An historical account of sub-ways in the british metropolis, for the flow of pure water and gas into the hoses of the inhabitants...

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British sub-ways.

BRITISH SUB-WAYS.

IN introducing this subject to general attention, it is necessary to premise, that British Sub-ways are distinctly different from the Roman: although they approximate in name, they differ in character and purpose; the former being for the reception of pipes and tubes, through which Water, Gas, and other fluids may flow into buildings, on the sides of the Streets they are constructed under; and the latter being large aqueducts, to convey all the waters of Rome, pure and foul, of every kind, under that City into the Tiber.

The Ancients, in erecting their Sub-ways, built them on a magnificent scale, as part of them shew at this day. Although they have ceased from their original purpose, the Sub-ways at Rome remain a model of the wisdom of our ancestors in their municipal regulations, and are an object of curiosity and interest to the scientific traveller.

British Sub-ways, then, are a modern invention, being a dry tunnel, immediately under the surface of the Streets, to receive pipes or tubes, to convey Water, Gas, &c. into the houses, without at any time opening the ground, or disturbing the

pavement; they at the same time give access to the Sewers below them, which properly resemble the Cloaca Maxima, or Great Water-way of Imperial Rome, by perpendicular shafts, or by inclined openings in the recesses, or in the body of the Sub-ways.

THE ORIGIN OF BRITISH SUB-WAYS—THEIR PROGRESS—AND COMPLETION.

By this arrangement the whole subject may be brought into view, and the importance of it fully developed.

Under the consideration of its ORIGIN, will be comprehended—The existence of a *great annoyance* to the Public from the frequent repairs necessary to the Streets of London, which stop the thoroughfares; as well as by taking up the Pavements to get to the Sewers and Pipes under the Streets—the constant recurrence or continuity of this annoyance—and the burthensome expence of it: shewing the necessity of an effectual remedy. *The remedy proposed—By whom and when—The Plan described.*

The PROGRESS OF SUB-WAYS will relate its discovery being announced by a Prospectus at a Public Meeting, called by advertisement at the City of London Tavern, on November 4th, 1822;

and another Public Meeting, called on the 4th of December, 1822:—That the objections then made were very few, and fully answered—That the public voice was in its favour—That it was approved by the scientific, by Architects and Surveyors, and generally by the Building Profession—by some of His Majesty's Ministers, and Members of the House of Commons, who recommended the formation of a Public Company to carry it into effect.

A second Prospectus issued.

The subject referred to a Committee, to report their enquiry into its utility, practicability, and expence.

Two Petitions to Parliament; and a notice in the London Gazette, " to apply to Parliament for an Act of Incorporation for building Sub-ways."

Letters to the Secretaries of State, Lord Liverpool, and Mr. Peel; and to the Under Secretaries, Mr. Hobhouse and Mr. Dawson.

Interviews with Davies Gilbert, Esq. M.P., as the leading Mathematician in the House of Commons, and now President of the Royal Academy—with M. A. Taylor, Esq. M. P.—with the Surveyor General of His Majesty's Board of Works—with the Directors of the New River Company, the Grand Junction Company, the

Chelsea Water Works Company, the Incorporated Gas Company, the City of London Gas Company—with the Commissioners of Sewers at Guildhall, and those of Greek Street, Soho—and with the Lord Mayor at the Mansion House.

Another Prospectus issued, and Circulars sent to the Peers and Members of Parliament.

A third Petition to the House of Commons.

A Petition to the Court of Common Council, Guildhall—with an Address to them in Court, when the Petition was referred to the Committee of Improvements—Attendance on that Committee.

A Public Meeting at the City of London Tavern, to receive the Report of the Committee of December, 1822, on the 17th of December, 1823—Alderman Garratt in the Chair; the proceedings at which were adjourned to the 18th of March, 1824, when the Report was approved, and the LONDON SUB-WAY COMPANY unanimously agreed to be formed.—This Resolution not subsequently acted upon—and why suspended at that period.

I now come to the COMPLETION of the Undertaking, which will take into its range a view of several important propositions by ingenious men, highly deserving adoption, which, combined

with Sub-ways, will embrace a magnificent National Work, highly important in producing a *summum bonum* to the inhabitants of this vast City, never possessed by any kingdom in ancient or modern history.

The first thing, then, is to shew the EXISTENCE of a malady, scourge, or plague to which the Metropolis has been subjected, by the impurity of the water supplied for the personal drink and culinary use of its inhabitants.

The next will point out an effectual REMEDY for cleansing the foulest waters; and supplying water at all times, clear as crystal, in the greatest abundance, through

THE SUB-WAYS.

And, finally, that the expence, though great in its formation, will ultimately repay itself, and reduce the public Taxes.

That it must be a Public Work, from its magnitude and importance, under a Royal Commission.

Concluding with a dutiful Address to the King.

The Origin of Sub-ways.

The Existence of the Nuisance, &c.

It will not require much argument to shew the existence of that which is daily before our eyes. The dirt and filth of London Streets are proverbial, and well expressed in several recent publications on that subject, from a few of which the following extracts are taken, *viz.*

From a Paper read before the Institution of Civil Engineers on the Construction of Carriage-way Pavements, by Mr. Bryan Donkin—London, 1824.

" The very short period during which the pavements of this great Metropolis remain in a tolerable state of repair, must have attracted the attention of all whom business or pleasure induces to traverse its streets in carriages or on horseback. The holes and inequalities with which every thoroughfare is filled, almost immediately after it has been paved anew, whilst they occasion intolerable jolting, destroy carriages prematurely, and, by making the footing for horses very insecure, render two-wheeled vehicles and horseback extremely dangerous.

