by hogs, who are very fond of them, and have a remarkable faculty of finding them. They grow just under the surface, within four or five feet of oak trees, in fields, and are highly esteemed by epicures the world over. Mr. Clayton, now in Sonoma, once found some red truffles, not the genuine variety, but a very good article of food, and a fair substitute, among the foothills around Santa Clara, and off a little from San José. He had himself dug up some interesting earth puff-balls at Roseburg, and found them edible and quite good for a fungus. Feeling confident that truffles exist on our coast, he recommended farmers engaged in grubbing around oaks to hunt for them especially, and try and recognize them, for thus they could add a new industry to our State, and increase the value of their farms. Capt. Simpson recommended hunting among the heavy oak forests of Oregon and Willamette valley.

THE GAMGEE PERPETUAL MOTION.*

Chief Engineer Isherwood goes on to say in his report to the Secretary of the Navy, which is dated New York, March 19, 1881:

From observations made by Professor Gamgee in the experimental working of this machine, he deduced the possibility of what he terms a zeromotor, in which, by means of properly adapted apparatus invented by himself, the heat in water or other objects at ordinary atmospheric temperatures may be utilized to vaporize liquid ammonia under very considerable pressures, but within the control of known means of retention. The high pressure gas thus obtained being used with the greatest practicable measure of expansion on a working piston generates power, becoming by that very expansive use greatly refrigerated and diminished in bulk, and partially liquefied at the end of the stroke of the piston, when it is exhausted and then returned by a method invented by Professor Gamgee to the ammonia boiler whence it came. The cycle is thus a closed one; no material is lost, and no heat is rejected in matter leaving the engine. The work done by the engine is due to the difference in bulk of the material when it enters and when it leaves the boiler, that difference being caused by the heat derived from water or other natural objects in the ammonia boiler and from the refrigeration resulting from the transmutation of a portion of this heat by the engine into the mechanical work performed by the latter. That this difference of bulk exists is indisputable, and if the proper mechanism can be contrived to utilize it, the idea of the zeromotor becomes realized. It will be observed that this power has not been obtained from artificial heat produced by the combustion of fuels, but from the heat of natural objects at ordinary atmospheric temperatures, and therefore costing nothing in money. This is made possible by the fact that liquid ammonia gasifies under considerable pressure at ordinary atmospheric temperatures, the sole difficulty in constructing the zeromotor being to find the means of economically condensing the gas after it has been used on a piston. Were it not for the refrigeration due to the expansive working of the gas, the condensation would have to be obtained by the application, externally to the condenser, of artificially produced cold, and the zeromotor could not be made a commercial success. It is only by obtaining the lower limit of temperature from the action of the engine itself, while the higher limit is furnished without money cost by natural objects at atmospheric temperatures, that commercial success becomes possible.

A MOTOR TO SUPERSEDE THE STEAM ENGINE.

The purpose of the Department in ordering an examination of Professor Gamgee's ice making machine was not to obtain an opinion on its ice making merits, but one as to whether his observations on the behavior of ammonia in the process were sufficiently accurate to warrant his inference of the practicability of constructing a successful zeromotor for industrial uses—a motor, in short, destined to supersede the steam engine. Accordingly the undersigned closely investigated the working of the apparatus. The facts of liquid ammonia gasifying at ordinary atmospheric temperature under very high pressures, and of that gas undergoing very great refrigeration when used expansively in doing work, are not called in question by any one. Both are well known phenomena. The special fact to be observed was whether any part of the ammonia which entered the cylinder as a gas left it as a liquid, and so far as the form of the apparatus allowed any observation to be made, such appeared to be the case. The possibility of the invention of a new motor of incalculable utility would seem to be established, and in view of the immense importance of the subject to the Navy and to mankind at large, I strongly recommend it to the serious attention of the Department, suggesting further that whatever facilities the Department can, in its opinion, consistently extend, be allowed to Professor Gamgee for the continuance of his important experimental inquiries in the Washington Navy Yard. He is most anxious to bring his invention, with the least possible delay, to a crucial test by the completion of the necessary mechanism, and its submission to any board of experts which may be ordered to experimentally ascertain its merits. For this purpose he proposes to use such parts of his present ice making machine as can be recombined in his zeromotor, adding the other necessary parts, and thus producing, with but little loss of time, an embodiment of his idea that will by simple trial show whether an unquestionably correct theory has been successfully reduced to practice.

