

THE COMMON ROADS.

By N. S. Shaler.



HE progressive nature of human desires is in no way more distinctly marked than in the endless carrying to and fro of goods which are required to meet the needs

or fancies of men. Our lower kindred are generally satisfied with what is afforded by the world immediately about them. The lowest savages are practically exempt from all the needs of transportation other than that which their own limbs can furnish. They win the sustenance, such as they obtain, from immediately about their dwelling-places. With each successive stage in the advancement of civilization we find a progress in the desires which brings about a need of transporting the products of the earth for greater distances; and at the present day our civilized men cannot be content in their daily lives without assembling for their use the products of the wide earth. Thus it comes about that the ways of communication created by man are at once the measure and the means of civilization. After all, human advancement depends almost altogether on the extension of the ideals of life. The easiest way for this enlargement, in all cases the first opportunity for such growth, comes through the desires which find expression in commerce.

The readers of this Magazine have already had the history of the most modern methods of transportation set before them in the articles on steamships and railways. I propose in the following pages to take up the earlier, and still, despite the vast utility of modern means of communication, the most important, ways of commerce, viz., the ordinary roads by which the greater part of human intercourse has been made possible.

For a very long time pack animals were the principal agent in land com-

merce, at least in the regions which were not provided with easily navigable rivers. Down to the beginning of the seventeenth century the larger part of the trade of the inland districts in northern Europe and Great Britain was effected by means of horses, mules, and oxen, bearing the burdens of commerce on their backs. The observant traveller may still note in those countries deep trenches, sometimes cut to the depth of twenty feet or more in the hill-sides, extending, like the ditches of old fortifications, straightway across hill and dale. When first noting these curious topographic features I was at a loss to account for them. I learned, however, from my archaeological friends, that they were the trackways worn deep into the earth by centuries of use by caravans. In the United States, owing to the slow development of our roads, pack animals were longer employed than in any part of Europe. Twenty years ago a considerable part of the trade between the mountain-valleys of the head-waters of the Cumberland and the more civilized areas on the east and west was carried on by means of pack-saddles mounted on horses or oxen. I have myself seen caravans going forth from the valleys of eastern Kentucky, composed of the small mountain-bulls, each with the ancient saw-buck saddle with its load of ginseng, goose feathers, and beeswax, the staple products of these remote farms. During our Civil War pack animals were extensively resorted to for military expeditions in the Appalachian Mountain district, and they are still much in use in the Cordilleran district of this country.

Carriages for the transportation of burdens over the land appear to have been invented in a very early day, yet probably long after the use of pack animals had been adopted. The most ancient form of land carriage appears to have been the sled, which was in use in Egypt at least four thousand years before our era. It seems probable that

the first step from this primitive instrument of transportation toward the wheeled vehicle came about in a simple way. Where a heavy burden is transported on a sled, it is a simple device to put round sticks beneath the runners, thus diminishing the friction. Some early inventor probably saw that it would be an advantage to pivot the roller upon the carriage, and so avoid the need of continually placing the cylinder beneath the runners, as the vehicle went forward on its journey. So far as we can see, the wheeled carriage began in Egypt, and thence rapidly extended to other countries.

The first general use of wheeled vehicles appears to have been in the form of the war-chariot, which, apparently originating in Egypt, extended rapidly to the fields of Asia. In earlier warfare the chariot was a very valuable instrument; against swordsmen, javelin-throwers, slingers, and archers, in an open country, it could operate with great effect. It was the practice of the Egyptians, as shown by the descriptive engravings on their monuments, to mount the detached pieces of the chariot on pack animals for transportation to the scene of action, assembling the parts for service before the battle. With the advance in military art, when the front of battle became stronger and was defended by compact lines of spearmen, and the evolutions of cavalry were more perfectly organized, chariots gradually fell into disuse; but it seems probable that to the use of the wheeled vehicle in war we owe the rapid diffusion of the carriage through the region about the Mediterranean, and to its general adoption in ordinary transportation.