" All are ready enough to detect the immediate cause of the speedy derangement of our pavements, in the immense number of heavy waggons, carts, and drays which constantly crowd the principal streets; few, however, think of looking for causes more remote, which are within the reach of remedy, and which especially deserve attention, as mainly allowing the immediate cause to exert its destructive influence. The subject of pavement, however, is too important to have escaped the notice of Engineers entirely. It has been investigated by some,

and various improvements in the method of paving have been proposed; but from objections taken either to the nature of the materials used, or the expence to be incurred, none of them have ever been generally adopted.

In most of our streets the pavement lies on a soft and yielding bed; in several, I have seen it bedded upon the vegetable earth, or natural soil of the place; and in others, where it has required to be raised to the original level from which it had gradually sunk, I have seen it laid upon sand. This last, however, is generally employed in too small quantity to be of any use; for sand, though certainly a convenient material for bedding, and supplying a more durable support than earth, is still very far from what is requisite—indeed, is altogether useless, if sparingly employed.

"But supposing, for argument sake, that the earth upon which a pavement is laid, has been previously well rammed when dry, the stones selected of one size, and carefully bedded, (which would undoubtedly make a better pavement than is generally seen), this is not yet enough; for the earth being spongy and absorbent, is softened in wet weather, and no longer yields a firm bearing to the stones; these, constantly exposed to heavy weights, and to blows from carriage-wheels, are put into motion, and churn, or pound the soil beneath, till it becomes a pulpy, semi-fluid mass, easily displaced laterally, *i. e.* from the under-surface of one stone to that of another, or upwards through the crevices between the stones into the street. One stone thus acts as a forcing-pump; for being depressed itself, the mud is either driven from below it laterally under the neighbouring stones, by which they are raised; or it is forced up through the crevices to the surface of the pavement.

"Thus it is that the pavement so soon becomes uneven and full of holes, and at the same time covered with mud, to the great annoyance of passengers generally. Few are aware of the source whence the vast quantities of mud are derived which we see daily taken from the streets; but the truth is,

the foundations of our pavements are actually carted away, as a nuisance."

From "Considerations on the defective State of the Pavement of the Metropolis, &c." by WILLIAM DEYKES, Gent.—London, 1824.

"The bad state of the pavement of the streets of London has for many years attracted my notice, and more particularly when driving or riding.

"I have been an attentive observer of paviers; and though convinced their operations might have been much better performed, I did not perceive by what means (depending upon their care and attention) the system could be materially improved. The subject has continually forced itself upon my mind; and without knowing wherefore, I have felt a peculiar interest in it. Under such circumstances, the amazing accumulations of mud and dirt which, though often swept up and removed, were still succeeded again and again by equally large quantities, could not fail to excite notice, and the reflection was induced—Where could it possibly come from?

"In every age of the world, and in all climes, the metropolis of empires was a chief object of regard to reigning Sovereigns, and attracted the notice of contemporary States. Ancient History abounds with descriptions of those of Egypt, Carthage, Babylon, &c., and of the various stupendous and surprising works of art which adorned and improved them, many of which have been chiefly instrumental in rendering particular reigns memorable through ages of after-times; nor has Sacred History overlooked the subject, or omitted to mention, with great accuracy of description, the renowned cities and wonderful works of early days.

"The lapse of centuries from a period anterior to the Christian era has not, it may be inferred, been productive of

that great improvement too generally supposed, if we reflect upon the prodigious works which the enterprise of earlier days produced; and a reflecting mind will readily imagine (not less from those ancient wonders, than from surprising modern inventions) that manifold and great objects may yet be accomplished by a liberal patronage of genius, and a judicious adoption of its emanations.

"England, the seat of Science, and nurse of Genius, has been foremost among the nations in promoting every object of liberal and enlightened policy, every charitable and philanthropic idea, and every project which by its utility could promote the happiness, comfort, or convenience of its people. Infant States consolidate their Governments, and form their Institutions upon her example; and nations of far earlier date seek in vain to rival her in approximating towards that perfect system to which the wisdom of succeeding generations will one day attain, and England lead the way.

"London, the renowned City of the world, and centre of commerce, has largely benefited by the enlightened course she has pursued. Her institutions and establishments (too numerous, and too eminently celebrated, to allow of more than general expression of admiration) are alike the wonder of the Old World, and the objects of emulation to the New.

"Amongst other objects of high importance, the improvement of the streets of London has been a prominent consideration; the progressive changes have been marked, and are too generally known to need more than cursory notice. Not more than two or three centuries ago, but few of the streets were paved at all; and the various histories of London record the arduous journey from Temple Bar to Charing Cross, and the impassable state of Holborn, arising from the defect. At a less remote period, the flag-stone pavement for foot passengers was introduced (how much to general comfort and convenience, every person is competent to judge).

"More recently the adoption of squared paving stones, instead of the small round ones, called pitching stones, together with the improved mode of paving in parallel lines from curb to curb, has materially improved the streets of London.

"Still, however, with every improvement hitherto suggested, the pavement of the streets has always been, and to the present day remains, most inconveniently defective, though very great annual expenditure has taken place; nor has any invention hitherto been announced to remedy the acknowledged defect. The names of Telford and M^c^Adam stand justly pre-eminent in the science of Road-making; and it is not for me, nor do I intend, to dispute their claim to high consideration and estimation: so far the reverse, that I am free to confess I do not conceive the theories and practice introduced by those gentlemen respectively can be improved upon. But this admission I must confine to apply to roads only. The application to streets of the principle introduced by Mr. M^c^Adam is now only in course of trial; and I refrain from expressing any opinion on its efficacy or fallacy. The experience of the public will best determine. But as Mr. M^c^Adam himself admits (if I do not greatly mistake) that his theory cannot with advantage be practised upon those narrow and confined streets which are great thoroughfares; and as many of the warmest advocates of the theory, and friends to the practice of *Macadamization* admit, whilst they regret, the increased creation and accumulation of dust and sand, in drawback of the merits of the device; it hence appears that, as applicable to streets, the point of perfection is not yet attained.

