They are exactly alike in all respects, and an air-tight joint is made between them by means of the rubber washers. These couplings are so constructed that the air pressure within serves to tighten the joint, and they may be pushed apart by the separation of the train without any injury. Such an occurrence as already explained leads to the instant application of all the brakes on the train.

By closing the small tap shown between the brake pipe and the triple valve, the brake on any vehicle, if out of order, can be cut out of the system. A release valve is also placed upon each cylinder as shown, so that in the event of the brakes being applied by the separation of the train, or the breaking of a pipe, or when the locomotive is not attached, they can be released by allowing the air to escape from each brake cylinder direct. The Westinghouse brake has been made to comply thoroughly with the Board of Trade conditions. Many people, however, do not appear to understand all that is involved in the second requirement, which runs as follows: In case of accident, to be instantaneously self-acting. This clearly implies: First, that accident to the train, or to any of its vehicles, shall cause the instant application of the brakes to the wheels of every vehicle in the train without the intervention of the driver or guards. Secondly, that any injury, however caused, which may impair the efficiency of the brake apparatus, shall, in like manner, lead to the instant application of all the brakes on the train. It then becomes impossible for a driver to run his train in ignorance of any defect in his brake apparatus, because such defect at once discloses itself by applying the brakes and stopping the train. Thirdly, that each vehicle shall carry its own brake power in such a manner that the destruction of the brake apparatus on one or more of the carriages shall not affect the efficiency of the brakes upon any of the others. No continuous brake which does not comply with such conditions can ever be satisfactory.—*The Engineer.*

HYDRAULIC ELEVATORS AND MOTORS.*

By B. F. JONES, Kansas City.

WHAT I have to say in relation to elevators and motors will be mostly in regard to questions that their uses necessarily bring up for settlement at the water-works office; also to show how I have been able in a measure to overcome some of the many difficulties that have presented themselves, as well as to discuss and seek information as to the best way of meeting others that still have to be dealt with. At the outset, therefore, let me state that I am not an hydraulic engineer, nor have I sufficient mechanical knowledge to undertake the discussion of the construction or relative merits of either elevators or motors. This I would respectfully suggest as a very proper and interesting topic for a paper at some future meeting by some one of the many eminent engineers of this association.

The water-works of Kansas City is comparatively young, and my experience only dates back six or seven years, or shortly after its completion. At this time it was deemed advisable on account of the probable large revenue to be derived from their use, to encourage the putting in of hydraulic elevators by low water rates. With this end in view a number of contracts were made for their supply at low special rates for a period of years, and our minimum meter rate was charged in all other cases, regardless of the quantity of water consumed. In most instances these special rates have since been found much too low, parties paying in this way being exceedingly extravagant in the use of elevators. However, the object sought was obtained, and now they are very extensively used. In fact, so much has their use increased, that the question is no longer how to encourage their more general adoption, but how to properly govern those that must be supplied. A present our works furnish power to about 15 passenger and 80 freight elevators, and the number is rapidly increasing.

Before going into details it seems proper to give at least a brief description of our water-works, as my observations are to a great extent local.

On account of the peculiar topography of Kansas City (and I believe it has more topography to the square foot than any city in the country) two systems of water supply have been provided, the high ground being supplied by direct pumping, and a pressure of about 90 pounds maintained in the business portion, and the lower part of the city being supplied by gravity, from a reservoir at an elevation of 210 feet, thus giving the business portions of the city, on high and low ground, about the same pressure. By an arrangement of valves, a combination of these two systems is effected, so that the Holly machinery can furnish an increased fire pressure at a moment's notice, into either or both pipe systems. Thus at some points the pressure is extremely high during the progress of fires, causing difficulties that do not exist where the gravity system of works is used exclusively.

Elevators have become an established institution, and in cities of any commercial importance are regarded as a necessity, hotels, jobbing houses, factories, and office buildings being considered as far behind the times when not thus provided, as a city without a water supply or a community without a "boom." The use of elevators has made it practicable and profitable to erect buildings twice as high as were formerly thought of. Perhaps some of the most notable examples of this are in New York city, where such structures as the Mills building, the buildings of the *Tribune*, *Evening Post*, and Western Union Telegraph Co., tower high above the surrounding blocks, monuments of architecture, that without this modern invention would reflect little credit upon their designers. It is now found less labor to go to the fifth, sixth, or even tenth floors of these great buildings than it was to reach the second or third, before their use. In these days, merchants can shoot a ton of goods to the top of their stores in less time than it would take to get breath for the old hoist or "Yo, heave O" arrangement. Thousands of dollars are sometimes expended on a single elevator, the cars are miniature parlors, and the mechanism has perhaps advanced to nearly the perfection of the modern steam engine. If then they have become such a firmly established institution, their bearing upon the water supply of cities is a subject to be carefully considered.