At first the use of wheeled vehicles in the peaceful arts of life appears to have been limited to cities and those highly cultivated districts immediately adjacent to them where open ways existed. The Romans appear to have been the earliest people who, with the keen economic sense always characteristic of them, saw the advantages which would accrue from the wider extension of this method of conveyance. The people of the imperial city at an early date began to extend carriage-ways throughout Italy. With

the spread of their conquests they bound the subjected countries together by a similar system of roads, the remains of which are still traceable throughout wide realms which once owned their sway. After the fall of the Roman empire the cities of northern Europe, for centuries lacking the energy of commercial activity which proceeded from the imperial city in its prime, allowed the Roman ways to fall into disuse. For nearly a thousand years those countries reverted to the primitive system of transportation by pack animals, a method which, indeed, had not disappeared in the Roman time save in the regions immediately adjacent to the main roads of travel.

About four hundred years ago wheel-carriages began once again to do their commercial work in northern Europe; at first the progress in the construction of wheel-ways was slow. Two centuries ago a large part of England was unprovided with such aids to transportation; and even within the last century the remote portions of Great Britain and Germany continued to be served with transportation by means of pack animals.

The first Napoleon, whose mind was singularly Roman-like in its quality, appears to have been the earliest of our modern statesmen clearly to perceive the relation of carriage-ways to the development of a country. He advanced the work of road construction in France in a remarkable manner; a large part of the great roadways of that country were undertaken during his reign.

Great Britain and Switzerland, the two European states in which local government enters in the largest measure into the scheme of the community, have the most complete provision for commercial intercourse between the village communities and the great commercial centres. In them only does life have what we may call a complete circulation.

In the United States various circumstances have tended to retard the development of carriage-ways, so that the country as a whole remains less provided with such means of communication than any other area of equal general culture in the world. The fringe of colonial settlements on the Atlantic coast remained for more than a century after

their foundation as tolerably compact bodies of folk which did not extend any considerable distance from the sea. Then came the rapid westward extension of the population, which led to the occupation of the fertile lands within the Appalachian district, and the rich plain-country of the Mississippi Valley. So swift was this westward movement of the people that there was no time or means for constructing good carriage-ways. The rivers and lakes of that country for a time furnished the more important channels of communication; where they did not serve, the ordinary dirt-roads in the dry seasons of the year afforded, by means of abundant and cheap draught animals, an opportunity for the transportation of crops to market. It is true the tax on industry laid on the people by these imperfect roads was a serious burden, but the land was rich in an enduring store of fertility, and the people were abounding in energy which made them ready for any struggle with their condition, and for an epoch that warred with the earth.

As the country became more settled the road problem had in some manner to be attacked. The communities did not feel themselves rich enough to create good roadways as public improvements; and so the first step toward such ways was by means of toll-roads built by corporations, which acquired by their construction a perpetual right to embarrass the commerce of the country by a tax laid upon every vehicle which used their improvement. In the districts of the West which were settled from New England toll-roads were relatively rare. The New England tradition has always been in favor of making such improvements at the cost of the community. The Virginia settlements inherited, however, the toll-gate tradition, and are generally characterized by the development of turnpikes. Thus in the districts peopled from Virginia almost every road readily passable in the winter season is subject to very serious tolls. The ordinary rate of toll for a wagon which can carry a load of two tons is about five cents per mile, or about a cent a bushel on wheat which is transported for a distance of ten miles.

Although the advantages derived from

readily passable ways are great, despite the toll which may be levied on transportation, the effect of the turnpike system on the development of the community is, on the whole, evil. The result of these ways is to limit human intercourse to that required for necessary commercial transactions. The burden falls heavily on the poor, and is not without weight even on the richer part of the population. Although the roads are generally owned by local capitalists their profits go to few pockets, and the revenues from the investment, often relatively very great, are mostly returned to commercial people, bankers, and other small capitalists who dwell in the towns.

The difference between the road-making motive of the New Englander, accustomed to the strong government of the town system, and of those from the Virginia group of States, who are bred under the weak communal system of the county organization, is perhaps better shown in the matter of roadways than in any other feature of the social life. At the present time in New England there is scarce a single toll-road, except it be where, as in the White Mountains, ways have been constructed for pleasure-travelling alone. On the other hand, in Kentucky and the other States which have inherited their theories of life from Virginia, there are no good ways which are really the property of the public. I am disposed to attribute, in good part, the retardation in the economic development, which is visible in these regions where transportation is hindered by tolls, to the effect of this encumbrance on human intercourse. The evident tendency of such embarrassments is to limit the social and economical development of the country which is affected by the evil. In the toll-gate districts the people have a momentous economic problem before them. The vested rights of the toll-roads are in most cases yearly becoming more profitable to the individual holders, and, of course, a heavier burden upon the masses of the people.

