PATENTED IMPROVEMENT

IN

STREET METALLING

For Increasing its Durability at Reduced Cost and Suppressing the Dust Nuisance of the Metropolis.

By I. Tipping, C.E.

Mr. President and Gentlemen,

Having for many years noticed the repeated complaints made by the citizens of the Metropolitan districts against that constantly-recurring nuisance, the "Dust Fiend," which not only causes serious injury to valuable merchandise, but is one of the most fruitful sources of discomfort and irritation to the populace, it becomes most desirable to devise some means whereby it may at least be mitigated to some appreciable degree.

After a long study of the question, I beg to lay before you my method, which, if adopted in practice, will, I believe, secure to the public, this long-felt desideratum, which, from a municipal and financial point of view, possesses manifest advantages over other methods of street construction.

I submit my views, in the first instance, to this Association that they may be thoroughly investigated by professional gentlemen of matured experience.

Street dust, as is well known, arises from mud dried on the metalling, being pulverised and put in motion by vehicular traffic, and thus made ready to be blown about by every puff of wind.
Colonial streets, with minor exceptions, are macadamised, *i.e.*, constructed with broken stone, whose interstices are filled with mud derived from the pulverisation of metal, hence the magazine of alternate mud and dust.

The system of macadamising was invented in and for Great Britain and its weather, which, being damp for the most part of the year, does not permit dust to become such a pronounced nuisance.

The Australian climate being just the reverse—its rainfall occurring for the most part in heavy showers of short duration, and being also subject to boisterous land winds—it would appear that such essential differences of weather call for some differences in street construction.

Improvement evidently must take the direction of producing a street surface, traffic upon which will produce a minimum of dust; from the nature of things, it cannot be entirely suppressed.

*Stone Pitching* holds the highest position for durability and comparative cleanliness, but is noisy, slippery, and expensive, and is not, therefore, adapted to general use in this climate.

*Ashlar Blocks*, closely jointed, have had their day of trial. They insured a durable clean surface, but afforded no sufficient footing to enable draught horses to work effectively; consequently, such blocks of stone are now only found where laid for tramways, as in the Commercial-road, London; at Milan, in Italy, &c. Such tramways are durable, easy, and quiet to ride over—Milanese 'buses travel almost as smoothly as railway carriages—but the thronging traffic of Melbourne streets could not be confined to straight lines. Hence, that system would be useless here, excepting on the main roads leading into the metropolis.

*Asphalt*, a cretaceous, bituminous rock—not the mixture of coal tar and metal siftings going by that name in Melbourne—was exhaustively tried a few years ago in London. Although clean and non-mud producing, as a pavement it did not wear well, and was dangerously slippery in damp weather. The writer visited Paris almost expressly to view the asphalted surfaces of its principal streets. They appeared to be fairly well adapted to that city of light traffic and drier climate, but in winter, when glazed over by a suddenly condensed fog, they become almost impassible.

*Wood Paving* has, during the past 50 years, been tried in every conceivable manner, under the belief that it was the only material capable of producing a durable, clean and noiseless surface. Unfortunately, every scheme, patented and otherwise, has hitherto failed in one important particular, viz., in not
affording a sufficiently secure footing in damp weather. The wood paving now being laid in Swanston-street, Melbourne, presents no novel feature excepting that red gum possesses superior durability; but it remains to be seen whether, from its resinous character and hardness, it will not prove to be the most slippery of wood pavements in damp weather. This drier climate is certainly better adapted to that description of pavement than Great Britain; but its initial cost will, in any case, debar it from general adoption until colonial municipalities are in a much better financial position than at present. It is not intended to dilate upon all the many methods of street construction, but merely to glance at recent attempts at improvement, and their failure to meet our especial requirements. Clearly, we need a surface which, while being sufficiently rough and gritty to ensure good horse footing, will be clean, at a cost for general use within the means of municipalities. No blocks or pitchers of either stone, wood, or other material have yet fulfilled those two necessary conditions. Can the desired improvement be produced by the use of broken stone? There is reason to believe it can.

Concreted Roads.—These consist of a mixture of metal, sand, and cement tightly rolled together. Several pieces of such road have been constructed, for especial purposes, in Great Britain, whose durability has been most remarkable, their vertical wear having been only one quarter of an inch in five years, under concentrated heavy traffic.

During a tour of engineering inspection in Europe, the famed military roads leading from Rome, constructed upwards of 1400 years ago, attracted my attention. I found them badly worn, and was informed they had never been repaired. They appeared to have been constructed originally to a height of three or more feet above the natural ground surface, and to consist of stones and gravel of all sizes, cemented together with pozzolana lime, etc. Their surfaces were clean, and footing good. These are the only roads which have come under my notice—together with the concreted roads in Great Britain just described—which combine those qualities, dust being difficult to produce from a surface presenting neither corners nor loose stones to grind down.

The last two paragraphs indicate a solution of the problem, which would probably have been adopted long ago but for erroneous suppositions of exceptional cost.

Five years ago the writer proposed to the Richmond Town Council that its metalling should be bound with cement instead of earth.

Argument.—The interstices of the metal laid city on the
streets may not now be expressly filled with earth, but they become filled with the detritus derived from the wear of metal, which comes to the same thing. It is the presence of this objectionable matter which is the source of all the mischief. A very considerable portion of this detritus or mud is produced by traffic ploughing through loose metal, which no sooner becomes settled, or what is left of it, than the mischief done is apparent in the form of mud and dust, which, under the pounding and friction of horsehoes and wheels, facilitates rapid reduction to mud of the remaining metal.