Professor Gamgee has perfected the calculations and drawings for the mechanism required to give practical effect to his invention, and there remains only to execute the mechanical work. He proposes to use the steam cylinder of his ice-making machine as the ammonia cylinder of the new motor, the present ammonia condenser, and the present ammonia boiler as a low pressure boiler, adding another ammonia boiler as a high pressure boiler. These, together with the ejector between the condenser and the low pressure boiler, a small pump for pumping liquid ammonia from the low pressure to the high pressure boiler, etc., will constitute the zeromotor—a machine, as will be apparent from this brief description, of the simplest, cheapest, and most manageable kind.

In the high pressure boiler the liquid ammonia will be gasified by the heat in water of atmospheric temperature to the pressure normal to that temperature. In the low pressure boiler ammonia is kept at a considerably less tension than in the high pressure boiler, and with this lower pressure ammonia gas the engine is operated, the gas being used as expansively as practicable and made to do work during its expansion, thereby becoming refrigerated, greatly reduced in bulk, and partly liquefied. Immediately on being exhausted the cooled and shrunken gas, and whatever liquid of condensation may be mingled with it, are discharged by the ejector from the condenser into the low pressure boiler, the ejector being worked by the higher pressure in the high pressure boiler. As a result the low pressure boiler is continually receiving ammonia and heat from the high pressure boiler. This excess of ammonia in the liquid form is pumped by an ordinary pump from the low pressure back to the high pressure boiler, while the excess of heat is continuously being converted into the mechanical work done by the engine. There is also the extinction of such part of the heat in the high pressure ammonia gas working the ejector as is due to the work done by it in forcing the contents of the condenser into the low pressure boiler. Of course the cylinder, heat condenser, the low pressure boiler, and their connections are protected from receiving heat from the atmosphere and surrounding objects by a non-conducting substance.

NO FURTHER USE FOR COAL.

The plan proposed is far from chimerical. It is based on well demonstrated thermodynamical principles. The whole is definite and precise, both in theory and mechanical detail, nor can it be shown, *a priori*, that there is not a fair prospect for success. There can be no doubt that the product of the pressure and volume of the contents of the condenser which are to be forced into the low pressure boiler, is less than the product of the pressure and volume of the ammonia gas which leaves that boiler to operate the engine, and that this difference which has not been produced by the external application of artificial cold, but by the working of the machine itself, is available for the production of power for industrial purposes. All that remains is to give the system a practical test in order to ascertain whether the mechanism proposed will act efficiently enough to realize the expected result. Should this prove to be the case, the steam engine will, within the near future, be certainly superseded by the zeromotor, for the great item of coal, whose cost is the principal expense of operating the former, will be wholly eliminated with the latter. If it can once be practically shown that a very much cheaper, lighter, and a far less bulky mechanism than the steamengine, including for the latter its boilers and, in case of steam vessels, the coal bunker and its contents, can be employed for the production of power to any amount without the use of fuel, nothing can prevent its introduction into general use for all industrial purposes, with the vast result of a great cheapening to mankind of every article of manufacture, from the daily bread of the poor to the luxurious textures which robe the rich. The whole world is concerned in the solution of this problem, and the poorer the person the greater is his interest in it. The source of heat for the steam engine is the continually diminishing supply of coal—a diminution that will be severely felt some centuries hence; but the source of heat for the zeromotor is as inexhaustible as the sun himself, and will last undiminished as long as he shines.

The success of the zeromotor is of more importance to the Navy of the United States than to the navies of the great maritime powers of Europe with which it may come in collision, because those powers have colonies and coaling stations on the farthest shores, while the United States possesses neither, and would consequently, in naval warfare, be at great disadvantage for want of coal—its navy, as a rule, having to render service within a reasonable distance of its own coasts the sole base of supplies. If coal, however, can be dispensed with, we are at once placed on an equality in this respect, and our cruisers enabled to penetrate the remotest seas as easily as those belonging to countries having possessions there.

VALUE OF THE ZEROMOTOR TO OUR NAVY.

The enormous importance of a motor capable of superseding the steam engine and furnishing power without the combustion of coal can be estimated from the fact that it would produce an industrial and consequently social and political revolution equal to what was effected by the introduction of the steam engine. The whole of modern society is based on the steam engine which mainly has made the difference between the ancient and the present world, for our civilization would be impossible without it. It is the inanimate slave which performs the labor of mankind, freeing them from the greater part of their drudgery and giving them the time and means for culture.