I am aware that much has been said in favor of the turnpike system of roadways. At first sight the arguments in support of this system seem rather strong; undoubtedly the fact that those

who wear the roads pay for the damage they do to them has some weight in favor of the system. If the tolls were contributed to the revenues of the community this argument would have more strength. The fact is, however, that such roads are generally profitable to stockholders, and they at once lead to an unequal distribution of the profits which labor wins from the land. Moreover, for each five miles of road there is commonly one family maintained in unproductive labor, because employed to collect the transportation charges. Thus in the State of Kentucky there are probably not less than one thousand families, or not far from two per cent. of the population, supported by toll-gate keeping. The average tax to the people of that commonwealth, beyond the expense of maintaining the roads in good condition, probably amounts to not less than one million dollars per annum, or somewhere near the ordinary revenues of the commonwealth.

Even if money considerations alone were to determine the system of ownership in the roads, the argument would be overwhelmingly in favor of the public ownership; but, on reasonable consideration, it is evident that there are other matters which are of far more weight than pecuniary considerations. The first aim of the philosophical statesman should be to promote human intercourse, for from that interaction of man on man come the largest elements of that condition which we term civilization. The most important part of this reaction is that which serves to knit the communal life together and to enlarge the sphere of association in the country districts. The charges for tolls on carriage-roads most unquestionably serve to limit this interaction of neighboring folk. Our system of communal government outside of New England is, as a whole, unfortunate. The county organization of our Western and Southern States is weak. There is little to bring the people who dwell a few miles apart together except the occasional county court, or fair-days, or the chance of social meetings in the shire town. To the evils arising from an imperfect political life which inheres in our county system, toll-roads add yet another drawback to

the interactive development of our rural communities. The farmer who knows he must spend half a dollar for tolls on a visit to the county seat is very apt to abide at home, and so lose the chance of contact with his fellow-men.

Great as are the present evils connected with our toll-road system, they have as yet received little attention from the public. The method of transferring public ways to private corporations is day by day extending over the larger part of the United States. I have myself seen several scores of these roads instituted, and I have yet to learn of a single case in which such ways have been unbarred by public action. Even in many cases where, by changes in the route of travel, the roads once prosperous no longer afford sufficient returns to maintain the ways in good condition, the tolls are not abandoned. Thus on the once much-used toll-road from central Kentucky to Cumberland Gap, and thence southerly to Virginia, the way over which the settlement of Kentucky was in good part effected, the tolls now afford but a trifling return. The road-way has been in good part destroyed by frost and flood, yet I have been compelled to pay a toll-rate of several cents a mile for passing over it, though it was necessary to take a pickaxe and spade in the wagon in order to render some parts of the road passable by wheels. At times this road is almost blocked even to horsemen.

There can be no question that the toll-road district of the United States has before it a problem of far more menacing nature than that afforded by our railway system. The difficulties should be at once faced. The turnpikes should be abolished by the exercise of that right of eminent domain which is fortunately retained in the organic law of our States. The cost of the action should be borne, in larger part at least, by the communities, and, perhaps, in small part by the commonwealth. It seems to me that our States should provide for a method by which the turnpikes may be condemned on due compensation to their owners and their ways made open to the public.

Where toll-roads have been most generally adopted as the system of

commercial and social intercourse, the people have usually been induced to accept this system, in good part, through their ignorance of the methods by which serviceable ways may be constructed. In most rural districts of the United States the common roads are built and maintained in the most ignorant and inefficient manner. In no other phase of public duties does the American citizen appear to such disadvantage as in the construction of roads. Generally road-making and the so-called road-mending are performed not by a tax of money but by an impost on the labor of the county. The voting part of the population is summoned each year to give one or two days to working out the road-tax. The busy people and those who are forehanded may pay their assessment in money; but the most of the population finds it more convenient to attend the annual road-making picnic in person. Theoretically the gangs of men are under the supervision of a road-master. More commonly some elder of the multitude is by common consent absolved from personal labor and made superintendent of operations.

