoughts of the man have any relation to the thoughts of the atoms? Those who try to account for mental processes by the combined action of atoms do so, not by the thoughts of the atoms, but by their motions. . . .

" Personality is often spoken of as if it were another name for the continuity of consciousness as reproduced in memory, but it is impossible to deal with personality as if it were something objective that we could reason about.. My knowledge that I am is quite independent of my recollection that I was, and also of my belief that, for a certain number of years, I have never ceased to be. But as soon as we plunge into the abysmal depths of personality we get beyond the limits of science, for all science, and, indeed, every form of human speech, is about objects capable of being known by the speaker and the hearer. Whenever we pretend to talk about the subject we are really dealing with an object under a false name, for the first proposition about the subject, namely, 'I am,' cannot be used in the same sense by any two of us, and therefore can never become part of science at all.

" The progress of science, therefore, so far as we have been able to follow it, has added nothing of importance to what has always been known about the physical consequences of death, but has rather tended to deepen the distinction between the visible part, which perishes before our eyes, and that which we are ourselves, and to show that this personality, with respect to its nature as well as to its destiny, lies quite beyond the range of science."

Health and Recreation.

Dr. B. W. Richardson, F.R.S., in a recent lecture, at the London Institution, on "Health and Disease," took the ground that there was no difference other than one of sentiment between work and recreation, which latter he held to be a question of sentiment altogether both in the young and old. It had always struck him that in the short and brilliant bloom of Greek history the reason why such excellence, physical and intellectual, was attained was the circumstance that from the beginning to the end of the Greek's career there was no such thing as work or play, but only life. If by some grand transformation we could in our day approach this ideal handed down to us by history, we should, in a generation or two, attain a degree of health which no mere sanitary provisions in the usual sense of the term can ever supply. Perhaps our climate and other conditions of life rendered a joyousness like that of Greece at its best unrealizable here. To the drawbacks of our heavy clothing in winter and our gross food at all seasons is added the unequal struggle for existence, dooming millions to a monotonous round of toil, until the whole body lends itself to the drudgery like an automaton, the movements of which the mind fretfully follows with little hope of any earthly relief. The most striking exception was the small but happy class who find in mental labor of a varied and congenial sort that diversity of work which is truly a recreation of the healthy and vital powers. Dr. Beard, of New York, had found that the life-value of 500 men of the greatest mental activity—poets, philosophers, men of science, inventors, politicians, musicians, actors, and orators—to be 64 years. On comparing this average with that of an equal number belonging to the rest of society, he found the latter to be but 50 years. In both instances the selection was made from those who had reached 20 years of age. A later calculation gave for 100 brain workers 70 years of life. Among the causes for this difference of 14 or 20 years in favor of judiciously varied brain work, Dr. Richardson and others had ascertained the most influential to be the recreative character of intellectual labor. Brain work Dr. Beard describes as the highest of all antidotes to worry. Scientists, physicians, lawyers, clergymen, orators, statesmen, literati, and merchants, when successful, are happy in their work without reference to the reward, and work on in their callings long after the necessity has ceased. Good fortune gives good health, Dr. Beard adds, and nearly all the money in the world is in the hands of brain workers, whose life is one long vacation. No doubt there might be an over-cultivation of mind which, so far from being recreative to the health of the body, would be positively injurious, just as there was often a no less mischievous over-cultivation of muscular power.

Preserving Meats.

In a series of lectures before the British Society of Arts, Dr. B. W. Richardson has been calling attention to putrefactive changes and the preservation of animal substances. One of the most remarkable of the many experiments made by the lecturer was with cyanogen gas. Dr. Richardson does not recommend this poisonous agent for the preservation of substances intended for food, but he calls attention to some of the striking results of the action of the gas.

