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THE NATURAL HIGHWAYS OF TRAVEL.

While in other countries the artificial means of intercommunication are works undertaken, completed, owned, and managed by the government, our policy has been to leave these matters to private enterprise, or to the management of corporations chartered for the purpose; although where the work was a matter of national necessity, or advantage, appropriations in aid have been made from the public treasury, and privileges have been granted to the stockholders who raised the principal means and carried forward the work. In many cases this assistance is judicious, and whatever may be the opinion as to the extent to which corporations may be thus aided, it is certain that such work as is necessary to keep open and in order our natural highways, as navigable rivers, belongs properly to the national government.

The rivers and lakes that form our splendid system of natural intercommunication are, and should be, free to all, and no company or corporation, should be allowed to obstruct them for their own benefit. The right of locomotion, even if not laid down in any bill of rights, declarations of independence, or constitutions, is one as inalienable and unquestionable as that of breathing. Especially is this right necessary in a country like ours, of such vast territorial extent, of such diversified topography, varied climate, and difference of products. By cheap and unobstructed communications the sectional interests become national and the parts become a whole, exemplifying our national motto, *E Pluribus Unum.*

We, therefore, regard the obstruction of a navigable stream as a national rather than a sectional calamity, but a calamity nevertheless, whether viewed in a general or local sense. If the resources of engineering talent were exhausted, in carrying railways or common roads across navigable estuaries and rivers, only by means of short span bridges supported by frequent piers, or bridges of too low an elevation to admit the passage of vessels without raising or swinging a draw, there might be reason in thus obstructing natural highways for the benefit of artificial ways deemed to be more valuable. But where a single span of trestle work or arch is not feasible, the suspension system is practicable, in most cases; or if neither of these is advisable, or possible, a tunnel may be substituted. There are few localities where the tunnel may not be used. It may be built on shore, in sections, if required, and sunk to the bed of the river, or on piers laid for its support, of sufficient hight to level the inequalities of the river bottom.

The superior cheapness of water carriage, especially for heavy and bulky freight, should be sufficient inducement to preserve intact our navigable rivers, and to improve them by the removal of obstructions that accumulate by natural agencies, rather than to add to these obstructions by building piers in the water way to act as *nuclei* for the accumulation of silt and the formation of sand bars. That this is the effect of such structures no observing person can doubt. Above the pier the current deposits its load of sand, gravel, etc., making an elongated Λ-shaped shoal; and below, the cross currents, by their eddies, do the same thing, so that on either side, in time, there is deposited an island of an elongated lozenge form, its longer diameter extending many yards both up and down stream, the pier itself being the center. Such obstructions, if formed by nature, either in the channel or on its borders, would be deemed, as they are, obstructions, and demand removal. That they are the result of artifical erections does not remove the objection to their formation. It is certain that, from what cause soever these obstructions occur, they are inimical to navigation, and to means of intercommunication, and, therefore, unworthy of toleration. Our rivers should be free, as free from artificial obstacles as from legal exactions.

THE SCIENTIST, INVENTOR, AND MECHANIC.

Not seldom the functions of these three great departments of human knowledge and progress are merged into one, so far as general opinion may reach, while the fact is they may be as distinct as any separate departments in any one art. The scientist deals with the qualities of matter and the laws which govern them separately or in combination. He is, or should be, in close communion with Nature, a student in her school, and a progressionist into her mysteries. He grasps the bare crags of knowledge, climbs to their summits, or explores their caverns. He notes the substances with which Nature works and the methods and agents of her working. Sometimes from the knowledge thus gained he becomes, himself, an inventor, but usually his investigations are too absorbing for him to relax his efforts in this direction, and he is satisfied with the almost endless vistas that open to him as he clears away the rubbish left by previous explorers and surmounts the obstacles placed by Nature herself. It is a noble department of human endeavor, as its demands are large, its obstacles formidable, and its rewards glorious. Moreover its field, although patiently worked by his predecessors, is ample enough for the exercise of all the energy and determination of the scientific explorer. However many may have scoured the ground before him, there are points of interest they have never seen, and mines of wealth they have never discovered—only dreamed of. But even if the scientific explorer is content to traverse paths already worn bare by the feet of his predecessors, he will not infrequently find unnoticed flowers by the roadside and rejected gems in the dust of the way. He prepares the way, by his accumulations of facts and his series of theoretical suggestions, for the inventor, who asks only the opportunity and means to give a living form to the scientist's discoveries.