I have ventured these few remarks to show the nature and scope of Prof. Gamgee's invention, which is not that of a machine for the application of power, but for the immensely more important purpose of generating power itself, so that, strictly speaking, it includes as a basis all other machines. I have wished to show this in order to make clear how different is his invention from those of others who may ask to have their apparatus tested in a Navy Yard, and to bespeak for it the most favorable consideration of the Department.

Professor Gamgee and able assistants—among whom is Mr. W. E. Sudlow, an accomplished mechanical engineer, thoroughly versed in the theory and practice of his profession—are well acquainted with the difficulties to be overcome. They are quite aware of all the objections that can be raised, and have well considered the means of obviating them. The subject has been carefully studied, and there are brought to bear upon it the requisite scientific and engineering information necessary to give it an exhaustive treatment. His engine, like the steam engine, is a heat engine, and produces power by the conversion of heat into mechanical work, the same quantity of work consuming in both cases the same quantity of heat, but with this immense practical difference, that the heat for his zeromotor is freely furnished to hand by nature, while for the steam engine it has to be excavated from the depth of earth and afterwards handled and transported by expensive manual labor.

What is now mainly desired is that Professor Gamgeemay be permitted to prosecute his experiments at the Washington Navy Yard to a conclusion, and there bring his engine to a practical test with as little delay as possible. Should the Department be able to grant this, the favor will be well and properly bestowed in the interest of the Navy and of the world. Submitted with great respect by,

Sir, your obedient servant,

B. F. ISHERWOOD, Chief Engineer.

* From the Report of Chief Engineer Isherwood, U. S. A., on the Gamgee Zeromotor.

Bitter Substances Developed during Fermentation.

We have on several occasions drawn attention to this subject, and have expressed an opinion that peculiar bitter substances are occasionally developed during the fermentation of saccharine fluids. As a rule the bitter flavor imparted by the hop is sufficiently strong to mark this extraneous bitter even if it be produced at all, but it must be within the experience of almost every brewer that beers do sometimes acquire an intense and peculiarly bitter flavor quite beyond anything that can reasonably be expected from the hops used. Some experiments by Mr. W. H. Langbeck recorded some time since, point to the occasional existence in fermented liquids of a bitter principle allied to colchicine. He prepared two samples of a fermented liquor from solution of glucose with small quantities of tartar, tartaric acid, kino, and a few drops of a mixture of formic and œnanthic ether. Fermentation was set up by means of sound pressed yeast, and was maintained at a temperature of 64° to 68° Fah. One sample, filtered through flannel after four days and allowed to stand for three weeks in a stoppered cask at 47° Fah., yielded a pleasantly vinous liquid. The second sample, not filtered till after five days, tasted intensely bitter, and grew worse on standing. The newly-formed yeast, at first of a whitish yellow, had taken a brownish color, died off, was precipitated by the more alcoholic character of the fluid, and formed with the alcohol in nascent state that substance which betrays itself by its bitterness in unhopped fermented liquors when the fermentation has been neglected. The compound in question is by no means innocuous. It was isolated by treating the liquor according to Dragendorff's methods I. and II. Langbeck succeeded in obtaining it in a crystalline form, and described its reactions. There is but little doubt that other products besides alcohol, carbonic acid, glycerine, and succinic acid are produced during the fermentation of worts, and some of these may materially modify and injure the flavor of the resulting beer; the use of chemically prepared sugars may tend to the production of these mysterious compounds, but at present our knowledge of the subject is very meager.—*Brewers' Guardian.*

A French Safety Lamp.

At the usual annual meeting of the Académie des Sciences, just held, the yearly prizes bestowed by the society in recompense of services to science have been awarded. Among others, M. Birckel, a civil engineer employed at the Pechelbronn mines, has received the Montyon prize—which is restricted to improvements in dangerous industries—for a modification of the Davy safety lamp. M. Birckel's improvement is very simple, consisting in providing the wire gauze cylinder with a double iron casing. The top case is movable, and slides over the under one, which is fixed, when a concentric movement is given to it by turning the hanging handle. These casings have corresponding openings of equal section, so that it is possible to more or less restrict the supply of air, or to shut it off altogether, and so instantly extinguish the gas burning inside the lamp when there is much light carbureted hydrogen in the atmosphere. It is not generally necessary to go so far as to extinguish the lamp by hand, because if the air supply be carefully regulated, any addition of combustible gas to the atmosphere will of itself cause extinction through lack of oxygen. M.

Birckel's lamp has been used for nearly a year in the Pechelbronn mines, which are very fiery, without any accident having happened.

