chances of death from meteoric downfall would be very great were it not for the very efficient protection afforded by our air. For in that case, as 400,000,000 exceeds 800,000 500 times, we might expect that on the average 500 persons would be killed each year. For the smallest meteor, traveling with planetary velocity, or many times faster than a cannon ball, would unquestionably be able to deal a fatal stroke. Fortunately there is no risk from these smaller meteors, for they are all vaporized in their rush through the air.

Wooden Pavements.

During a recent discussion of the American Society of Civil Engineers in this city of a paper by Mr. E. P. North, on "The Construction and Maintenance of Roads," Mr. Edward R. Andrews made the following interesting remarks:

Mr. North states that a well made macadam road constructed with trap rock is, after an earth road, the pleasantest and safest known. But trap rock or other really good materials for making macadam roads are not available everywhere, and at best macadam roads are only adapted for pleasure travel in parks or suburban towns, where they can be constantly watered and never allowed to get out of repair. Macadam is not adapted for general use in cities. Under heavy traffic, the surface is constantly ground into powder, which rises in dust in the summer, and they are very muddy in the winter. Even in Paris, where the maintenance is most thorough, the streets being continually watered in summer in the manner described by Mr. North, and frequently washed after a day of unusual wear, and scraped by a large army of cantonniers, yet, after heavy rains, the mud is frequently nearly ankle deep, and in very hot weather during the intervals of watering, or in frosty weather, the air is filled with most penetrating dust. Mr. Flad describes the same state of things in St. Louis; and, in Boston, when, in winter, there is no snow to cover the ground, and on account of the cold, the streets cannot be watered, the dust is intolerable; and in summer, where, for economy's sake, watering is neglected, a large part of the material with which the roads are made is blown into the sea.

The compressed asphalt, so common in London and Paris, when constructed as thoroughly as it is in those cities, and as that on Fifth avenue in front of the Hotel Brunswick has been, is a most excellent pavement, but it also demands the most careful maintenance. No dirt should be allowed to accumulate upon it. In frosty or in damp weather, coarse sand or fine gravel should be spread over the surface to give a good footing for horses. This is done abroad, and then it is not slippery; it is very quiet, and in fact has almost all the qualities needed in a perfect pavement, but it can only be laid on levels, and is expensive.

Stone block pavements are in many parts of the country the cheapest, and possibly may be the best where the traffic is very heavy, but it is emphatically the worst pavement for streets of residences or wherever quiet is desirable; and there is no question but that if the incessant din from the rattling of omnibuses, heavy teams, milk wagons, etc., from which one suffers in large cities paved with stone blocks, could be dispensed with by adopting a quiet pavement, the length of life of citizens would be increased and the general health improved. Such would have been the case long ago in New York had it not been that the wooden pavements laid during the "Tweed" days were such evident jobs. In London, wooden pavements give entire satisfaction. The earliest were not quite successful, but the defects in construction have been remedied, and now broad areas of heavily worked streets previously paved with stone are being laid with wooden blocks, which are found to wear satisfactorily.

In the West, where stone for pavements cannot be had, wooden blocks are largely used; but, as wood is cheap and can be replaced without much expense, no sound principles are followed in their construction. In the Eastern States, no one will allow that a wooden pavement can be good except when newly laid, when all agree that it is delightful. There seems to be an unwillingness, even among engineers, to give the subject the attention it deserves. All agree that stone pavements are a curse, and that it would be a blessing if a good substitute could be found, but because wooden pavements, as they have been made here, have not been a success, condemn them as a class.

Mr. North has stated what has been the general practice in laying wooden pavements in this country. Many methods have been tried, but they have almost without exception been "laid with *green* or wet blocks, more or less thoroughly dipped in tar, on a bed of sand, not always well rammed, with or without the interposition of a tarred pine board, with transverse joints from one to one and a half inches wide filled with gravel and coal tar," and I might add, the whole done in a most unworkmanlike manner.

The results are what might have been expected. The careless manner in which the joints have been filled, has left many channels open for the admission of water, which undermines the sand foundation, so that there is an uneven subsidence under the passing wheels, and holes, small at first, but daily growing larger, appear, so that the surface is soon destroyed. The result is but little better when tarred boards are laid under the blocks. This practice of tarring wet, sappy boards and blocks seems to be an invention to make them decay as soon as possible. It closes up the cells of the wood, so that the moisture cannot escape: fermentation immediately follows, which quickly destroys the strength of the fibers and reduces them to punk. A pavement, constructed in this manner, would fail of course. Thoroughly seasoned wood might be benefited by the tarring process, but green wood never.