As before intimated, there are many questions involved in the use of hydraulic elevators, that particularly concern towns supplied by direct pumping, and perhaps other places where the supply by gravity is somewhat limited. In a few larger cities supplied by ample reservoirs and mains, some of the difficulties suggested are not serious. Very little power is necessary to perform the actual work of lifting, with either steam or hydraulic elevators, but on account of the peculiar application of the power, and the great amount

of friction to be overcome, a very considerable power has to be provided. It has been estimated, by good authorities, that not more than one-quarter of the power expended in most cases is really utilized.

With all hydraulic elevators of which I have cognizance, as much water is required to raise the empty cars as though they were loaded to maximum capacity. Still, to be available for passenger purposes elevators must have capacity of upward of 2,500 pounds, particularly in hotels, where the cars are often arranged with separate compartments underneath for baggage. In general use it is exceptional that passenger elevators are fully loaded; on the contrary less than half a load is ordinarily carried, and for this reason it would appear that no actual benefit is derived from at least one-half of the water consumed. In this connection it has occurred to me that passenger elevators could be built at no great additional cost, with two cylinders, small and large, the two piston rods of which could be connected so as to both operate the same cable, either or both furnishing power, the smaller cylinder to be used for light loads, the larger for heavy work, and the two together for full capacity, this independent valve arrangement to be controlled by a separate cable running through the car. Whether this plan is practicable or not must be left to elevator manufacturers, but it seems to me that with the Hale-Otis elevator for instance (which is conceded to be one of the best) it could easily be accomplished. Certainly some such arrangement would effect a great saving of water, and perhaps bring water bills to a point that this class of consumers could afford to pay.

Hydraulic elevators where the water is used over and over again, by being pumped from the discharge to elevated tanks, cut little or no figure in connection with a city's water supply. When fuel, first cost, attendance of an engineer, and the poor economy of the class of pumps usually employed to perform this work are considered, the cost of operating such elevators is greatly in excess of what it would be if power were supplied direct from water mains, at any reasonable rate. The following remarks will then relate almost exclusively to that class of hydraulic elevators supplied with power directly from the water mains.

Let us now consider whether they are a desirable source of revenue, and in this my knowledge does not exceed my actual experience. Few elevator users appreciate the great quantity of water their elevators consume. Even in Kansas City, where, on account of the high pressure carried, much smaller cylinders than ordinarily are required, it is found that passenger elevators frequently consume 500,000 to 800,000 gallons of water per month, which will make a very considerable bill, at the most liberal rates. I have, therefore, concluded that the quantity of water was so large that, unless liberal concessions were made, it would be a hardship to consumers to pay their water bills, and have therefore made a special schedule, according to quantity, for elevators and motors, these rates standing below our regular meter rates, and running to the lowest point at which we think we can afford to furnish the water. This schedule brings the rate below what we would receive for almost any other legitimate use of water; and, in view of our rapidly increasing consumption, and the probability of soon having to increase all our facilities, it is an open question whether this will continue a desirable source of revenue.

In Kansas City we have elevators of various manufacture: the Hale-Otis, Ready, Smith & Hedges, O'Keefe, Kennedy, and perhaps others, each having its peculiarities, but alike demanding large openings in the mains for supply. These large openings are objectionable features with any water-works, and especially so with direct pumping. An occurrence from this cause, about two years ago, is an experience I should not like repeated, but is one that might occur whenever the pressure in the mains is depended upon to throw fire streams. In this instance a large block of buildings occupied by jobbing houses and having three elevators was burned down, and the elevator connections broken early in the fire, allowing the water to pour into the cellars in the volume of about twelve ordinary fire streams. This immense quantity of water had to be supplied from a 6-inch main, fed from only one end, which left little pressure available for fighting the fire, and as a matter of course failure to subdue the fire promptly was attributed to the water-works. We have since had up hill work to restore confidence as to our ability to throw fire streams, although we have demonstrated the fact hundreds of times since.

From this time we have been gradually cutting down on the size of openings for elevator supply, but under protest of the elevator agents, who have always claimed that they should be allowed at least a 4-inch opening in the mains, until we have found that under 80 to 90 pounds pressure two to four 1-inch taps will answer the purpose, provided the water pipes are of ample size.