"Leaving Mr. M^c^Adam's system in full possession of the roads, and to its action upon the streets of London, according as experience shall teach the public to adopt or reject it, I shall state, under distinct heads, the various faults, defects, and inconveniences of the pavement of the Metropolis, always meaning, in the general term "pavement," the carriage-way only of the streets.

"1st.—The pavement is so continually out of repair, that it baffles the most vigilant superintendence to keep even the greatest thoroughfares in a tolerably good state:—in instance of this, the new and most expensive pavement (equal to any in London) with which the whole of the Strand has recently been repaved, already evidences impairment fully characteristic of the causes to which the general imperfections of pavements are herein attributed.

"2dly.—The dust in dry weather is greatly annoying, and highly injurious to goods and furniture, to say nothing of personal feeling and annoyance in having the eyes blinded, and the mouth choked therewith; and no sooner is there a wet day, than the streets become ponds of mud. By the time the accumulation is almost intolerable, the scavenger commences the annoyance of sweeping, and scooping it into his carts, and splashing and bespattering every passer-by, not prudent enough to cross out of his way, and be content to be covered over the ankles with mud, rather than over neck and ears. To this item may also be charged the never-ending scourings, brushings, and cleansings of carriages, by which the superb and highly painted and polished panels are scratched and defaced, and their lustre obscured. As to ladies' and gentlemen's dresses, I leave individual feeling to its own operation.

"3dly.—The unevenness to which the surface is liable, and which gives rise to many accidents by passengers and horses falling. From the same cause, carriages and vehicles of every description become shaken, and old, and deteriorated many years earlier than, upon passage over a surface more evenly preserved, they would do; whilst the jolting motion (which the most improved springs cannot obviate), and deafening noise, being also attributable to this cause, further increase the items of the account chargeable to this head of defect and consequent inconvenience.

"4thly.—The wide-gaping intersections or interstices between the paving stones. To those who have neither sprained

an ankle, nor filled a shoe with mud, this item will not be intelligible; but to those who have, I need say no more. By the admirer of the grandest quadruped in nature—the horse—the subject will be appreciated, and felt with a compassionate interest inherent in every generous breast, when convinced (as every person must be, at all qualified to form an opinion) that to this cause, in a very great degree, may be attributed the various injuries to the sinews and tendons of the legs, the fruitful source of all the founderings, firings, and blisterings which that noble animal in its brief existence endures.

"The several points of consideration, though stated under separate heads, are intimately connected in cause and effect, and may therefore be treated of collectively.

"The necessity of frequent repair arises almost wholly from the aptitude of the earth, on becoming saturated with wet, to lose its natural consistency, and become mud; and consequently that foundation for pavement which ought to be hard and inductile, becomes soft and penetrable. The multitudinous and unceasing passage of immense weights over the surface keeps the stones in constant sway and motion, and propels them downwards into the softened foundation. The surface of the pavement being thus once disorganized, and even a single stone forced below the general surface, each succeeding wheel in its revolving motion jolts into the hole thence formed, and acting with an impelling power from time to time, deepens and enlarges it; the effect of which is, that the stones in immediate contact, losing on one side that equal support which previously existed, incline to the defective part, and the defective parts existing in many places, hence the ruin spreads, and the streets become such as every day's experience presents to our view.

"The second head of objection results from the same cause as the preceding. The gravel in the interstices between the stones becoming wet, loses its proper consistency. By the operation of gravitation, and law of motion, as the heavier body

sinks, or is impelled downwards, the lighter body of fluid is thrown upwards, and ejected. Thus the gravel between, and the earth under the stones, are forced upwards in quantity in proportion to the sinking of the stones, and form on the surface of the pavement, mud more or less diluted, according to the quantity of rain which it has imbibed. The gravel in a wet state exudes also by the lateral pressure of one stone against another. To make myself better understood on this point, I may be allowed to amplify. As Fleet-street extends east and west, suppose a team and waggon proceeding westward—the purchase for the feet of the horses will be on that edge of each stone which is towards the west, and the pressure consequently against the stone immediately eastward of that acted upon: the effect will be, that the wet gravel will be pressed upwards from between those stones acted upon, and an interstice or gap formed on the opposite side, which becomes the nuisance noticed under the 4th head of objection. The horses and waggon returning eastward, the same action takes place, but in an opposite direction; and thus each particular stone, instead of being fixed firm and immovable, becomes a rocking stone, and by consequence all its angles are destroyed, the edges become rounded, and the stones unfit for further use but in secondary or minor streets. As this climate is particularly subject to rain, the evils pointed out are constantly in progress, and cannot, under the present imperfect system, be checked, although many thousands of pounds are annually expended in the endeavour. As the correctness of the foregoing explanation may by some persons be doubted, I request the public individually to consider—from what source the (otherwise amazing) quantity of mud which is washed by rain into the sewers, and carted away by the scavengers, arises. Where does it come from? How is it else produced? Are cause and effect confounded, and mistaken the one for the other? Is the mud or the dust the primary nuisance?—in other words, does the dust (in the first instance) result from the mud, or the mud from the dust? The former must certainly be the real state of the case.

"To be convinced of it, let any person reflect how nicely imbosomed, roundly elevated, and plump a new pavement for a short time appears after many loads of gravel have replaced past expenditure; let him consider what renders fresh gravel always necessary upon relaying pavements; by which will be induced the further consideration in immediate connection with it—of what becomes of the vast quantities which from time to time are expended.

"The foregoing observations embrace also the considerations connected with the third and fourth heads of objection. The unevenness of the surface of the pavement, and the dangerous openings between the stones, alike result from the causes pointed out; all the defects are consequent upon each other; and when once dilapidation commences, speedy impairment and disorganization follow, and are shortly succeeded by total and irretrievable destruction.