The writer therefore submits that the interstices of the metal should be filled with a material not liable to softening in wet, nor to blowing out in dry weather. The only known available material supplying these conditions is Cement Mortar, which, after the interstices have been closed to the utmost by rolling, should be grouted to a depth of three to four inches, and by a second method grouted before rolling. By rolling and grouting a fixed level surface will be produced, affording good footing. A metal road thus consolidated will then be ready for immediate traffic, instead of, as at present, requiring to receive considerable traffic before it can be said to be in a completed condition.

By this method of completing the construction of a metalled street no dust or mud-producing material will be present, and its wear, judging from the results of concreted metalling done elsewhere, will not exceed the tenth part of an inch vertically per annum. Machine-broken inferior stone will answer as well as the best quality of hand-broken; indeed, honeycombed stone may probably be found equally, if not more, suitable. One-tenth of an inch vertical wear would amount to one cart-load of dust per month from the surface of Collins-street between Elizabeth and Swanston streets. Hence the cost of sweeping and watering would be vastly reduced.

When stating principles it is not necessary to explain minute details, but these have been most carefully considered. The estimated maximum cost of cement mortar grouting is 1s. 6½d. per square yard. The present cost of a three-inch coat of metal is about 5d. per square yard; therefore, the cost of cemented metalling will be 1s. 11½d. per square yard. Such metalling may be expected to last five years, or, with an allowance of 20 per cent. for repairs, costing in total, say, 2s. 3½d., or 5½d. per square yard per annum. The cost of metalling on the present system under similar conditions cannot be less than 1s. per square yard per annum, a difference of 6½d., which, for 100,000 square yards of metalling to the busiest streets in the city, would amount in five years to £2,708 saved to the Corporation and available for other public works.
Country roads constructed on the present system require a depth of not less than twelve inches of stone. Under the system I advocate six inches in depth would suffice, and practically such roads would never need repair—once made they would be done with; but the immediate advantage of the application of my system would be to boggy ground, into which ordinary metalling gets thrust out of sight, or so mixed with mud as to be of little service. I am acquainted with portions of roads in the Shires where hundreds of tons of metal are spread every winter, making on each occasion but a transient improvement, and to the troublesome thoroughfares leading into Melbourne.

I will now endeavour to examine some of the objections which may be preferred against the adoption of cemented metalling for city streets.

1. That patch repairs would be difficult. Such might be the case as compared with the existing barbarous practice of dumping a barrow-load of loose stones on a hollow place, to the dread of all drivers. But accepting the results of successful trials, the homogeneity of cemented metalling, together with its imperviousness to water, leads to the conclusion that hollows are not to be expected. Should they in course of time occur, they would, before filling, require to be squared out, a process quite practicable with suitable tools. A patch laid with cement, and well rolled down, would at once restore that part of a street to a perfectly finished surface.

2. That it will be more difficult to open the streets to obtain access to gas and water pipes. To which answer may be made that breaking through a crust of 3 inches thick will be effected with much greater facility than quarrying out 9 inches in depth of concrete underneath wood paving. It may also be replied that the gain in the use of an impervious crust is so great as to counterbalance many times over such occasional inconveniences.

3. It may be objected that cement mortar, when worn off, would make dust. Granted, but how much? Certainly not the hundredth part the quantity which will find lodgment in the niches of wood paving. It may be argued that no more mud can at present be made than is represented by the amount of metal worn away. Under the existing system of metalling there is no practicable means of removing mud effectively, as it lies between, as well as also adhering to the surface. All the scraping and brushing which can be applied leaves a street in such wise that in twenty-four hours of wet weather it is again as bad as ever. It must, therefore, be evident that mud is the agent in producing further mud; or, in other words, mud makes mud. And in order that this mud-producing operation may be stopped, the cause itself must be got rid of. On a metal
cemented surface places for lodgment of mud will be very small; therefore such a surface could be brushed and washed almost as clean as flagged path. Thus the "dust fiend" would be to a very considerable extent abolished.

Hence both durability and cleanliness can be obtained by a metal cemented surface; and I therefore submit that, on the production of such a surface, lies the secret of success in street pavements.

4. It may be argued that, if cementing will make so smooth a surface, horse footing will be bad; or that, if the cement would not be so hard as to preserve a smooth surface, but would break away, that then pieces of metal would be loosened, and that we should have the spectacle of numerous solitary stones rolling about, to the inconvenience of traffic and lamming of horses, etc., etc., to which I may at once reply that no such complaints have been made of concreted metalling; that its wear could not have been only a quarter of an inch in five years if pieces of metal became loose.

At the outset of the adoption of cemented metalling full and complete success may not be attained in "hitting" the best mixture of mortar, but working on the lines of the principle here advocated would quickly lead to the discovery of the best compost. A metal cemented street would crown and complete Macadam's famous invention.

Approximate comparative estimates of cost of street paving on the three following systems—repairs, cleansing, and interest included—at per square yard during a term of 20 years:

<table>
<thead>
<tr>
<th>System</th>
<th>Cost (per sq. yard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Macadamising</td>
<td>£1 1 0</td>
</tr>
<tr>
<td>Wood Paving</td>
<td>£2 3 0</td>
</tr>
<tr>
<td>Cemented Metalling</td>
<td>£0 11 8</td>
</tr>
</tbody>
</table>

Note.—There are from 500,000 to 600,000 square yards of metalling in the City of Melbourne proper.

I am Gentlemen,

Your most obedient servant,

I. TIPPING, C.E.

Melbourne, 1st September, 1884.
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