The "water hammer" produced by the quick acting valves of elevators has always been objectionable, both in its effect at the pumping-house and upon water mains and connections. To obviate this, Engineer G. W. Pearson has suggested the use of very large air chambers on the elevator supply, and still smaller openings in the mains, his theory being that the air chambers would not only materially decrease the concussion or "water hammer," but that they would also act as accumulators of power (or water under pressure) to be drawn from at each trip of the elevator, and replaced when it was at rest. This plan I have never seen put to actual test, but believe it to be entirely practicable, and that we will have to ultimately adopt it.

All things considered, the plan of operating elevators from tanks in the top of buildings, supplied by a small pipe connected with the water-mains and arranged with a float valve to keep the tank filled, I believe to be the best manner of supply, except for the great additional cost of putting up such apparatus. By this arrangement the amount of water consumed is no less, in fact it would ordinarily be more than with a direct connection with the mains, but it has the advantage of taking the water in the least objectionable manner. Still, if this mode of supply were generally enforced, the large first cost, an additional expense of operating, would undoubtedly deter many from using elevators.

Another evil in connection with the use of elevators, and which no doubt is common, is the habit many parties have of keeping a key or wrench to turn on and off the water at the curb. This we have sought to remedy by embracing in our plumbers' rules the following: "All elevator connections in addition to the curb stop for the use of the Water Company must be provided with another valve where the pipe first enters the building for the use of occupants of the building." Without this extra valve it was found almost impossible to keep parties from using the curb valve. In most cases the persons were perfectly responsible, and as there was no intent to defraud the company by the act, they would claim this privilege as a precaution against the pipes bursting or freezing. This practice was very generally carried on, and

was the direct cause in at least two cases of very serious damage. In the instances referred to, the pipes burst between the elevator and the area wall of buildings, and the valves outside had become so worn from frequent use that they would not operate, allowing the water to literally deluge the basements before the water main could be turned off.

One of the greatest causes of waste from elevators is the wearing out of the piston packing, this being particularly troublesome in most of the Western cities, where the water supplied is to a large extent from turbid streams, carrying more or less fine sand or "grit," which cuts out the packing of the pistons very rapidly. The only practicable remedy for this is close inspection, to see that the pistons do not allow water to pass, a fact that can readily be determined from the noise made in the cylinder when the elevator is in motion going upward.

I have reserved one of the most annoying features of elevator supply for the last, hoping to work myself into a mood to do the subject justice, but doubt if it can be done in language proper to use before this dignified body. I remember on one occasion the mayor of our city, in discussing a job of plumbing, said that it seemed to him "that even a plumber ought to know something about plumbing." Now it would seem that even elevator agents ought to know something about elevators, but from the following incident, which is but one of many, I am led to believe that they are not infallible to say the least. Only a short time since, one of these very reliable (?) agents reported at our office that he had just attached a new indicator to the elevator of a leading hotel. He was asked: "What does it register?" and promptly replied, "Cubic feet." In this case our inspector had already made an examination, and had correctly reported as follows: "Hale elevator; indicator started at zero February 28; internal diameter of cylinder, 12 inches; travel of piston for complete trip 30½ feet; indicator registers for complete trip, 4."

When it is understood that we had for a long time been assuming that elevator agents knew about all there was to know on the subject, a comparison of statements of this agent and our inspector is somewhat startling. Now let us see what the difference amounted to: At the end of the month the indicator had registered 12,994; calling it cubic feet, this register would equal 97,195 gallons. According to our inspector, this same register would equal 578,233 gallons, or a difference of nearly half a million of gallons for a single month. Our experience with the agents in Kansas City has shown that they will, if allowed, put any kind of an indicator on the most convenient point of any sort of an elevator, without the slightest regard as to what it was intended to indicate; then report it as registering cubic or lineal feet, whichever they find the indicator marked. On the same principle they could as well change the fulcrum of a Fairbanks scale, and then claim it weighed pounds correctly, because pounds were marked upon the bar. We have lately prepared a blank, upon which these agents are required to make a detailed report upon the completion of an elevator before the water will be turned on, which it is hoped will to some extent correct this trouble.

I have come to regard an elevator indicator with a feeling of wonder. Some years ago, when the "planchette" first came out, I remember that it acquired quite a reputation as a particularly erratic piece of mechanism, but for real mystery and innate cussedness, on general principles, commend me to the indicator. Why, I have known an indicator after registering a nice water bill, to deliberately and without provocation commence taking it all off again, by going backward. This crab-like maneuver the agent readily explained by saying the "ratchet had turned over," but even he was unable to show us how to make the bills after these peculiar gyrations. I also find that it is quite a favorite amusement for indicators to stop entirely, like a balky horse, after which no amount of persuasion will bring them to a realizing sense of their duty.