"I have refrained from imputing any of the defects in the existing system to the paviers, though an observation or two might be made in that point of view of the subject: but it is nevertheless my confident opinion that no care on their parts could render materially better a system, the results of which have hitherto proved so bad:—there exists a radical defect."

From a Prospectus of Mr. Macarthy's Patent Pavement.—London, 1826.

"The necessity for interposing a hard durable substance between the soil, naturally loose and soft, of public streets and roadways, subject to considerable mercantile and other traffic, must at all times have been apparent; and hence the origin and use of pitching, or pavement.

"The construction of the street-ways in ancient cities, is totally inapplicable to the streets of modern cities. The

ancient street-ways, once formed, or rather built, might occasionally require repair ; but time would do much to consolidate the original construction ; and even when repair became requisite, the necessary operations would be confined to the surface-covering of the soil.

"If durability had been the only desideratum of a carriage-way pavement, improvement would scarcely advance beyond what has already been done. But progressive civilization has taught the European world, that something more than strength and durability must be effected by the modern Ædile, or Curator of the public ways. And it may not be altogether foreign to the purpose, to observe, that, in the time of the Romans, the construction of the highways was matter of state, the Ædile being a magistrate of high rank, invested with considerable powers ; whereas, amongst the moderns, the street or road surveyor is in little estimation ; has neither rank, station, or precedency; is too often the mere pavier appointed or employed by the local Board or Trust; and altogether without authority beyond that of a tradesman executing an order. Hence, probably, the slow improvement in the construction and repair of streets : so that the work were executed cheaply, little selection was made as to the material, and until lately, a very faulty judgment was exercised with relation to method and workmanship.

"It is well, however, that a better spirit is awakened. Road Trusts have abandoned many of their ill-judged methods ; and experiments have been largely tried with reference to the streets of our metropolis. Mr. M^c^Adam has discovered, and extensively applied, much that is useful, and worthy of universal adoption as to roads ; yet as to streets and the more public thoroughfares for general traffic in particular situations, it must be admitted that, if his plans have not wholly failed, they have not yet succeeded : still the public owe much to that gentleman, since in broad and open roads, where the line of carriage-traffic is not confined to one or two narrow widths

of ordinary carriages, his method is little objectionable; but where street-ways much frequented are limited in breadth, and not exposed to sun and air, we hazard little in asserting, that Mr. M°Adam's plan is utterly inappropriate. In a narrow street, only wide enough to admit of one carriage passing at a time, his plan, executed in his best manner, would not remain conveniently passable six hours of a busy day.

"Some observations may be necessary to convey to those who have hitherto only cursorily considered the subject, a knowledge of a few of the difficulties attending it.

"Numerous heavy carriages, carrying from one to six or more tons, pass over the same line, or track, of many of the leading streets, during ten hours every day throughout the year, Sundays excepted. The weight is borne upon wheels, it is true; but all writers of authority agree that these, as at present made, are of a form and inclination calculated to grind and destroy whatever substance they roll over, or which may be opposed to them.

"The materials composing street-pitching are subjected not only to this pressure, but also to the percussion arising from the tread of heavy draught-horses, shod with massy iron, following one another, each striking the same stone in rapid succession, with a force equal to a ponderous sledge wielded by a powerful arm.

"Whatsoever time might have effected towards consolidation of the present stone-pitching, and however ingenuity of contrivance may have accomplished the work of time, such pitching becomes loosened, disturbed, and even destroyed, by the operations of the numerous Water and Gas Companies, who yet minister to our habitual wants, whether of necessity or of convenience.

"Amongst other unavoidable disturbers of the streets are

to be numbered the Commissioners of the Sewers, whose labours are absolutely necessary to cleanliness, and to health, its concomitant.

From " Practical Instructions for the Improvement of the Carriage Pavements of London," by J. C. ROBERTSON, Editor of the Mechanics Magazine—1827.

" The defective condition of the carriage-ways of the British metropolis, and of almost all the cities and towns of England, forms a singular exception to that high state of improvement which the public works of this country generally exhibit. It is an evil which every one observes, and feels, and complains of, and which has nevertheless subsisted for a long series of years, without any serious or rational attempt being made to have it remedied. Travelling has made wondrous strides in point of ease and expedition, and this has necessarily been the consequence of much improvement in every thing on which quick and comfortable travelling depends—of improved roads, improved carriages, improved driving, &c. But, as regards the roads, it is those of the *country* alone which have partaken of this improvement; for still, at every town you enter, you find things nearly as they were fifty years ago; the causeways as rugged, rutty, and merciless to flesh and bones, as they were in the days of our grandsires.

" Mr. M^cAdam, who has done so much, by the system to which he has given his name, to improve the country roads of England, has been recently employed to relay some of the streets of the metropolis on the same plan; and every thing that could conduce to give the experiment a fair trial—money, time, and facilities of all sorts—have been placed at his command. The experiment, however, may be regarded as a complete failure. The utmost that Macadamization can be said to have effected any where in London, is some gain in point of

smoothness, and a diminution of the noise occasioned by the passage of carriages and waggons—benefits that compensate but poorly for the many serious evils with which it is attended. In all the great thoroughfares that have been relaid on Mr. M^c^Adam's system, such as Westminster and Blackfriars Bridges, Oxford, Bishopsgate, and Coleman Streets, where the traffic is busy and incessant—where carriages of all descriptions are constantly passing to and fro, and in the most zig-zag directions—the *metal*, as it is called, is so rapidly ground to dust, that it is only by a constant supply, at a great expence, of new materials, that the carriage-ways are kept in a passable state; and in all weathers, whether wet or dry, the produce of this perpetual grinding process is alike annoying and injurious to the inhabitants and to passengers. At one time you have to wade your way through pools of mud, at another to buffet it amidst clouds and whirlwinds of dust; clothes, houses (inside and out), furniture, health, and comfort, are all alike sufferers by the nuisance. Every passing creature and thing serves as it were the office of a mud or dust cart, and every adjacent building as a resting place for the flying favours of Macadamization. Nor does the evil stop here; for after all the mud and dust thus carried off, there still remains an abundant residue, which finds its way into the public sewers, supplying them with a sort of food which must ere long (should the system not be abandoned) produce obstructions most injurious to the bodily constitution of this great metropolis, and which can only be removed at great inconvenience and expence.*

