surfaces of skew-bevel wheels), etc., etc. The last seven chapters deal in a very complete manner, with tooth gearing, and with the form, strength and dimensions of teeth. The author, while acknowledging a free reference to Willis' mechanism, and Rankine's Geometry of Machinery, has introduced much new and interesting matter in connection with (*a*). The computation of *Limiting Numbers of Teeth, Spur and Pin Gearing*, (*b*). The Double Contact of Epicycloidal teeth in Inside Gear, (*c*). The Odontoscope, for showing effect of Wear in Bearings upon Velocity-Ratio, (*d*). The Oblique rack and Wheel, with new Theory of Oblique Screw Gearing, etc., etc.

The above works are all in excellent type and form.

THE REMOVAL OF RAIN-WATER FROM TOWNS, CONSIDERED WITH REFERENCE TO THE SEWERING OF BERLIN.

(Abstract from paper by M. Knauff in Gesundheie-Ingenieur.)

The Author quotes from a recent pamphlet by Waring, the engineer who designed the drainage of Memphis, the opinion that the admission of storm-water into the deeply-laid sewers of a town is generally a mistake, and nearly always wholly unnecessary. Waring affirms that rain-water is not in itself either a foul or polluting liquid, and can do no damage to streams; and that only in such cases in which surface-drains are liable to injure the road-ways, to cause the flooding of cellars, or to interfere with the traffic, does it become necessary to provide sewers to carry away the rainfall. He distinguishes between underground drainage adopted as a matter of principle, and employed only as an occasional means of avoiding road-crossings, &c. Waring believes the large modern deep-laid sewers to be wrong in theory, and he sums up his remarks as follows:—"The present method of disposing of the rainfall is a survival of ignorance, and its continuance only shows the preponderance of traditional practices."

The Author traces the advocacy of the separate system to the writings of Chadwick, Philips, and Rawlinson, and instances the drainage of Alnwick, Tottenham, Leicester, and many other towns in England, in accordance with this system, over thirty years ago. The advantage formerly claimed for the practice of admitting the rain-water into the sewers, in order, namely, that it might flush the ill-constructed culverts which at that time existed, no longer stands good under the improved formation of modern sewers. The larger the diameter of the sewers, the greater will be the tendency to the deposition in them of detritus, and the more completely the rain-water can be excluded, the more constant will be the flow in the sewers of the smaller diameter, necessary for the house drainage alone. An argument against the admission of the rainfall into the sewers is the impossibility of accurately ascertaining what volume of water may, under certain circumstances, have to be carried away in a given time. Excessive rainfall, under the mixed system, gives rise to evils of the worst kind, and even in Berlin, in May and September of the present year, the basements of the houses have been flooded by the overflow from the sewers. A consideration follows of the parties upon whom the charges for damages from sewage overflows should fall. The Author observes that the flooding of basements during storms, by the backing-up of the house drains, is a specific evil of the mixed-sewage system, which does not pertain to many other methods of town-drainage.

A Table is given of the heaviest known rainfall, in millimetres, in a number of towns, during specified periods of time, varying from 25 millimetres in 90 minutes (equal to 46 litres per hectare per second, or 4.1 gallons per acre), to 37 millimetres in 10 minutes (equal to 617 litres per hectare per second, or 55 gallons per acre).

The rainfall, assumed as the basis of calculation for the drainage of Berlin, was 23 millimetres per hour, only one-third of which is supposed to reach the sewers. The Author quotes the experiments of Hawksley, Bidder and Haywood in 1857-8, who came to the conclusion that not less than 50 per cent. of the rainfall must be carried away by the sewers, and this amount is usually provided for by English engineers. A formula based on this percentage follows, and the Author shows that the area of the Berlin sewers is insufficient. Their insufficiency can only be remedied by means of numerous storm-overflows, and if the use of such overflows be permitted, there is no reason why the main outfall should not be of perfectly arbitrary size, with hundreds of outlets to guard against the possibility of overfilling. Hobrecht's opinion on the advantages claimed for the separate-system is adduced. The assertion that a twofold system of sewers, in the case of the separate-system, must be more costly than a single one, is examined, and the arguments quoted by Fegebeutel, for and against each plan, are stated in detail. The Author is of the opinion that the facts of Fegebeutel are derived from the writings of Baldwin Latham. The quality of street-washings, which have usually been asserted to be nearly as rich in manurial ingredients as domestic sewage, is examined, and the Author gives a Table of the amount of nitrogen, which would be partially or wholly lost by keeping the rainfall from the sewers. He states that on the road surfaces of a town of one hundred thousand inhabitants, the excrementitious matters of the population would contain, in nitrogen, approximately as follows:—

	Nitrogen. Kilograms.
Dung and urine of 4,000 horses - - -	= 6,359
" " 5,000 dogs and cats - -	= 500
" " birds and poultry - -	= 25
Leather cuttings, etc. - - - - -	= 216
Let it further be assumed that in the third part of the excreta of 9,000 men (a quarter of the adult male population void their excreta improperly on road surfaces, or courtyards) the nitrogen = $9{,}000 \frac{5.48}{3}$	= 16,440
Total - - - - - -	= 24,040 kilos or 52,998 5 lbs.

or equivalent in round numbers to 66 kilograms (145 46 lbs.) of nitrogen per diem, and in the one hundred and fifty-one rainy days of the year, to say, 10,000 kilograms (22,046.2 lbs.) The excreta of one hundred thousand persons would contain about 133,050 kilograms (426.2 tons) of nitrogen, and the proportion thereof, present in the sewage on the one hundred and fifty-one rainy days would be, deducting the above 16,440 kilograms —162,712 kilograms of nitrogen, or about sixteen times the amount credited to the rainwater from the street-surfaces. The Author assumes, then, that 94 per cent. of the nitrogen of the population would be found in the sewage, as against 6 per cent. in the rainwater from the roads. The contrary opinion of Way, that the washings from the streets are as rich in *manure ingredients as the house drainage, is quoted.* The impossibility of keeping road-detritus out of the drains, and the fallacy of deep gutters or channels for street-drainage, is shown. The views of Hering are examined and quoted at length, and in conclusion the Author remarks, with respect to the drainage of Berlin, that, in the construction of new roads, the crown of the roadway must be considerably lowered; that proper observations must be made of the proportion of the total rainfall which has to be carried away by the sewers; that for the sections of the sewering still to be carried out, a heavier rainfall than 23 millimetres (0·9 inch) per house must be provided for; that, in the portions of the sewers which are executed, numerous additional overflow channels must be made, as the provision of storm-outlets alone does not appear to be sufficent to check inundation. The street-gullies must be fitted with improved gratings; the ventilation of the existing and future sewers must be carried out on a better system than at present. The stoneware pipes, forming the house-connections, must be *tested more carefully, as respects their imperviousness and* durability; the joints of such pipes must be made in cement. Proper back-flow traps must be provided for all the soil-pipes in cellars and the junction between the down-pipes (of iron), and the trap must be made of iron pipes with lead joints.

CRANES AS LABOUR SAVING MACHINES.

A PAPER READ BEFORE THE AM. SOC. OF CIVIL ENGINEER.

A well constructed crane or other similar power machine requiring only one man to drive it would do as much work as could be done by the manual power of ten men, but in one-tenth of the time. It seems singular that railroad and water-side depots and workshops should so rarely be laid out with reference to the employment of such laborsaving machines. The most economical working result is obtained from machines so arranged that when they take hold of the load, it is *not released until final deposit.* The Author considered the following systems for transmitting or applying, power.

1st. The well-known hydraulic system with pressure pumps, accumulator and distributing pipes.