Even at the best, these indicators are very apt to get out of order, necessitating greater watchfulness in supplying elevators than for any other purpose for which water is furnished.

Accidents in connection with the use of elevators are common throughout the country, and in Kansas City had, until within a short time, become of altogether too frequent occurrence. The great cause of this I believe to be due to the fact that the parties who usually operate elevators are the very ones who know least about them; the corrosion of pistons, crystallization and oxidation of cables, and many other disorders common to elevators, being matters they do not comprehend. The frequency and fatality of these accidents in Kansas City finally led the city authorities to appoint an Elevator Inspector, who is under heavy bond, and whose duty is to examine every elevator at least once a month, and to grant license to run only such as he deems in safe condition. Thus far since the establishment of this office we have had no serious accidents, which leads me to the belief that in most cases a monthly examination will discover in time the causes of many terrible casualties; also that it is not safe to operate elevators unless so inspected by some competent person.

The hatchways of elevators in large buildings are points greatly feared by firemen. They well know that when a fire once reaches this shaft, it takes but a moment for it to be carried from floor to floor, until the building is soon past saving. Although this great danger is well known, it is the exception rather than the rule to provide elevators with fire-proof hatches. A properly constructed elevator should, it seems to me, be provided with hatches, or better still, built within brick fire-proof walls, with openings to be kept closed when not in use. In this way costly buildings, valuable merchandise, and many lives would be saved from fire every year.

Although considerable has been said on the subject of elevators, I am aware that the ground has not been covered, and that difficulties have been pointed out more than remedies suggested. There is much yet to be brought out by the engineers, to whom the subject more properly belongs.

In the mean time, although elevators claim many of the objectionable features in the business of water supply, most of them are not of a nature that should condemn their use; on the contrary, I hope that with the joining of our experience there will be an improvement in the methods of their supply. Inasmuch as they must be furnished with water, all that can be done is to adopt such rules and fix such rates as will compensate in some degree for their objectionable qualities.

WATER MOTORS.

My remarks on this subject I trust will be more to the have been point than they upon the questions already discussed. Certainly my ideas are more decided, so far at least as supplying water motors is concerned.

In many respects I believe water motors furnish as nearly perfect power as it is possible to attain. A motor, for in-

* Read at Buffalo meeting of the American Water-Works Association, May 15, 1883.

stance, properly connected and supplied by the even pressure from a reservoir is probably the most reliable and steady power known, not excepting the most improved and costly steam engines. The convenience and little attendance necessary in operating make them especially desirable for many purposes. Where only small power is required, or even where considerable power for only occasional use is desired, they are particularly well adapted, and can be driven at small expense. Even for greater power they possess advantages over steam engines which, to a considerable extent, compensate for the large water rates that ought to be paid for their supply. These advantages are in the first cost of a motor, as compared with a steam engine, the saving in attendance and fuel, the convenience and cleanliness, and in some cases a saving in insurance by reason of their being no fire risks attendant upon its use. At just what point steam becomes preferable, however, is a question depending considerably upon water rates, but to some extent on other circumstances, leaving it largely a question of judgment. As with elevators, there are difficulties involved in their supply that unless carefully guarded make water motors anything but a desirable source of revenue. How often is the argument advanced: "Why, I only use water for a quarter of an inch jet!" Showing how little people who use motors or elevators or fountains realize the quantity of water they consume. This class of consumers may be placed on one footing, to wit, a class who, in spite of the fact that they are supplied with water for much less than any other, feel that they are imposed upon, and cannot be made to think otherwise.

Though not as large as for elevator supply, water motors require liberal openings in the mains, and frequently the fault of having too small supply pipes is sought to be remedied by openings in the water mains much larger than needful. A table prepared by an engineer who had given the matter study, or by some motor manufacturer, showing the size of taps, or openings, for the proper supply of motors, with the various jets, under different pressures, would be of general use to water-works people. In order to use water to the best advantage, the full pressure in the main, so far as practicable, should be had at the jet, but in order to accomplish this it is not necessary to use as large taps as are ordinarily demanded, but to provide supply pipes of sufficient capacity to deliver the water to the point of discharge with the least possible friction. Lately this theory has been put in practice to some extent by us, and the result has shown that in this manner we are able to supply motors through smaller taps than before, and with as satisfactory results.