"Streets constantly in want of repair, always mending and never mended—a great increase of expenditure (amounting in some cases, as the writer has been assured, to triple and quadruple that incurred under the old system); inundations of mud in winter, and clouds of dust in summer; persons and property injured; the very *prima viæ* of the city obstructed; —such are the evil consequences of a system, which offers in

* The Macadamization of Bishopsgate Street alone is stated to have occasioned an expence of about £1,500 for clearing the Sewers.

return only a little less noise, and a little more ease to those who ride.

" All these evils are of course proportionably diminished, according as the traffic is more or less frequent. Nor is it meant to be denied, that in many retired streets and squares Mr. M^cAdam's system has been and may be adopted with counterbalancing advantages. Wherever, in fact, the traffic is not greater than on most country roads, Macadamization will be found equally beneficial—with this difference only, that the number of persons liable to be annoyed by the vicinity of a dusty or muddy road, is greater in town than in the country.

" That a system which suits the country well, should fail so completely in town, is only what might have been naturally expected from the great difference between the two. Why were causeways of hard granite ever thought of for towns at all? And why have the blocks of these causeways been made, from time to time, larger and larger? Because, doubtless, of the greater traffic in town than in the country, and of the insufficiency of streets constructed of smaller and less durable materials to withstand the tear and wear which that traffic occasions. What, then, is this attempt to extend the system of Mr. M^cAdam into the hearts of our cities, but a recurrence to that very state of things, which general experience long ago pronounced to be intolerable?

" The very fact that Mr. M^cAdam's system is pretended to be equally good for town and country, ought of itself to be decisive of the fallacy of that pretension. It is *impossible* that any system whatever could produce the same results, under circumstances so diametrically opposite.

" A writer in the Mechanics Magazine (Vol. II. p. 216, June 12, 1824), has proposed, as subsidiary to ' an improved line of Sub-ways,' that the ordinary paving should have an ' underlayer of large unhewn stone, well bedded in earth ;' and

this suggestion he enforces with a remark particularly worthy of attention :—' It is a matter,' he says, ' of no surprise that ' the paving stones sink into hollows without the aid of other ' causes than the looseness of the earth on which they are laid; ' it generally consists of broken bricks, the refuse from cinder ' hills, and uncementing rubbish of all descriptions; *the sur-* ' *prise is,* that no *means have yet been adopted to reach the root* ' *of the evil, by producing a better bedding surface for the* ' *superincumbent paving.*' "

From " Hints to Paviers," by COLONEL MACERONI—1825.

" However true it may be, that an observant traveller cannot fail of being struck with admiration at the excellence of the turnpike and other roads throughout this country, he must, at the same time, be very much surprised at the badness of the *carriage pavement,* even of the principal streets of this astonishing metropolis. It is difficult for him to understand how, in a country where every mechanical art is best understood, and actually applied to the most useful purposes—where ingenuity, guided by science, is ever on the research, and ever sure to be rewarded for each fresh improvement—how, in the very capital of such a country, the carriage pavement should be, perhaps, worse than that of any other metropolis in Europe. It is, to be sure, justly boasted that this city enjoys the advantage of commodious and matchless footpaths; and that the existence and goodness of such footpaths are, in one point of view, of more general convenience and personal comfort than that of a perfect level and easy carriage pavement, inasmuch as the safety and convenience of the thousands who walk, should be preferred to that of the dozens who ride in their carriages. But in a city like this, teeming with life and activity, throughout which so many thousand public conveyances perpetually travel at so rapid a rate, the state of the *carriage pavement* must surely be a matter of very great importance.

"Previously to pointing out what I conceive to be the most advantageous method of improving the carriage pavement of London, I think it will be expedient to offer a few observations on the nature and construction of such pavements on the Continent as are most remarkable for their excellence and durability.

"The ancient Roman paved roads, such as the Via Appia, the Sabina, the Flaminian, Emilian, &c. &c., first claim our attention. Of these, there are still tracts of many miles in perfect repair in Southern Italy, especially in the neighbourhood of Rome. A good foundation of gravel, broken limestone, or of basalt, was sometimes applied, where the nature of the soil required it. It is unnecessary to mention the causeways of solid masonry, over which they were at times carried, as such causeways, in certain situations, were as indispensable as they would be at the present day under the same circumstances of locality.

"The stones composing the pavement of these roads are uniformly of basalt, of a polyangular shape, containing, on an average, about four or five feet surface, and about twelve or fourteen inches in depth or thickness. They are generally more or less slightly pyramidical, and placed with the base or broadest surface uppermost. It is by no means in every instance, as is asserted, that these stones are laid in a bed of mortar; in many situations I have found it to be otherwise. Neither are their edges chipped with any great nicety; the juxta-position is, however, well contrived, and indeed very remarkable; for although they vary *ad infinitum* in shape, angles, and more or less in size, they are fitted together as though each had been expressly cut for its situation.

"It would appear, that in many places large tracts of these roads have been intentionally destroyed, either for the sake of the materials, or for the purposes of war and devastation; other portions have, in the lapse of ages, disappeared with the gradual changes to which the surface of this earth is subject,

especially in inhabited districts, when barbarism rapidly succeeds civilization, or civilization barbarism. Such portions, however, as have been left to contend with the mere wear and use for which they were constructed some two thousand years ago, are in as good order and preservation as ever.