The inventor must have a practical mind, whether he has a practical knowledge of mechanics or not. The constructive faculty is absolutely necessary to the inventor. He takes the facts discovered by the scientist and gives them form, which the mere student never could have done. In his hands the crude or bare facts of scientific investigation, in connection with the experiments necessary to their development, assume form and may be brought forth into useful shapes to bless and assist toiling millions, instead of merely astonishing and entertaining gaping audiences. The curious experiment becomes under him the useful possibility; the discovery of the student becomes to him a suggestion of practical use; facts, or even possibilities, are to him living realities.

But it is the mechanic who elaborates the idea of the inventor. He it is who clothes it with a practical form, furnishes it with nerves of steel and muscles of iron, and endows it with life and motion. Without his skill the result of the scientist's search and of the inventor's thought would be comparatively valueless. Indeed, his skill is frequently the only means of making the inventor's idea useful. In short, the mechanic, who as the model maker elaborates the inventor's idea, is often the real inventor. The crude, unworkmanlike contrivance of the inventor, that in his unskillful hands is merely a travesty on a machine, is made to assume form, proportions, elegance, and efficiency. So valuable is mechanical skill to the perfection of an invention that it is not surprising that practical mechanics constitute the large proportion of inventors. But if valuable inventions are often made by unskilled persons, it is seldom they are successful until after they have passed through the hands of the mechanic; and sometimes the addition or alteration, made by the mechanic and modestly termed an improvement, is the element of the inventor's success.

THE PRESERVATION OF TIMBER.

Perhaps the solution of no modern engineering problem has been more earnestly sought than a cheap, reliable, and universally applicable method of preserving timber. Although methods have been devised which approximately fulfill these conditions, there has yet been nothing attained that is suitable for universal adoption in architecture and in other branches of the arts.

It would appear at first sight an easy matter to preserve wood from decay, when it is remembered that the chief causes of decomposition, at least the chief immediate causes, are changes in its hygrometric condition. Rapid successions of dampness and dryness will speedily destroy most species of timber. There are a few species which are naturally protected by essential oils contained in their texture, but such woods are too rare and valuable for general use.

The physical characters of different kinds of timber afford the clue to the difficulties in solving this problem. Wood is a porous material of great absorbent power upon nearly all kinds of liquids. Many kinds will absorb their own weight of water under favorable circumstances, and part with a large portion of it again when exposed to warm currents of air. To preserve such woods from decay implies the stoppage of the pores, by filling them with some impervious substance or the saturation of the timber with some antiseptic material.

No process based upon either of these principles has as yet been discovered not attended with some drawbacks. Either the process is expensive, or the texture and grain of the wood suffer change, or its natural beauty is marred so as to render it unfit for ornamental work. The latter consideration may be left out of the account, when wood is to be applied to the coarser purposes of engineering, as piles, railroad-ties, pavements, etc., but the item of expense tells more heavily in these cases than in ornamental work, where the cost of the material is a small item in the cost of the structure.

But natural decay is not the only destructive agent against which it is desirable to provide. One of the greatest objections against wood for building purposes is its liability to destruction by fire. Many processes have been devised to remedy this evil, and although a recent Italian process has been favorably spoken of as being free from the objections pertaining to processes of earlier date, it is quite probable that further news respecting it may not be so favorable.