Arriving on the ground long after the usual time of beginning work, the road-makers proceed to discuss the general question of road-making and other matters of public concern, until slow-acting conscience convinces them that they should be about their task. They then with much deliberation take the mud out of the road-side ditches, if, indeed, the way is ditched at all, and plaster the same on the centre of the road. A plough is brought into requisition, which destroys the best part of the road, that which is partly grassed and bush-grown, and the soft mass is heaped up in the central parts of the way. The sloughs or cradle-holes are filled with this material, or perhaps a little brush may be cut and heaped in, making a very frail support for the wheels. An hour or two is consumed at noon-day by lunch and a further discussion of public and private affairs. A little work is done in the afternoon, and at the end of the day the road-making is abandoned until the next year. I have seen much of this work, and have come to the conclusion that

when the "militia" are employed in road-making they are about as effective as they are in public defence.

The experienced traveller who finds himself at the beginning of a newly mended road will betake himself to the nearest house and learn how far the improvement extends; if for the distance of ten miles, he will then inquire by what circuit, not exceeding fifteen miles in length, he can escape from the danger of the repairs. After a time nature mends the damage done by the process of reconstruction, and the journeyer may find once again a way tolerable, save where the hill-sides are steep or the ground wet. In the winter season such roads, at least in the counties where the soil is of a clayey nature, are often practically impassable. In such regions, after a distressing experience of some decades, the people find themselves willing to turn over to a corporation the precious privilege of controlling their highways. A little knowledge as to the art of road-making, an expenditure of not more labor than is normally given to the annual repair of the roads, would in most cases have secured to the community about as good roads as they obtain by the construction of turnpikes. In other words, our system of ignorant mismanagement in the construction and maintenance of rural ways leads to a vast and purposeless expenditure. If we take the misapplied expenses of our country-ways, if we count at the same time the mere social disadvantages which they bring to the people, it is probable that the sum of the road-tax in this country is greater than that of our ordinary taxation. From some data which I have gathered in my personal experience with roads, I am inclined to think that even in New England the cost to the public arising from ineffective roadways, as well as from the waste of money expended on them, amounts to not less than an average of ten dollars a year on each household. In this reckoning I have included the loss of time and of transporting power of vehicles, the wear and tear of wagons and carriages and the beasts which draw them. It is probable that the expenditure in this direction is greater

than that which is incurred for schools or any other single element of public interest. I am inclined, indeed, to think that it comes near the sum of all our State and Federal taxation together.

The evil of poor roads, depending as it does in great measure on the lack of engineering skill as well as an indisposition to endure direct taxation for public improvement, must in the main be remedied by a slow growth in the public knowledge of road construction. Something, however, may be done through education in the schools and by means of the press to hasten the coming of a better system of ways. There is in this country a set of colleges which are resorted to by students who in their maturer years are to have a share in rural affairs. Thirty or more of our States received the foundations for agricultural and mechanical colleges from the Federal Government. Each of these schools should have a good course of teaching in the matter of roadways. Some of them already nominally pay a certain amount of attention to the matter, but the instruction is generally of a very imperfect sort. There are no good text-books treating of the subject, and the instructors are commonly without much experience in the matter. It seems to me that public ways in general (the conveyance problem of our modern society) lie at the root of all economic development, and are closely connected with social development. They are essential features in the physiology of our commonwealths, and as such should have a large place in any instruction which concerns the management of public affairs. It would be greatly to the benefit of our system of road management if men could be thoroughly well-educated for the duty of road-masters. A well-instructed expert could readily take charge of all the roads in an ordinary county. Bringing to bear the experience which has been gained in the art of road-making, he could greatly diminish the cost of construction and maintenance, and, without any addition to the present expenditure of labor, secure good and permanent ways. No other step seems so likely to advance this element in our policy so effectively as the institution of educated road-masters.

The matters which have to be considered by a road-master are of an extremely varied nature and demand a wider training than is necessary in most of the mechanical arts. In order to indicate, in a general way, the range of knowledge and the nature of the problems which must be dealt with by such an officer, I shall briefly consider the conditions which should control the construction of carriage-ways. I am not without hope that this statement will prove of service to persons who may have to deal in a practical way with the matter of road construction, but who must approach the matter without careful training.