Observe how differently wooden pavements are constructed in London. Mr. North describes several methods, either of which is vastly superior to any of the patented systems used here. A rigid foundation of bituminous or cement concrete is universal. This costs more than sand, but it is permanent, and will prevent the blocks from sinking under the wheels. English engineers, in discussing pavements, call the foundation the true pavement, the blocks being the wearing surface only. The "Henson" pavement, with some modifications, strongly recommends itself to my mind as the best for this country. Instead of a layer of tarred paper on the concrete, I would use a thin layer of pitch, with oil enough in it to make it permanently slightly plastic, setting the blocks upon it while hot and soft, using the strips of tarred felt between the rows, and driving the blocks together as described by Mr. North. The tarred felt would make a very close joint. Then pour melted pitch over the whole surface, taking care to fill every crevice, and upon this spread fine sharp gravel, which will work into the ends of the blocks and form a surface resembling macadam, and afford a far better footing than wide spaces between the rows, which serve as receptacles for mud and dust. It is easy to keep this pavement clean. No water can penetrate it, so that it will not be injured by frost. The blocks themselves, if creosoted, will not absorb water, and if laid without spaces between the blocks, the drainage will be surface drainage solely, which is of the first importance.

But the pavement would be short-lived if *green* and wet blocks are used. It is not practicable to use, as Mr. North says is the case in London, "wood better seasoned than the pine generally used by house carpenters in this country." Seasoned wood cannot be obtained in sufficient quantities here. But, what is far better, it can be preserved from decay. I have no faith in any method of wood preservation for paving blocks which does not exclude water. The blocks are so short that any soluble preparation is quickly washed out of them, and, if not made waterproof, they are certain to absorb the seeds of destruction from the filth in the streets. The blocks should be well saturated with creosote oil, whose chemical constituents act preservatively upon the fibers of the wood by coagulating the albumen of the sap, while the fatty matters act mechanically in obstructing the pores of the wood and keep the water out. At the same time, as oil cannot be injected into wood full of moisture, the thorough artificial seasoning, which forms a part of the process of creosoting as carried on in this country, is as useful to the timber as any of the metallic salt processes.

By thoroughly creosoting the blocks, expansion and consequent throwing out of the blocks is prevented. They will not shrink or expand. The wood is also rendered homogeneous; the sap wood becoming as durable as heart wood. Looking to sanitary considerations, the creosoted wooden pavement is perfect. The carbolic acid contained in the oil is a powerful disinfectant, and as the pavement described will not absorb any deleterious substance from the surface, it has only to be kept clean to maintain the best sanitary condition. This is far from being the case with wooden pavements laid on the American plan. They soon become a mass of decaying vegetable matter, and, as their powers of absorption increase with their disintegration, they become filled with corruptible matter absorbed from the filth of the street, and as their surface becomes filled with holes, it is absolutely impossible to keep them properly clean.

A good wooden pavement is also an inexpensive one. The cost, including a cement concrete foundation, 6 inches deep, would not exceed $3 per square yard. The system of maintenance adopted in London, of making it a part of the contract of construction, would insure good workmanship in laying the pavement, and a good permanent roadway afterward. It would not be difficult to find responsible and honest contractors willing to take such a contract at a fair price.

In considering this subject, one should not overlook the statistics of accidents gathered in London by Col. Haywood, which show that a London horse will travel on granite 132 miles, on asphalt, 191 miles, and on wood, 446 miles, before an accident occurs.

The actual wear of wooden blocks is very slight, as long as the fibers of the wood are sound. Mr. North states that it is one eighth of an inch per annum in the streets in London, with the heaviest traffic. Mr. Geo. Frederick Deacon, Member Inst. C. E., in a paper read before the Inst. of C. E., states that in Great Howard street, Liverpool, which is a shop street, with a traffic consisting chiefly of carriages, amounting to about 94,000 tons per annum per yard in width, the pavement was worn to the extent of $\frac{5}{8}$ of an inch in four years. This would give a life of nearly twenty years before the blocks would be reduced from 6 inches to a thickness of 3 inches, which is still sufficient to maintain the blocks in place.

In Oxford street, in London, where the traffic is equal to 300 tons per foot per day, the amount of wear has been found to be from 1-16 to $\frac{1}{8}$ inch during three and a half years. This street is laid with the Henson pavement. This slight wear is largely due to the fact that the ends of the fibers do not broom, and thus retain their original strength.

The cost of creosoting is $12 to $16 per thousand feet, board measure.