"In my research," says Dr. Richardson, "I used a saturated alcoholic solution. The mode of procedure was as follows: The specimens of beef and mutton, two pounds each, were placed in glass jars, the jars were charged with coke vapor, and, when quite ready, a measured quantity of the alcoholic solution of cyanogen was introduced from a graduated syringe. The stopper of the jar was immediately inserted, firmly secured, and closely sealed down. After many experiments I found that thirty minims of the alcoholic solution of the gas was the sufficient measure for the perfect result of preventing putrefactive change. Of thirty-six specimens sent out, on a return voyage all came back completely preserved. Of the same number of specimens retained at home in a room heated up to 84° Fahr., all remained in like manner free of putrefactive change. When a specimen so preserved is taken out of the jar it is found to be free of any taint of putrefaction. There is no escape of gas from the bottle; there is no change of color; there is no unnatural softness and no unnatural hardness of the structure. The only peculiarity that is noticed is a faint odor of the cyanogen, which lasts even after exposure of the structure to the air for a long time. Exposed to the air, the meat retains its freshness as long as fresh flesh does, and after it has been cooked it is preserved much longer than ordinarily cooked fresh meat. Two specimens of meat, one of beef, the other of mutton, after being preserved by this plan, and after making the return voyage, were cooked by roasting, and were placed in a larder by the side of other specimens of beef and of mutton of the same size which had been cooked, but in no other way treated. When these last were entirely changed, and were covered with mould, the cyanogen specimens were as fresh as ever. I replaced the changed pieces by others freshly cooked, and when again these were decomposing, the cyanogen specimens continued good. After keeping these cooked specimens eleven days, and finding that they no longer gave forth the odor of cyanogen, I fed a dog with some of the mutton, and, as he was uninjured, I breakfasted myself on the remainder. The meat had been through an extreme test—a return voyage to Rio, exposure to the air uncooked for three days, and exposure after cooking for eleven days—yet it ate as naturally as if it had been killed two days only, and cooked but a few hours. All I can report about it as peculiar is that it had a very slight bitterness, like the bitterness which is tasted sometimes in eating pheasant. It was the taste of cyanogen in an extremely diluted form. In some natural meats, in the flesh of the pheasant specially, the same taste is commonly present."

How the Velocity of Cannon Shot is Measured.

The initial velocity of a shot, or, in other words, the rapidity with which a projectile flies at the outset of its career, is now measured at Woolwich by an electrical instrument, the invention of Major Le Boulengé, a Belgian officer. As in the case of other instruments of a like nature, the shot is made to break through two wire screens, placed at some distance from one another. The interval is usually about 100 feet. The screen is simply a wooden framework with fine wires zigzagging across, and it is these fine wires which the shot cuts. One screen is near the muzzle of the gun, and the other at the distance we have mentioned. No. 1 screen is in connection with an electro-magnet in the instrument house, and No. 2 screen with a second, the two magnets hanging close together. While the wires in front of the screen are perfect, an electric current passes without interruption, and the electro-magnets in connection with them are endowed with power, but this power ceases as soon as the shot cuts the wires of the screen. Before the gun is fired there is suspended to the magnets two rods of iron, which remain, however, only so long as the magnets are magnets. When the shot is fired, No. 1 screen is torn, and down falls the rod suspended to No. 1 magnet; an instant afterward, when the shot has reached No. 2 screen, No. 2 magnet also loses its virtue, and down falls the second rod. The time between the falling of the two rods is so small, that ere the first has fallen half its length the second has dropped upon a trigger, which trigger darts and strikes the side of No. 1 rod. When the latter is picked up, the first thing is to examine the surface for the mark of the trigger, for the position of this mark, whether high or low, tells the operator what he wants to know. The rod, being of a given weight, always takes the same time to fall, and according whether it has fallen half or quarter its length, so the time taken by the shot to travel between the screens has been long or short. In a word, the rod has only to be compared with a prepared scale in order to read off the number of feet per second at which the shot has gone on its way.