A carriage-way is a device by which the energy of our larger domesticated animals may be applied to the transportation of burdens carried on wheeled vehicles. The conditions of the problem demand a consideration of three distinct factors, viz., the character of the earth's surface, the form and action of the vehicles, and the work done through the feet of the animals which draw them. In the management of every roadway these three elements of the problem have to be carefully considered. I shall discuss them in the order in which they are named.

First, as to the character of the surface over which the roadway is constructed, we note that the conditions depend in the first place upon the character of the soil-covering, and in the next on the nature of the declivities. The greater portion of our roadways, and in most cases the whole of the structure, is founded upon a soil or detrital coating which commonly covers the bed-rocks to a considerable depth. This coating in most roadways forms the support of the wheels as well as the treadway of the draught animals. Where the roads are provided with an artificial surface of imported materials, as is the case with most of our costlier ways, the natural detritus must support this artificial platform. The way in which the soil-coating acts under the peculiar conditions applied to it in the roadway depends upon the peculiar constitution of the material of which it is composed. Its constitution varies in different seasons in a measure which is in the main

dependent on the amount of water contained in the detritus.

In the dry summer weather the soil covering on which the road lies is commonly so far compact that it resists the tread of wheels and of animals' feet, so that a way may be maintained with great ease. When, however, the material is full of water, the particles composing it slide over each other under the influence of the sheering strains, such as the wheels bring to the mass, in other words, take the form of mud. When in this state the soil divided by the edge of the wheel quickly slips around and grasps the spokes and felloes so as to create a great resistance to the motion of the vehicle. Moreover, the carriage itself moves in an oscillating manner. It is a pendulum, and has a rate of vibration determined by the form and weight of the structure. These vibrations cause the wheels from moment to moment to bear with diverse energy on the surface over which they tread. The result is that the trackway is soon cut into cradle-holes; at first these have but slight depth; each successive vehicle has its oscillations forced into the rhythm of the preceding, and its wheels operate to cut the depressions to a greater depth. If, as is commonly the case, these depressions contain water, the churning action of the wheels constantly serves to wash a portion of the dissolved mud out of the cavity, and thus still further to deepen it. Where the soil is of a clayey nature, that is, where the grains which compose it are so fine that they hold considerable water between them by capillary attraction, then it is still further unfitted for this purpose by what is called the heaving action of the frost. The contained water, expanding as it freezes, pushes the particles asunder and destroys all the adhesion which tended to grow up between them. The result is that when the frost disappears from the ground its loose texture (the spaces for the storage of water) is increased by the expansion of the ice, and it is even more incapable of bearing up wheels.

Where the soil is of a sandy nature the difficulties arising from the slipping of the material under the tread of the wheels are less considerable than in the

case of clay, and are manifest at other seasons of the year. As long as the sandy soil contains a certain quantity of water, the grains, owing to their general irregularity, are held face against face, as bits of glass are when their several surfaces have a little water between them. Sand of an angular character is thus pretty well bound together when wet, but when dry, the adhesion is destroyed and the particles are free to slip by each other when the wheel presses upon them. In general, sandy roads are better in the rainy season than those of clay, while ways resting upon clay soil, though frequently impassable in wet seasons, are often excellent when in a dry state.

Clay roads can only be made into satisfactory ways by means of effective drainage, so contrived that the least possible water will remain in the material which feels the effect of the tread of the draught animal or the down-wearing thrust of the wheel. Deep side-ditches are absolutely necessary for such roads, and the narrower the roadway the more effective will be this drainage work. It is a great mistake in such roads to have any more width than is imperatively necessary for the uses of the structure. If the ditches extend to a depth which would maintain the crown of the road two feet above the water-level, and the roadway is of the least possible width, the problem of protection against mud is most easily solved.