Spruce does not absorb oil readily on account of the compact character of its fibers, yet it will take in a gallon of oil per cubic foot; hemlock, pine, both white and yellow, and porous oak, are more absorbent. Wood which is the most destructible, because it absorbs water readily, is really the best for creosoting, as, for instance, the gums and cottonwood.

The amount of carbolic acid in the oil I have not taken any pains to ascertain. The quantity depends upon the character of the coal from which the gas was made, varying from 5 to 10 per cent. It has been ascertained, however, through careful experiments by a Belgian chemist, that the wood preserving qualities of creosote oil are due rather to the waterproofing imparted to the wood by the hydrocarbons contained in it than by the carbolic acid. The latter is very volatile, and were it not retained by the gummy, resinous oil would quickly escape into the air. In England no reference is made to the quantity of carbolic acid contained in dead oil to be used in the specifications for contract work. Carefully conducted experiments of my own with pieces of yellow pine, 8 inches by 8 inches and 9 feet long, have shown that six months after treatment they did not absorb any water during a soaking of 48 hours under water.

ENGINEERING INVENTIONS.

An improvement in moulds for sewer building has been patented by Mr. James Burns, of San Antonio, Texas. This improvement relates to moulds or centerings for use in building sewers of concrete, artificial stone, or brick; and it consists in a collapsible mould, made of convenient length, and of the cross sectional shape required for the sewer, and fitted on wheels, so that the sewer can be built in sections around the mould and the mould moved along the trench from time to time as the sections are completed.

An improved railroad switch, patented by Mr. Conzac S. Bastright, of Lebanon, N. H., is so constructed that the wheels of a train of cars advancing from either direction will bring the switch rails into line with the rails of the main track should they be in line with the side track, so that a train cannot run from the main track to the side track unless the switch rails be purposely arranged to produce that result.

Mr. Robert Schneckenburger, of Jackson, Mich., has patented an improved self-adjusting packing designed for rotary engines, rotary pumps, blowers, air compressors, etc. The invention consists in a rotary engine one of whose cylinder heads has a steam passage and apertures connected by a groove in combination with a packing strip.

Mr. Peter Barclay, of East Boston, Mass., has patented an improvement in lubricators for steam engines, wherein the oil is caused to flow in regulated quantities by means of steam pressure. The invention consists in a cup having a perforated diaphragm near the bottom, by which a general pressure on the oil may be obtained without any condensing tube in the cup.

Messrs. Franklin O. Wyatt and Edwin Smedley, of Dubuque, Iowa, have patented an improvement in iron trucks for locomotive tenders and railroad cars, the object being to construct a strong and durable truck, capable of withstanding severe shocks without tearing asunder, and which, after being bent, may be restored to shape.

Gold and Silver in Maine.

Important mining discoveries have been made in Maine during the last few months. Companies have been organized, and work is being energetically prosecuted in various parts of the State. The deposits are principally of gold and silver. The Acton lode, in York county, is reported by Professor Stewart to be one of the best defined fissure veins on the continent. It has been traced for two miles from north to south in nearly a right line, and the surface exposures show that it ranges in lateral diameter from eight to twenty feet. The Riverside Mining Company has been organized at Camden, in Knox county, with a capital of $500,000. Work was begun about six weeks ago, and is being pushed night and day. The shaft of the Fort Knox mine, at Prospect, opposite Bucksport, on the Penobscot River, is now down sixty-two feet, and the ore from the bottom contains both gold and silver. A fine specimen of very rich ore from the Deer Isle mine, on Deer Island, Penobscot Bay, has just been exhibited in Bangor. An assay resulted as follows: Gold, $30; silver, $60; copper, $10; lead, $17. The Owl's Head mine, seven miles below Rockland, at the mouth of Penobscot Bay, is showing specimens of quartz very rich in gold. The Hampden Mining Company has a shaft eight miles westward from Bangor, which is down sixty-five feet, and blasts throw out ore of good quality. The Atlantic mine, at Blue Hill, is equipped with steam engine and drills, and the shaft is already sunk over fifty feet. The assayer of the Blue Hill Mining and Smelting Company writes, under date of the 11th January, that things are progressing at a lively rate. Five or six other mines report favorably, and important additions to their outfits will be made in the spring with a probable enlargement of operations.

MAGNESIUM STEEL.—A half per cent of magnesium changes coarse-grained into fine grained steel and greatly improves the quality. The magnesium is introduced through an opening in the cover of the crucible, after inserting some small bits of charcoal, in order to remove the free oxygen. Without this precaution there would be danger of an explosion.—*Ber. der Chem. Gesell.*