A Good Suggestion to Housekeepers.

No one knows until she has tried it, says an experienced housewife to one of our contemporaries, how much she may change the aspect of things about the house by using a little varnish. On a sunshiny day take the old chairs and tables out on the porch or by an open door, and, after thoroughly dusting and wiping off with a damp cloth, apply a thin coat of varnish, and so cover up scratches and marred spots of all kinds. It will dry in a very short time, and you will be surprised to see how much good you have done. A flannel cloth, with a very little linseed oil, is good to rub furniture with, but the greatest care must be exercised to prevent any oil being left on the wood to attract dust. It must be rubbed until you would not know, except by the improved appearance, that any oil had been used.

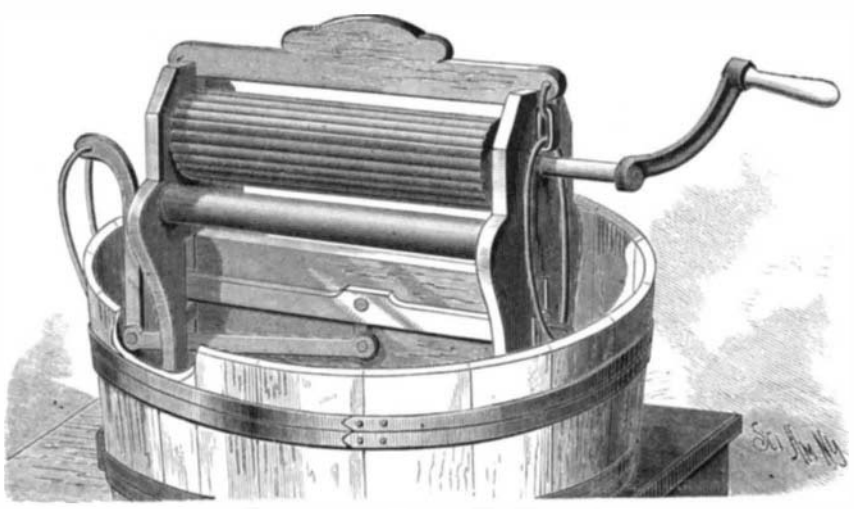
NOVEL WASHING MACHINE.

The washing machine shown in the annexed engraving employs a system of rods and levers by which the vessel and water in which the clothes are washed are made to produce the pressure necessary to cause sufficient friction for cleansing the goods, and insure a uniform pressure upon all thicknesses of material without the use of springs or complicated devices.

In machines of this class it has been the general practice to employ springs to produce the necessary pressure, and this is the principal reason why clothes washers have not come into more general use. Where springs are used the thicker the goods the greater the pressure and the more difficult it is to use the machine, but where the weight of the tub, water, and washing apparatus is employed the pressure is uniform on all thicknesses, and the work of washing with the machine becomes easy.

The washing machine, consists of three rollers mounted in a frame fixed to the bottom of the tub, two of the rollers having stationary bearings, while the third or upper one has movable bearings connected by straps with a cross bar beneath the lower rollers. This cross bar is connected by a link with a lever fulcrumed in the frame of the machine; the longer arm of the lever being connected with a standard rising from the bench.

The side of the tub opposite the standard is pivoted or hinged to admit of the oscillation of the tub as the rollers adapt themselves to clothes of different thicknesses. This invention was lately patented by Mr. J. K. Dugdale, of Richmond, Ind.



DUGDALE'S WASHING MACHINE.

Effects of Optical Slits.

M. Trève has lately described some curious effects. Looking through a fine slit at a vertical object (a post or a mast for instance), he finds the perception much more distinct when the slit is horizontal than when it is vertical. On the other hand, to distinguish horizontal lines more clearly, the slit must be held vertically. But if, in general, one look at a house or a landscape through a fine slit, it is found that the maximum of brightness of the horizon is when the slit is horizontal. This effect, it is said, is also produced with the solar and lunar disks; they are seen much more distinctly with the horizontal slit. M. Trève has reproduced the effect by photography, and the negatives taken with the horizontal slit were more distinct. The light appears to be propagated with more intensity through the latter than the former, the vertical bands of solar photographs showing well the interferences and passage of light through a vertical slit. Again, if a cross-slitted disk be held between the sun and white screen, the horizontal part of the cross on the screen is brighter than the vertical. The practical application of these experiments of M. Trève to photography would appear to be the relation which they bear to the shape of the apertures of diaphragms and to instantaneous shutters. Is it a fact with regard to the latter that the uncovering of the lens horizontally admits more light, and therefore produces a picture more quickly than a shutter which opens vertically? There may be no difference, but the point, at any rate, is worth deciding.—*Photographic News.*

Seaweed Jelly.