To effect any satisfactory solution of the difficulties which beset such roads it is necessary, however, either to construct an artificial surface of timber or of stone, which is always a matter of great cost, or to mingle some binding materials with the clay. If gravelly materials or, what is better, shingly waste such as is often produced by frost action on slaty stones can be commingled in the proportion of one-half with the clay, a firm road-bed can commonly be secured, provided the road is well ditched. This commingled gravel or other solid substance must extend at least for a foot below the surface in order to withstand any heavy carriages. In many cases an equally good result can be accomplished by covering the surface with repeated coatings of any

shrubby vegetable matter. In northern Minnesota I have seen the material known as "excelsior," *i.e.*, strip-like shavings, cut by machinery from blocks of wood, serve admirably to prevent the motion of the clay, and I am of the opinion that it would, in clay countries where stone cannot readily be obtained, but where timber is plenty, be an admirable device to have a machine for making excelsior to be used as a road material. On the surface such woody matter rapidly decays, but when worked by the wheels into the clay it may last for several seasons. At no great cost the material might be saturated with creosote, and thus rendered much more resisting to decay. The finest branches of trees, the leaves of pines, even rushes, may serve the need, if they can be cheaply applied.

In sandy countries the problem of road maintenance is very much simpler than it is in the regions underlaid by clay. The aim here should be to have the roadway as narrow and well defined as possible. In most cases it is desirable to have all the vehicles run in the same track, with an abundant growth of vegetation either side of the rut, for by this means the shearing of the sands is in a great measure avoided. Ditching beyond a slight depth to carry away the occasional rain-water is not desirable, for it tends to hasten the drying of the sands, which is to be avoided as much as extreme wetness in the case of clays. Where possible, the road should be overhung with trees, the leaves and twigs of which, catching in the roadways, will serve still further to diminish the effect of the wheels in moving the sands about. The best sandy roads in this country are those frequently found in southeastern Massachusetts, where there is but a single trackway, with occasional places where teams can pass each other. I know roads of this description lying upon very incoherent sands which have maintained themselves for a century at an average annual expense of not more than two days' labor for the mile of length. I have seen where, with the spirit of improvement, the old road had been widened and treated to a course of ploughing in which the way had been made almost impassable to heavy bur-

dens in times of drought. In their best days such roads are almost as good as tramways. A little care with occasional cradle-holes, or, if the road be very much traversed, small amounts of clay or oyster-shells placed in the grooves, will maintain them in excellent repair. Where a sandy way is double tracked, the teams, in passing each other, cut up the wheel-trenches and destroy the growth of the plants on either side of them, and so reduce the superficial portions of the sand to a very mobile state.

We come now to the type of roadway which should be constructed wherever the culture and condition of the country permit the expenditure of a considerable amount of money on its main carriage-ways—a construction commonly known as the turnpike. The essential feature of all such ways consists in the substitution of a compact mass of stony matter in place of one of ordinary soil as the wheel- and hoof-bed. It is commonly assumed that such ways need be very costly, and, indeed, the method of construction usually adopted causes them to be far more expensive than is necessary for their reasonable use. When properly built they so far spare the expenses of reconstruction as in many cases to be, in the long run, more economical than clay roads. All macadamized roads should be double; on one side covered with stone, on the other having the ordinary foundation of the soil. If the soil-way is kept in fair repair, it will be preferred by sensible teamsters for more than half the year in all regions, and in many sections of the country for more than three-fourths of the time. In preparing such a way care should be taken, where possible, to remove the whole of the soil proper in order to secure a foundation on the subsoil, which, having escaped in the main the action of frost as well as the disorganizing effect of roots, is firmer than the over-soil. Founded on hard-pan or subsoil, it is commonly possible to make a tolerably permanent road by placing upon the bed a layer of from eight to twelve inches of broken limestone, or, what is better, a less thickness of broken shale. The fragments should, if possible, in all cases, be of a somewhat limy nature, for in such materials a process of natural

cementation goes on whereby the mass soon becomes very firm. If possible, the interspaces should also be filled with powdered or finely broken limestone, not with sand, which usually does not add much to the firmness of the way. Where the underlying layer of soil is not very compact, it is in almost all cases advantageous to lay a floor of flat stones in the fashion of a loose pavement, and upon this to place the true macadam or broken bits of rock material.