The pressure of the gases inside the gun as the shot is being expelled is recorded by the crusher gauge, an American invention. This is a tiny pillar of copper placed loosely in a tube, the end of which, made of steel, stands firm and fast, no matter what the pressure; consequently the soft copper pillar, when subjected to the action of the gas, gets compressed, or crushed, and assumes something of a barrel shape. The pillar and its case, being affixed to the base of the shot, gets the full pressure of the gunpowder gases, and its length afterward denotes how much this pressure has been. To secure more trustworthy pillars of the metal it is the practice to compress them first of all to a certain degree, to remove any honeycomb or imperfection, and, thus uniformly compressed, they may be relied upon to record the strain with accuracy. Comparison of the fired pillar with other pillars which have been subjected to known pressures, at once reveals the degree of force to which the former has been subjected in the gun. The maximum pressure, or strain, to which the 80 ton gun should be subjected is set down as 25 tons on the square inch, and it is with the aid of this crusher gauge that the strain exerted in the various experiments has been ascertained.

The Progress of Dentistry.

Some hopeful results in the practice of dental grafting have been recently brought to the notice of the French Academy by MM. David and Magitot. Two principal forms of such grafting are distinguished—the graft by restitution and the graft by borrowing. In the former a tooth is reimplanted, after having been extracted with a view to certain operations, which would be impracticable in the mouth. M. David has adopted this method for rectifying the direction of teeth, for treatment of caries in the extracted tooth and periostitis, and for stopping, also for facilitating operations on another tooth, or in another part of the mouth. The consolidation of the tooth restored to its socket occurs generally on the tenth or twelfth day. In cases of periostitis the process is somewhat slower. In the graft by borrowing, a sound tooth may be substituted for a decayed one. As regards transplantation from the lower animals, of course no zoological species has hitherto furnished teeth similar to ours in form, dimensions, color, etc. Still, sound roots (from a lower animal) may be substituted for bad ones, and may serve as a solid base for pivoted artificial teeth. The transplantation from one human being to another would generally involve objectionable mutilation. But sound teeth may be utilized for the graft when their extraction has become otherwise necessary. A tooth may be transposed from one part of the mouth to another. Practicing the dental graft by restitution, M. Magitot has operated in sixty-two cases, and fifty-seven of these have been decided cures—a success amounting to ninety-two per cent.

The History of Diphtheria.

It is often said that diphtheria is of modern origin, a penalty for the unsanitary conditions of modern civilization. Dr. Mackenzie, senior physician to the Hospital for Throat and Chest Diseases, in London, finds the disease to be a very ancient one. The first description of it occurs in the writings of an Indian physician, a contemporary of Pythagoras. He next identifies it with "askara," a fatal epidemic frequently mentioned in the Talmud. In the seventeenth century diphtheria was widely prevalent in Europe, and extensively fatal. In 1802 Dr. Cullen, of Edinburgh, seems to have described the disease under the name of *cynanche trachealis;* and in 1826 Bretonneau's classical work appeared.

"After this," writes Dr. Mackenzie, "the disease seems to have passed from the minds of English physicians and its very existence to have been almost forgotten." From such forgetfulness the medical profession was thoroughly aroused by the great epidemic of the years 1858-9, since which time diphtheria has not appeared in England with anything like the same malignancy.

PATENTS PERTAINING TO THE HOUSEHOLD.

An improvement in the class of clothes driers having radial arms for supporting the line, invented by Mr. R. E. Rye, of Mount Pleasant, Mich., provides a means of easily raising or lowering the frame that supports the line.

A novel pounder or washing machine, which presses the clothes alternately in opposite directions, is the invention of L. C. White and G. M. Walton, of Cleaveland Mills, N. C.

Mr. F. Mohr, of New York city, has invented a platform rocking chair whose oscillations are limited by a novel arrangement of an arm and rubber covered stop pin.

A dishpan having a hinged cover and a drainer combined, in a novel and convenient way, has been patented by Mr. J. F. Hutchinson, of Portland, Me.

Progress of Steam Engine Economy.

With Smeaton's early Newcomen engines the consumption of coal was 29·76 lbs. per hour per horse power. Afterward, as improved, 17·6 lbs.

In 1811 the Cornish pumping engine required 10·87 lbs. per hour per horse power; in 1842 the improvements had reduced it to 2·90 lbs.

In 1863 the best marine engines consumed 4 lbs. of coal per hour per horse power, but in 1872 only 2·11 lbs. was required.