" The pavements most similar in construction and solidity to the ancient Roman, are the modern Neapolitan. The stones of these are also of basalt, but in lieu of being polyangular, they are rectangular quadrangles, mostly squares, generally of about four feet surface, and six inches in thickness. The sides are very accurately wrought, as well as the surface, which is left as rough as is consistent with a good level. These stones are laid in a thick bed of the best Puzzolana mortar, and always so arranged, that the lines of junction are never parallel with the line of road,* but cross it diagonally. This pavement excels in evenness and level, is very permanent, but expensive, and liable to become dangerously smooth, which renders it necessary, from time to time, to cut grooves on its surface. The city of Naples being admirably provided with sewers and sub-ways of the most solid construction, the necessity for disturbing the pavement very seldom occurs, so that the expence, though great, is pretty much confined to the first laying.

" The pavement of modern Rome is also of basalt. The stones are parallelograms of about two cubes in length ; and on being set up endways, they present about ten inches square surface. Although they are accurately cut, and equal in size, they are simply fashioned by a few skilful blows of the hammer. More mortar is used in the construction of these pavements than even in the Neapolitan. I have observed the bed of the

* Opposite the Foundling Hospital may be seen a bit of expensive pavement, the stones of which are most accurately wrought and fitted together ; but the lines of junction, being parallel to the line of road, deep furrows have been worn between the stones, in a few weeks after they were so carefully laid. Moreover, having no kind of *condensed* homogeneous foundation, it cannot be expected to retain its level, if subjected to the shocks of heavy carriages.

best Puzzolana mortar, on which they are laid, to be above a foot thick.* Rome being provided with the most extensive and complete sewers and sub-ways of any city in the world, its pavements, or, as they may be called, horizontal walls, have likewise very seldom any occasion to be disturbed.†

" The next kind of pavements that it may be necessary to mention, are those of Florence, of Sienna, of Milan, and some other cities of Northern Italy. These may, indeed, be assimilated to a kind of stone rail-road, as there are particular tracks allotted for the wheels, and others for the horses. The tracks for the wheels are composed of stones of very large dimensions; they are of marble, lumacular limestone, or of a very hard sand-stone; most of them, particularly at Florence, weighing several tons. They are laid with much precision, in lines of about three feet broad. The spaces for the horses

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* When the Roman or Neapolitan pavement is fresh laid, care is taken to cover it a foot deep with earth or rubbish, to protect the mortar, until it is set, from the jars of the carriages. The London paviers, who use no mortar, but lay their stones in loose gravel, nevertheless take especial care to imitate this practice, and carefully protect their loose stones and gravel (from the cold I suppose !) with a stratum of earth or rubbish, which speedily produces pools of mud or clouds of dust. This is not merely ridiculous, but an abominable nuisance.

† At present there are in Rome but few streets which exhibit the ancient polyangular pavement. In most parts of the city it lays at the depth of from eight to twelve feet beneath the present surface. The accumulation over the whole extent of the Forum Tranjanum, which was cleared away by the French in 1813, was, on an average, about twelve feet. That over the Forum Romanum, situated between the Mons Capitolanus and Mons Palatinus, was still greater.

I believe it will be found that the level of most cities has a tendency to gradual rise; as more materials are introduced into them than are ever taken out again. The numerous sackings, burnings, and subversions endured by Rome in the barbarous wars of the lower empire, and the "good old times" that followed, have produced a considerable rise in its level. This has necessarily been greater in the lower parts, between the celebrated seven hills, whose relative elevations have diminished proportionately. Thus the famed Tarpeian rock or precipice, on the south side of the Capitol, has, by the process of subtraction from the top, and addition to the bottom, during more than two thousand years, been reduced to less than forty feet in height.

between these lines are paved with small stones, and are, as well as I can recollect, about four feet wide. In some of the squares, the small pavement predominates; while the lines of large stone-ways cross it in every necessary direction. Nothing can be more easy or agreeable than this pavement, which is suitable to carriages of every description, without the limitation or confinement of an iron rail-road, but with nearly the same smoothness.

"Among the causes which appear to me to have contributed to the extraordinary duration of the *ancient* Roman pavements, the geological nature of the surface over which they are constructed, is not the least prominent. With the exception of the Pontine Marshes, and some tracts about Brindisi (Brundusium), Taranto, and Peruggia, nearly the whole of them have been carried over a surface of volcanic tuffo, of greatly compressed Puzzolana, or of calcareous or basaltic rock; all which furnish the best possible foundation. In countries where chalk, clay, gravel, or sand, are frequent at the surface, as in England, France, Alsace, part of Lombardy, &c., even these Roman pavements, when not kept in repair, have speedily become impracticable for carriages.

"The size and weight of the stones composing the ancient Roman pavements certainly do, *when once laid on a compressed substratum*, oppose much *vis inertia* to the weights which roll over them, while their polyangular shape prevents any acute, or even right angles, being presented to partial pressure. This polyangular shape, and the excellent juxtaposition of their sides, prevent any continuous line of junction being presented to the course of the wheels, which would so much tend to create ruts, and other irregularities; moreover, the stones being slightly pyramidical, produces a tendency to conduct the shocks towards the inferior centre of each, or laterally to the superior edges, which are well supported by the surrounding ones.