It is the general custom to prepare the broken stone for roadways by the slow process of hand-breaking, and a large part of the cost of such construction is due to the expense of this labor. Modifications of the Blake Crusher are now in use for the preparation of macadam material. All those machines which I have seen are too heavy for the best service in road-making. Machines should be prepared which are sufficiently portable to be placed now here and now there along the line of the roadway where stone can be secured, so as to avoid the large cost which is now incurred in hauling the material to the crusher and thence to the place where it is to be built into the road. One of the best contributions to the art of road-making would be a convenient machine of this description. Moreover, all the machines which I have seen are worked by steam-power. It should be possible to operate them by horse-power as well. After the roadway has been covered with broken stone, the mass should be firmly bedded by the use of heavy rollers. It is the custom, away from our cities, to trust this bedding to the chance action of wheels. It is, in a fashion after much, damage to vehicles and horses' feet, fairly bedded, but the work is never so well accomplished as it is by the roller.

Of course, such costly apparatus for road-making is not within the means of any rural commune, but if our road-making were turned over to large governmental communities, say the counties or associations of towns, it would prove far more economical than the present shiftless system. The machinery appropriated for the construction of roads, including a full array of suitable ploughs, scrapers, steam-crushers, and rollers

could probably be afforded for about two thousand dollars. Under the charge of a skilful road-master, in most sections of the country high-grade roads could be constructed at a cost not exceeding \$3,000 per mile. Assuming that a road of this description serves the need of a strip of country for a mile on either side of the way, the cost would be but \$2.50 per acre on the area served. In general, however, it would be safe to assume that the service of the road would be rendered to twice this area per mile of length, and thus the cost would be reduced to \$1.25 per acre.

One of the most considerable benefits which we could hope to arise from the proper education of road-masters, and from the permanent employment of such officials, would be found in the improved location of such ways. Very few of those who have to determine the position of our rural ways are capable of making an adequate survey for such work. A proper determination of a common road-line demands even more attention than for the alignment of a railway. It is true there are certain features which have to be considered in railway lines which do not necessarily enter into computation in a road; but owing to the fact that the common road is more dependent on the character of the subsoil than a railway, there are complications about placing the former of these ways which do not enter into the computations of the railway engineer. Moreover, railways commonly cut so deep to secure their beds that the character of the soil, as regards its resistance to pressure, is a matter of relatively little importance. Furthermore, a railway connects with the trade of a country only at its stations, while the common road should be accessible to the neighboring land at many more points on its line. Properly to place the ways of a community demands on the part of a road-master a very careful training in the principles of way-making.

In order to secure a satisfactory alignment of our country-roads it is extremely desirable to have good topographic maps of the field which is to be traversed. These maps must give in a clear way all the important topographic

features of the district; the lay of the streams in relation to each other, and the slope of the surfaces which compose the area are essential features in such a map. Until the present decade no such maps have existed in this country, except, perhaps, in small areas about our great cities and at certain points in the shore belt which have been charted by the United States Coast Survey. The United States Geological Survey is now engaged in making a map of the whole country, which, though designed for geological purposes, will afford great help to our rural population in determining the fittest position for their ways of communication. With a good topographic map of this description in the hand, it is possible to plot a projected road in such a manner as to secure a minimum grade between the points which it is intended to connect. Where such a map does not exist, the determination can only be made after a careful reconnaissance through the country, with more detailed surveys to show the relative advantages between routes. In such work the training of an expert road-master will be of the utmost importance to the interests of the community.

It is in the study of the road project, as regards location, that we find the greatest difficulty in our American system of rural ways. My much experience with this problem has convinced me that an educated road-master can do much for our people in bettering the placing of our roadways. I have frequently to traverse a road three miles in length which crosses two deep valleys, the declivities making it very difficult, if not impossible, to maintain the ways in fair condition. The difficulties might have been avoided, and a nearly horizontal way secured, by a slight deflection from the present line.

The difference between well aligned ways and those which are placed haphazard in the country is, as far as the commercial interests of the people are concerned, of very great importance. In several counties well known to me in this country, I am satisfied that the difference which could have been effected by the exercise of a little skill amounts in the tax upon the community to many thousand dollars per annum.