It is a general practice throughout the country to make annual or monthly rates for water motors, and from my observation I believe I can safely venture the assertion that in three-quarters of the cases the rates charged will not equal 50 per cent. of the lowest meter rates in force in these places. Although the Kansas City Water-Works has not perhaps been generally accorded the reputation of being the most liberal "monopoly" in the country, still I have had occasion at times to make some such claims as an inducement to its generous support. But with all its liberality, I am free to say that we cannot begin to meet the rates for motors that parties claim to have paid almost everywhere else.

The St. Louis Water-Works, where the rates are substantially the same as in Kansas City, have been quoted as having the following motor rates, but whether correct or not my inquiries have failed to determine:

"On the supposition that motors are to be used ten hours per day for 300 days per year, motors are assessed for—

$\frac{1}{4}$ inch jets.....	\$120 per annum.
$\frac{3}{8}$ "	198 " "
$\frac{1}{2}$ "	300 " "

These rates based upon a charge of 50 cents per 1,000 gallons."

From Col. Flad's Report as Engineer of Public Works, May 1, 1876, p. 70, it is found that with 42 pounds pressure a $\frac{1}{2}$ inch orifice will discharge 2,160 gallons per hour, 21,600 gallons in 10 hours, or 6,480,000 gallons in 300 days, which at 20 cents per 1,000 gallons would amount to \$1,296, for which they assess the rate \$300. From all of which I would conclude that there must be a lack of harmony somewhere between the engineering and office departments.

I have made some estimates myself for water motors, basing rates upon the number of hours it was claimed the motors would be in use, and afterward supplied the same motors by meter measurement; in every case found that at least twice as much water was used as had been estimated. Although estimates were carefully made upon what was believed to be a reliable basis, these repeated similar results have led me to the conclusion that the only way to supply motors is to make it an object to the users of them to be economical. In other words, I believe the way to supply water motors is upon an estimate that they will run 24 hours per day and 365 days per year, or, more properly still, supply them only by meter measurement. At all events this is henceforth my policy; or, in other words, "on this rock I stand," believing it the only equitable way out of this difficulty.

That class of motors or water engines operated by water pressure in close cylinders upon pistons as with steam in a steam engine, I believe could be easily supplied by measurement of water without a meter. This could be accomplished by the use of "revolution counters" or indicators, as the amount of water required per revolution could be readily determined, and when once computed the cylinders would measure out the water as accurately as a meter. The only objection to this plan is the expense of counters, which is considerable; and as to indicators, it may have been observed that I have little faith in their reliability. With cheap revolution this class of motors would be free from many of the objections raised in regard to motors generally.

The practical conclusion that I would draw from a consideration of this subject is that the question of whether the supply of hydraulic elevators and motors is desirable in its effects upon the water supply is one that hinges so delicately upon their being carefully governed, connected, and restricted, that while on the one hand they may be made the source of large profit, and at the same time a public benefit, on the other hand, unless all the details of their supply be carefully guarded by the wisest rules and greatest watchfulness, their capacities for waste are so great and the rates charged necessarily so low, that they may become the greatest source of loss with which we have to contend. I therefore trust that this discussion will be continued until an interest is felt that will result in our all receiving much useful information upon two most important factors of our business.

As this paper has been long for the information contained, I will close with the earnest wish that it may at least be of service in bringing these important but often neglected subjects to

the attention of the thinking and intelligent body of men, of whom many have had much longer and more general experience in relation to these matters, and whose views when expressed will consequently be of more interest and have greater weight. Thus as a result may we all derive the benefit of whatever useful information there is to be gained by this annual interchange of experiences in the all-important business of public water supply.

WATER SUPPLY OF SMALL TOWNS.

WE now describe the new waterworks lately erected for supplying the town of Congleton, Cheshire. The population is about 12,000, and the place is a seat of the silk manufacture. After various expensive plans had been suggested, in the year 1879 a complete scheme for the supply of the town with water was devised by the then borough surveyor, Mr. Wm. Blackshaw, now borough surveyor of Stafford. These we now illustrate above by a general drawing, and a separate drawing of the tower. With respect to the mechanical arrangements, the Corporation called in Mr. W. H. Thornbery, of Birmingham, consulting engineer, to decide on the best design of those submitted, and this, with modifications made by him, was carried out under his inspection. The water, for the supply by pumping, is obtained from springs situated at the foot of Crossledge Hill, about a mile from the town. It does not at present require filtering, but space enough has been allowed for the construction of duplicate filtering beds without in any way interfering with the present appliances. These filter beds are shown in