The seaweed, *Arachnoidiscus japonicus*, which is used by the Japanese and Chinese to pack porcelain and other articles for exportation, is said, by the *Journal of Applied Science*, to be made use of in France for the purpose of making a spurious fruit jelly. When placed in a tumbler of water it absorbs the water in a few minutes; then a number of shoots grow, and constitute a jelly nearly as transparent as the water from which it is made. The jelly is easily sweetened with glucose, and cochineal or other coloring matter is added with equal facility to imitate the color of the fruit. The perfume and the taste were the only real difficulties that remained to be overcome. After considerable study it was discovered that by using a mixture of certain ethers with tartaric acid, glycerine, etc., a perfect imitation of the odor of raspberries was produced. By putting a little of this essence to the seaweed which has been allowed to develop itself in water, a substance is obtained which has the consistency of fruit jelly, though no fruit has been used, which is sweet, though no sugar has been employed, and which has the color and fragrance of raspberries, though altogether destitute of that fruit. When this ceases to please, another very good fruit flavor is produced by treating castor oil with nitric acid. The jelly still retains a little of the fibrous nature of the plant, and has a tendency to split and fall to pieces, instead of forming adhesive lumps. Examined by the microscope, it has no resemblance to the jelly made from fruit. Then, as the jelly must be colored, it is easy enough to discover the presence of an artificial dye. Without resorting to the laboratory, it suffices to dissolve a little of the suspected jelly in some tepid water, and dip a white silk ribbon in the solution. If it is a natural jelly the ribbon will only be a little soiled; but if the jelly has been artificially colored the ribbon will also be colored.

ENGINEERING INVENTIONS.

Mr. William H. Birge, of Franklin, Pa., has patented an improved storage tank for petroleum, so constructed that the floating cover can never sink to the bottom of the tank, and so braced that it will stand all weather and wind storms without the necessity of an external roof or other inclosure. The floating cover is so constructed that it will serve the purpose of a roof and afford ready access to the interior of the tank, and also a partial roofing made in sections whereby the body of oil is protected from rain and from fire.

An improvement in connecting rods has been patented by Mr. Jacob J. Anthony, of Sharon Springs, N. Y. The object of this invention is to provide a lubricating connecting rod for cranks, crank pins, slides, or other parts of mechanism where connecting rods are used. It is composed of a straight tube forming an oil chamber, having a journal box secured on each end and communicating interiorly. The caps of the journal boxes are held in position by straps extending parallel with said tube and on either side of it.

Mr. Daniel Gallafent, of Woolwich, County of Kent, England, has patented an improved rotary engine, which may be driven by steam, compressed air, water, or gas, and which may be adapted for use as a pump, a water meter, a blower or exhauster, or as a hydraulic buffer for absorbing or destroying the recoil of heavy guns, or other purposes.

Mr. Robert H. Elsworth, of Bayonne, N. J., has patented an improved boat for transporting city sweepings and offal to sea and safely and quickly discharging them. The invention consists of a barge covered amidship for nearly its entire length with a peaked roof or deck that slopes downward on both sides from a central longitudinal line at an angle of about forty-five degrees to the side-rails of the boat; and it consists, further, of hollow or box guards extending along each side of the boat or barge above the water line, open at the top and provided at the bottom with doors that swing open downward, these doors being simultaneously operated by ropes or chains that are made fast to winches or other suitable devices, the intention being that the sweepings and garbage loaded on the sloping deck and in the guards shall be quickly discharged on either side of the barge by opening the guard doors, so that even in very shoal water the barge load may be discharged clear from the barge and without interfering with her movements.

IT is stated that the Bank of France has almost entirely abandoned chemical tests in favor of the camera for detecting forgeries. The sensitive plate not only proclaims forthwith the doing of the eraser or penknife, but frequently shows, under the bold figures of the forger, the sum originally borne by the check. So ready is the camera to detect ink marks that a *carte-de-visite* inclosed in a letter may to the eye appear without blemish, while a copy of it in the camera will probably exhibit traces of writing across the face, where it has merely been in contact with the written page.