The character of the vehicles which are used upon a roadway has a great influence upon its endurance to the beat of the wheels. With the same burden a two-wheeled cart does far more damage to the road than one of four wheels, and this because of the suddenness in the motion of the wheels and their irregular, twisting movement in the trackway. Where the axles are short and the wheels close together the damage to all, save turnpike-ways, is greatly increased, for the reason that there is no chance for the growth of grass between the treadway of the wheels and the footway of the horses. This principle appears to have been recognized in some parts of the country. Thus in the neighborhood of Boston, where the ways are made solid by macadam or other rubble, the distance between the wheels is generally about five and one-half feet; while in the sandy-road district of Cape Cod the length of the axle is usually half a foot greater. The greatest defect of our American carriages is that for a given weight of carriage and burden the tires of the wheels are extremely narrow. It is true that on ill-conditioned and muddy roads a narrow wheel-tread is advantageous for the reason that the thick mud has a less extended hold when it wraps around the felloes and spokes; but with this arrangement the interests of the roadway are sacrificed to the convenience of the individual who drives upon it. These narrow wheels, with tires often not more than an inch in diameter, cut like knives into the road-bed and so deepen the ruts. If we could require that no vehicle should have a tire less than an inch and a half in diameter, and that all springless carriages should have tires at least two inches in diameter, increasing in width with the burden, we would secure our ways against a considerable part of the evils from which they suffer.

The foregoing considerations make it tolerably evident that the problem of carriage-ways in this country is a serious and much-neglected matter. I therefore venture to suggest what seems to me to be a method of making head against these evils. I would, in the first place, suggest that in the Federal Department of Agriculture there should be a commissioner of roads, having at his com-

mand sufficient means to prepare and print as public documents accounts of the condition of roadways in this country, with essays on the method of their construction. Each State should likewise have a commissioner of public ways whose duty it should be to advance education in this class of questions in every possible manner. To him the town or county road commissioners should be required to report. He should cause to be constructed a map showing the location and condition of all the roadways in the State. These ways he should classify as regards their condition. This system would secure a record which would set forth the actual condition of the transportation roads in all parts of the country. The effect of the system would be to enforce on the local authorities the sense of the importance of the problems which they have in hand. The reports of the national commis-

sioner and those of the several commonwealths would convey information to the people.

An effective national commissioner of roads would doubtless succeed in arousing enough interest in many States to secure the appointment of local authorities in the several commonwealths. Gradually in this way we could hope to bring the people to an understanding as to the evils under which they ignorantly suffer from their ill-conditioned carriage-ways. To secure this understanding is the real difficulty which lies in the path of the reform. Here, as in many other similar matters, the most difficult part of the reform is to bring the need of it clearly before the people. Our country-folk wallow in the mire of their ways, pay excessive tolls, endure, in a word, a grinding taxation, generation after generation, without appreciating the burden which rests upon them.

THE MINIATURE.

By William McKendree Bangs.



It was late in May. The weather had begun to be warm unusually early, and the Barnetts had already gone to their country place.

It was not far from the city, and Barnett daily made the journey to his office without difficulty. He had now returned, and was seated in an easy chair upon the piazza. Mrs. Barnett stood near, some impatience manifested in her manner.

"Paul," she said, presently, "Mr. Winchester is to return to-morrow, is he not?"

"The steamer was reported this afternoon. Perhaps I should have gone to meet him; but I will confess that all this promised too much comfort." And he lazily stretched his legs before him, and yawned. Mrs. Barnett's impatience became annoyance; but she continued, shortly:

"Why is it that he came so seldom to see us? I hope you will ask him to come here often."

"I asked him often enough," Paul an-

swered, "but he would not come. Perhaps he will do better now. Sometimes he is not above seeing the error of his ways."

"It was such a pleasure, too, to see him always. He enjoyed himself so thoroughly."

"He did everything thoroughly. That came of his earnestness and his strength."

"How gloriously strong he was!"

"Yes; but you see how his strength misled him," Paul replied, slowly. "You must remember that strong men have stronger passions, stronger temptations than some of us. It may be that, after all, strength is a doubtful blessing."

"Oh, Paul! You are too distressingly philosophical. Why have you become so lazily content?"

Paul smiled at her in the provoking, languid manner which had grown upon him.

"Perhaps it is not well to be lazy," he said. "But surely you would not have me less content?"