So far as we are aware, no process has ever been discovered that could be very cheaply applied to both the preservation of wood from decay, and also from fire, and which at the same time could be relied upon as certain. The most simple and the cheapest method adopted, has been that of the application of fireproof paints; but paints are liable to crack upon exposure, and from the natural shrinking and springing of timber, and thus give access to moisture. This method has been only partially successful.

It is impossible to give here anything like a detailed notice of the various wood-preserving processes. A whole class of them is included in the impregnation method, in which different chemicals possessing antiseptic properties have been forced by pressure or absorption into the pores of the timber. Sulphate of zinc, sulphate of copper, corrosive sublimate, creosote, carbolic acid, coal tar, etc., have been employed, the three last with the best results yet attained, so far as preservation from natural decay is concerned. None of these processes have been without failures in some instances. So far as these failures relate to the creosoting of wood, they are doubtless due to the imperfections in the method of performing the work. Sulphate of copper has also been used quite successfully but is expensive. The use of coal tar products is the cheapest method yet devised, but it is obviously unadapted to use where a finish is to be given to wood. The smell of timber thus preserved is also an objection to the process. We see then that anything like a perfect process for preserving timber under exposure to high temperatures and variations in hygrometric condition is yet to be devised. It may be that it is impossible to invent any method that shall cover all the conditions of the problem. The rich reward, however, which most certainly awaits the fortunate discoverer of such a method, ought to stimulate experiments in this field and give the world something far ahead of anything yet proposed.

VENTILATION IN BUILDINGS.

The topic of ventilation has been discussed and re-discussed, and a library might be collected of books and lectures and reports of learned societies upon the subject; yet churches, theaters, school houses, and private houses, judging from universal complaints, still remain unventilated. We hear, indeed, from time to time, of success in the use of apparatus for ventilating capital buildings, or parliament houses, but when circumstances compel us (as they do occasionally) to visit some such place, we find but little to praise in this respect. We however moderate our disappointment when we reflect how very difficult it must be to keep a pure atmosphere in these places. For the most part buildings in which people congregate are ventilated about as well as a certain horse car, the unwonted brilliancy of whose lamps elicited some inquiry on the part of a curious passenger. The phenomenon was explained by the scientific conductor's pointing out some flues admitting fresh air from the outside to the small cells inclosing the lamps, in order, as he learnedly stated, that the foul air from the lungs of the passengers might not totally extinguish them.

The amount of learning displayed in discourses on ventilation would make even our scientific conductor open his eyes. Few indeed who have not given a lifetime to the study of this important subject, can be aware of the intimate relations existing between the geological periods and the scientific mode of getting bad air out of a room and replacing it with pure air. It would be still more preposterous to suppose that ordinary practical minds could be able to grasp this subject without being first well grounded in the cosmical theories of La Place, and the "Principia" of Newton. In short the subject embraces, if the harangues and discourses of Professor this or Doctor that are any index to its magnitude—all the knowledge as yet attained by mankind, with a very large proportion of what is yet unattained.

An English journal states that Dr. Edward Smith, F. R. S., read a paper on ventilation before the Society of Arts, on the evening of the 24th of February, in which he treated the subject *comprehensively without recommending any particular plan.* Treating the subject comprehensively is the mode. Of what use is it to descend to particulars when so much science can be displayed in generalities? Of what use is it to teach others if we fail to show that we ourselves are learned?

The fact is that the science of ventilation is small, the art is easy, and the learned discourses which have lately dragged their tedious lengths along in the *Journal of the Franklin Institute*, and have burdened the pages of many other scientific journals, as well as the patience of their readers, are called for no more than learned discussions upon the problem how to avoid cutting two holes in a back door to let out two cats, one being a large one and the other a small one.

We have many times urged the supreme folly of treating the subject in the ridiculous manner described, and have given rules, the simple observance of which will insure well ventilated apartments. To apply these rules requires common sense, mechanical skill in construction, and arithmetic; "only these and nothing more." It seems, however, that upon this

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