IN a letter to *La Nature*, M. Cornillon states that when observing the sun lately with a telescope, he was struck with certain undulatory movements on the disk. On inquiry into their cause he is led to connect them with the wind blowing on the earth's surface at the time. They vary in intensity with this, and they have generally (but not always) the same direction as the wind. Where they have a different direction they indicate a change of weather, or at least the direction of the wind next day.

The Timber Line of Mountains.

Some very interesting facts were brought out at a meeting of the Academy of Natural Science of Philadelphia, concerning the timber line of mountains. The highest Alpine vegetation consists for the most part of short stemmed perennials. Lower down are found dwarfed trees of species, which, still further down the mountain sides, form forests of considerable height, and which, as trees suited to merchantable purposes, make what is known to mountain travelers as the timber lines. In the mountains of Colorado the forests commence at about 7,000 feet above sea level, and continue up to about 11,000 feet, when they suddenly cease. At this point the coniferous trees are from thirty to forty feet high, and above the same species exist as stunted shrubs, seldom exceeding three or four feet in height, and often but a foot, though trailing widely over the ground. In this dwarfed condition they are often found some 1,500 feet higher up, or half way from the recognized timber line to the top of the mountain. On Mount Washington, in New Hampshire, which is a little over 6,000 feet high, the timber runs up to about 4,000 feet, while Mount Webster, a mountain forming the southern peak of the same chain, and about 4,000 feet high, has little timber above 3,000 feet. Roan Mountain, in North Carolina, is about 6,300 feet above the level of the sea, and on some parts of it timber extends to its summit. At a height of 6,000 feet a black oak was measured that was five feet in circumference at three feet from the ground, and forty feet high.

The question as to the peculiar course of the timber line is a mooted one. Until recently it has been referred wholly to climatic conditions, of which temperature and moisture have been regarded as the chief elements in producing the result. The objection urged to this theory is that the dwarfed and gnarled cone-bearing species, extending so many hundred feet up the mountain sides, never produce seed, which leads to the alternative of believing that the seeds have been carried up the mountain sides in enormous quantities and to great distances from the fruiting trees below by winds, or else that there were seed-bearing progenitors of these scrubby trees, beneath the tall protecting branches of which they had their earliest stages of growth. The result of an examination of different parts of Mount Washington favors the latter supposition. As is generally known, there is a railway running straight up the mountain side from the base to the summit. Near the timber line a cut about ten feet deep had to be made through an area covered by mature balsam firs. Under the trees moss and dead roots and old fir leaves had made an earthy strata of a foot in depth. The moss was still green from the rains, melting snows, and fogs of this elevated region, and sustaining the various kinds of low vegetation common to such heights. Young firs were springing up in great abundance, but all the larger trees were dead, though here and there might be seen a branch with a few lingering green leaves. This mass of dead, standing timber occupied several acres, and the reasor of the death of the trees was evident. The cut showed that the forest stood on a mass of large but loose rock, through which the water from the mountain above rushed, carrying with it all the earthy matter on which the larger trees had subsisted, but leaving the tough, turfy matter at the surface, on which the smaller trees of the same sort may live for many years. With the death of the larger trees there is an increase of light, and then the grasses and sedges speedily take possession, holding together the loose soil and permitting, in many cases, an increase of the earthy layer by holding much of the disintegrated rock which washes down from above.

A careful examination of the patches of scrubby spruces above the timber line not infrequently shows dark patches of vegetable mould, evidently the remains of larger trees that have been growing, where now only the masses of small scrubby plants exist. In some places a sharp stick may be pushed down among the dwarf firs and spruces, and the mass of roots intermixed with earth found to be but a foot or so deep over the loose rock from which the earth has been wholly washed away. Again, there are some places, often nearly an acre in extent, where the scrubby firs are still standing, dead, from the earth having been washed away, not leaving enough for even the moderate demands of these small bushes.

It is evident that many of these dwarfed specimens are of a great age. Some that were examined were certainly fifty years old, though the stems at the ground were no thicker than a man's wrist, and, trailing on the ground, occupied but sixteen or twenty square feet of space.—*N. W. Lumberman.*

Large Locomotives.

The working of the experimental locomotive, "No. 10," lately tried, of the Pennsylvania Railroad, has been so satisfactory that ten more of the giants are to be built at the Altoona shops this summer. The driving wheels of the "No. 10" stand 6 feet 6 inches above the rails. It is said that ever since it was put upon the fast train between New York and Philadelphia, this engine has been making a mile in fifty-seven seconds on up grade with a long train in tow without getting heated. It makes more than a mile a min-