on which the water tower is built. The boilers, two in number, are of the ordinary Cornish single-flued type, 5 ft. diameter by 18 ft. long, with flue 2 ft. 9 in. diameter, with three Galloway tubes. They were made by Messrs. Hill & Co., of Manchester. The engines and pumps were made by Mr. Albert Scragg, of Congleton, and the brick, stone, and builder's work was executed by Mr. Thomas Kirk. The waterworks were opened in the autumn of 1881, and since then have constantly afforded an abundant supply of water. There is also an independent gravitation system, also arranged by Mr. Blackshaw, for supplying an outlying part of the town. The cost of the works was exceedingly moderate, being not more than £12,000, including the water mains for distribution.

PROCESS FOR SOFTENING HARD WATER.

The available water of many villages and small towns is that of the chalk beds, but it is invariably very hard, and should be softened. We have received so many inquiries respecting a simple means of carrying out Clarke's water-softening process, that the following description of a set of apparatus devised for this purpose by Messrs. Law and Chatterton, M.M.I.C.E., may interest many besides those who contemplate the construction of small waterworks supplied by the chalk springs.

The apparatus, as made in various sizes by Messrs. Bowes, Scott, and Read, of Broadway-chambers, Westminster, we illustrate by the accompanying engravings.

Softening hard water.—The disadvantages attending the use of hard water either for drinking purposes, steam generation, lavatory purposes, and for many manufacturing pur-

WATER SUPPLY OF SMALL TOWNS.—CONGLETON WATERWORKS.

our perspective illustration, but they are not yet built or required.

The waterworks are situated very near the springs, from which they are only separated by a road, under which the collecting pipes run. There are two circular collecting tanks of brickwork, two pumping wells, engine-house, boiler-house, chimney stack, and engine-driver's dwelling-house, all inclosed by a wall. On the top of Crossledge Hill is erected a circular brick water tower 35 ft. high to the underside of the service tank, which is of cast iron 30 ft. internal diameter, supported on rolled girders. The tank is capable of containing 50,000 gallons of water, and it is provided with the usual rising and service mains, overflow and washout pipes. There is an arrangement for pumping direct into the mains in case the tank should require cleaning or repairing.

The pumping machinery is in duplicate, and each set consists of a horizontal condensing engine, with cylinder 18 in. diameter, stroke 30 in., fitted with Meyer's expansion gear, governor, fly-wheel 12 ft. diameter, weighing 4 tons, jet condenser with a single acting vertical air pump, situated below the engine room floor, and between the end of the cylinder and the main pump. Each main pump is 10 in. diameter, horizontal, double-acting, worked by a prolongation backward of the piston-rod. The valves and seats are of gun metal, 8½ in. diameter. The capacity is 350 gallons per minute, raised 206 ft. The air vessel is 21 in. internal diameter and 6 ft. high, and is fitted with a hand pump for renewing the supply of air if necessary. The rising main from the air vessel to the service tank is 9 in. diameter, and 307 yards long, laid up the steep slope of the hill

poses, are well known, but as there are several methods of softening waters which are hard in different degrees by different substances, we may be pardoned if we here reproduce, for the convenience of some of our readers, a few passages from the sixth report of the River Pollution Commission, 1874, pages 21 and 201-16, which give some very valuable information on the relative merits of hard and soft waters in domestic and trade uses. "Some of the mineral substances which occur in solution in potable waters communicate to the latter the quality of hardness. Hard water decomposes soap, and cannot be efficiently used for washing. The chief hardening ingredients are salts of lime and magnesia. In the decomposition of soap these salts form curdy and insoluble compounds containing the fatty acids of the soap and the lime and magnesia of the salts. So long as this decomposition goes on the soap is useless as a detergent, and it is only after all the lime and magnesia salts have been decomposed at the expense of the soap, that the latter begins to exert a useful effect. As soon as this is the case, however, the slightest further addition of soap produces a lather when the water is agitated, but this lather is again destroyed by the addition of a further quantity of hard water. Thus the addition of hard water to a solution of soap, or the converse of this operation, causes the production of the insoluble curdy matter before mentioned. These facts render intelligible the process of washing the skin with soap and hard water. The skin is first wetted with the water and then soap is applied; the latter decomposes the hardening salts contained in the small quantity of water with which the skin is covered, and there is then formed a strong solution of soap which penetrates into the pores, and