" It is necessary also to remark, that the carriages used in Italy, both anciently and at the present time, are what would be deemed in England very light; besides which, the wheels of the modern Roman and Neapolitan carts are of a larger diameter than any used in England. It would appear that the carts of the ancient Romans were generally two-wheeled, drawn by two or four oxen. Travelling was for the most part performed on horseback, or in litters carried by two mules. Chariots for travelling do not appear to have been used at all much before the close of the Republic. They were both two and four-wheeled, but not made to carry more than two persons, besides the driver. They do not appear to have had any springs; the wheels were very low, and not more than thirty-two or thirty-three inches apart. So that altogether, it may be presumed, they were more calculated to bruise the bones of the riders, than injure the pavements over which they bounced.

" Such, in a very few words, are the best pavements I have had an opportunity of observing; and there is reason to believe there are no better existing. It does not, however, follow, because they are good, and perfectly well adapted to their respective purposes and localities, that any of them might be applied with advantage to the streets of London. I think it may be easily shewn, that neither the ancient nor modern Roman, the Tuscan, or Neapolitan, would possess the qualities required for such an application.

" To pave London after the ancient Roman plan, would, in the first place, be attended with enormous expence, and entirely new stones would be required for the whole undertaking. Stones of so large a surface would also become most dangerous for horses, at any pace faster than a walk,—or when drawing heavy weights,—or upon an acclivity. In London, waggons and carts are in general use, of far greater burthen than any which were anciently or are at present used in Italy. Some of our stages and vans, to a very considerable weight, moreover add great velocity. I shall be told, perhaps, that

in proportion to this horizontal velocity, the vertical gravitation is diminished; but these carriages have very small fore-wheels, upon which the drivers, with extraordinary stupidity, contrive to place the greater part of the load.* Such small wheels, so overloaded, descend with great violence into the least depression of the pavement, and are thrown up (to fall again) by the slightest protuberance.

"I very much doubt whether, even in point of durability, either the modern Roman or Neapolitan pavements would succeed in London. Considering the friable nature of most descriptions of mortar, I suspect that the repeated shocks of very heavy carriages would pulverize and detach it from the inferior surface of the stones, part of it would work out, and the stones become loose.† A further great objection to any such solid masonry pavements is, the frequent necessity of partially taking it up, to lay gas and water pipes, and to repair our trumpery crumbling brick sewers.‡

"The foregoing objections will equally apply to the modern Neapolitan pavements. The modern Roman has not the defect of being too smooth, but it has that of homogeneous chemical solidity, which will not admit of its being perpetually displaced for the temporary purposes above mentioned. Moreover, where are we to get a sufficient quantity of such Puzzolana mortar as is employed in Italy, with which the pavement becomes as one rock?

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* The pertinacity with which this custom is followed, is somewhat surprising in this scientific country. What are we to say to the riders too? We frequently see five or six in front on a stage-coach, without a single person behind, or even inside!

† I have seen portions of ancient Roman road broken up by the passage of heavy artillery. A very few such large stones displaced, will render the road impassable for carriages.

‡ Our sewers are admirably planned and levelled, but the materials and the construction are very deficient of the necessary solidity.

" With regard to the pavements, or, as I have ventured to call them, the stone railways of Florence, Sienna, Milan, &c. &c., the objections to their adaptation to the streets of London must also be obvious enough. Independently of the enormous expence of the materials, such a system could never answer in streets where vehicles of all descriptions, going at every degree of velocity, have occasion to cross, pass, and run abreast of each other, over the entire breadth of the street. Such large stones, whether of granite or limestone, would soon become dangerously smooth, their longitudinal edges would wear, the contiguous stones sink, and ruts continually be formed along them."

The continual Recurrence of this Annoyance.

This is a regular annual operation; it commences soon after Midsummer, and continues till the funds are spent by the Commissioners of Paving, &c.; and when they have not money enough, they apply to Parliament for more. This will appear from the common observation of every one, as to the fact itself, and by the Act of Parliament in 1823, entitled " An Act for altering and " amending two Acts, passed in the eleventh and " thirty-third years of his late Majesty King " George the Third, for consolidating, extending, " and rendering more effectual, the Powers granted " by several Acts of Parliament, for making, en- " larging, amending, and cleansing the Vaults, " Drains, and Sewers, within the City of London " and Liberties thereof; and for paving, cleansing, " and lighting the Streets, Lanes, Squares, Yards,

" Courts, Alleys, Passages, and Places, and pre-
" venting and removing Obstructions and Annoy-
" ances within the same.

" Whereas an Act was passed in the eleventh year of the reign of his late Majesty King George the Third, intituled, ' An Act for consolidating, extending, and rendering more ' effectual, the powers granted by several Acts of Parliament, ' for making, enlarging, amending, and cleansing the Vaults, ' Drains, and Sewers within the City of London and Liberties ' thereof; and for paving, cleansing, and lighting the Streets, ' Lanes, Squares, Yards, Courts, Alleys, Passages, and Places, ' and preventing and removing Obstructions and Annoyances ' within the same;' and it was thereby enacted, that, for defraying the expence of paving, cleansing, and lighting the streets, lanes, squares, yards, courts, alleys, passages, and places, and preventing annoyances therein, and of making, enlarging, widening, deepening, altering, and removing all or any of the common sewers, public drains, and vaults within the said City and Liberties, one or more rate or rates, assessment or assessments, should, at such time or times as the Commissioners acting in the execution of the said Act, should think fit to order and direct, by writing under their hands and seals, or the hands and seals of any seven or more of them, be made, laid, and assessed in the several Wards of the said City, by the Aldermen or their Deputies, respectively, and the major part of the Common Councilmen of each Ward, upon all and every person or persons who should inhabit, hold, occupy, possess, or enjoy any land, house, shop, warehouse, cellar, vault, or other tenement or hereditament within the said several Wards, and who by the laws then in being, were or should be liable to be rated towards the relief of the poor in the respective parishes where he, she, or they should respectively live or reside, for raising such competent sum or sums of money as the said Commissioners should, from time to time, judge needful, and direct; so as such rates or assessments did

not in any one year exceed in the whole the sum of one shilling and sixpence in the pound, of the yearly rents of such of the said lands, houses, shops, warehouses, cellars, vaults, or other tenements or hereditaments respectively, as should be situated in any street, lane, square, yard, court, alley, passage, or place, actually begun to be new paved, by virtue and in pursuance of the said Act, or of any former Act of Parliament, AND ONE SHILLING IN THE POUND of the yearly rents of such of the lands, houses, shops, warehouses, cellars, vaults, tenements, or hereditaments respectively, as should not be so situate; such rates respectively to be from time to time ascertained by the rates at which such respective lands, houses, shops, warehouses, cellars, vaults, or other tenements or hereditaments, should be from time to time assessed towards the Land Tax:

"And whereas an Act was passed in the thirty-third year of the reign of his late Majesty King George the Third, intituled, 'An Act to explain, amend, and render more effectual an Act passed in the eleventh year of his present 'Majesty's reign, intituled, 'An Act for consolidating, extending, and rendering more effectual the powers granted 'by several Acts of Parliament, for making, enlarging, amending, and cleansing the Vaults, Drains, and Sewers within 'the City of London and Liberties thereof, and for paving, 'cleansing, and lighting the Streets, Lanes, Squares, Yards, 'Courts, Alleys, Passages, and Places, and preventing and 'removing Obstructions and Annoyances within the same:'

"And whereas, in consequence of the redemption and sale of the Land Tax, by virtue of the several Acts of Parliament made and passed for that purpose, the rates to be assessed by virtue of the said recited Acts, can no longer be fairly or justly ascertained by the rates at which the said lands, houses, shops, warehouses, cellars, vaults, tenements, and hereditaments are assessed towards the Land Tax, some of the said lands, houses, shops, warehouses, cellars, vaults, tenements, and hereditaments being no longer subject to any assessment

towards the Land Tax, and the rates at which others of them are assessed thereto, having been considerably increased since any assessment was made upon several of the said lands, houses, shops, warehouses, cellars, vaults, tenements, and hereditaments, the Land Tax payable in respect of which has been redeemed or purchased:

"And whereas it is expedient that the rates to be assessed by virtue of the said recited Acts, for the purposes aforesaid, should be just and equal rates, and that the powers and provisions of said recited Acts should be altered and amended: But as the same cannot be effected without the aid of Parliament;

"Be it therefore enacted, and it is enacted by The King's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons in this present Parliament assembled, and by the authority of the same, that from and after the passing of this Act, the provisions contained in the said recited Acts, and hereinbefore recited, which require that the rate or rates, assessment or assessments, to be laid or assessed upon any lands, houses, shops, warehouses, cellars, vaults, tenements, or hereditaments, shall be ascertained by the rates at which such respective lands, houses, shops, warehouses, cellars, vaults, or other tenements or hereditaments shall be assessed towards the Land Tax, shall be and the same is hereby repealed.

"And it is further enacted, that from and after the passing of this Act, the restriction contained in the said recited Act of the eleventh year of the reign of his said late Majesty, which prevents rates or assessments being made, which shall in any one year exceed in the whole, the sum of ONE SHILLING IN THE POUND, of the yearly rent of such lands, houses, shops, warehouses, cellars, vaults, tenements, or hereditaments as should not be situate in any street, lane, square, yard, court, alley, passage, or place actually begun to be new paved by virtue and in pursuance of the said recited Acts, or of any former Act of Parliament, shall be, and the same is hereby repealed.

" And it is further enacted, that from and after the passing of this Act, the rate or rates, assessment or assessments, for defraying the expences of paving, cleansing, and lighting the said streets, lanes, squares, yards, courts, alleys, passages, and places; and preventing annoyances therein; and making, enlarging, widening, deepening, altering, and removing all or any of the common Sewers, public Drains, and Vaults within the said City and Liberties, to be made, laid, and imposed by virtue of the said recited Acts and this Act, in the several Wards of the said City, and other places within the limits of the said recited Acts and this Act, shall be just and equal pound rates, and shall be laid according to the respective annual rents or value of all and every the lands, houses, shops, warehouses, cellars, vaults, tenements, and hereditaments respectively authorized to be assessed by the said recited Acts, or either of them; but subject to the exceptions and provisions in the said recited Acts, or either of them contained, so as such rates and assessments do not in any one year exceed in the whole the sum of ONE SHILLING AND SIXPENCE IN THE POUND, of the respective yearly rents or value of such lands, houses, shops, warehouses, cellars, vaults, tenements, and hereditaments."

The burthensome Expence of it.

The amount of this charge against the public is not sufficiently known, or not properly attended to when it is. From the official documents of the City of London, in the Chamberlain's brief Statement, published annually by that Corporation, it will be seen that upwards of £26,000 per annum was expended *within the City*, on the average of seven years previous to, and including 1822, for paving only; and that £10,000 a year more is as regularly expended for the Sewers.

This, it should be observed, was before the late Act of Parliament, just quoted, for raising the Taxes 50 per Cent., that is from 1s. to 1s. 6d. in the pound on the full rent; consequently, if

£26,000 was collected for paving, and
10,000 for sewers

it is 36,000
and 18,000 being 50 per cent. additional

it makes....£54,000 a year, which is regularly spent for these purposes. Now, the City being nearly one-fourth of this extended metropolis, it will appear that £54,000 being
multiplied by 4 produces the immense sum

of.....£216,000 as the total annually collected and expended for keeping up the present wretched condition of the streets of London.

The observation, so frequently made to those who have never been in London, that the streets are paved with gold, appears from these estimates to be not merely an amusing tale to astonish, but that the joke is almost realized, at the expence of the inhabitants, from year to year.

This will be authenticated by the following official Documents, printed for private distribution in 1823.