

Beyond this, large funds are to be established for increased activities of the various graduate schools.

If Harvard and "Tech." with their huge endowments, and their large alumni lists, find their situation serious, what must it be for the various engineering schools and smaller endowed institutions of learning throughout the country? If these great schools find it difficult to retain the services of suitable men on the faculty, what must be the struggle in institutions where the professors have the possibility of getting not \$5500 but \$2500 and even less as a reward for a lifetime of devoted service? In engineering schools particularly the war developed a serious situation. Men who had determined upon a career of teaching found that it was difficult to provide even the bare necessities of life on their salaries, unless they were fortunate enough to have private means or outside income. Besides this, many found for the first time opportunities to render service to large manufacturing or engineering companies where the prospects of greater comfort in life and secure old age lured them from their chosen profession. Obviously, if the standards of our colleges are to be maintained and improved additional resources are necessary. Industrially we are headed toward a loss of our position if the ranks of science and engineering are not supplied with capable men.

Not only should the drives now being undertaken have full support, but college alumni generally owe a duty to their respective institutions to assist in bringing about financial conditions that will insure the retention and building up of teaching staffs fully adequate to the demands which the country is making on our higher institutions of learning.

### Gas and Aircraft Warfare

ENGINEERS have an especial interest in two phases of the proposed Army reorganization, aside from the subordination of all technical officers, discussed in these columns Aug. 21. These two phases are the inadequate provision for air service and chemical warfare. In previous wars there were, leaving out the Navy, three combat branches of the military machine—infantry, cavalry and artillery. The cavalry ceased to function in this war, but two new services, aircraft and gas warfare, with a technique setting them apart from the other combat arms, assumed major importance. In aircraft we barely had a beginning when we entered the war; in gas warfare we were totally unprepared. Despite our previous unpreparedness and the rise of these branches to first importance, the General Staff proposes to emasculate them. If their plans are adopted we shall find ourselves in another conflict no better prepared than we were at the beginning of this war.

It is alleged that gas warfare is inhuman, and for that reason is barred from future wars by the League of Nations pact. The evidence, however, does not support the contention. The proportion of fatal to total gas casualties is lower than the percentage of fatal to total bullet and artillery casualties. But, beyond that, it is certain that, despite the spirit of the League of Nations pact, other nations will continue to prepare for gas warfare, both in offense and defense. If we could be certain that gas would never again be used, we could, with clear minds, discontinue all gas-warfare study. No sane man, though, will place complete reliance on any peace pact. Laboratory experimental

work, it is true, is to be permitted, but not the full-scale experiments and drill in gas attack and defense which alone are effective in military preparedness.

Regarding the air service, nothing need be said as to the need for aggressive experimentation and the maintenance of effective air forces and equipment. Today, while England is arranging to maintain an air force of some 50,000, the United States, despite its big war development, could not put a single effective squadron in the field. The machine built up under stress of war should very properly have been scaled down to a peace basis. But it should not have been reduced to impotency, demobilized to its weak pre-war position.

Both services are scientific to the last degree, and therefore of special concern to engineers. Engineering societies owe a duty to the country to protest against the inadequate provision for these arms of the service.

### The Albany Waterworks: 1800-1919

G LIMPSES of the doings of the Albany Waterworks Co., a century and more ago, afforded by official minutes, show the trustees trying to solve some of the same problems that confront water-works men today. In particular, the demand for water outran the capacity of the works, "wanton waste" prevailed and rates had to be readjusted to make income equal outgo. Much the same difficulties are experienced in Albany under municipal ownership a hundred years later and to them are added the later problem of so treating a highly contaminated water as to render it safe for human consumption.

The basis of charging for water in Albany in 1802 (see page 605 of this issue) seems absurd enough now but it was no more unsound than those in force in many cities today. The amount paid for water by citizens of Albany when the works were started depended on the number of fireplaces in the house—which at best was a measure of ability to pay rather than of service received. A little later a more rational basis, the size of aperture, was adopted, but in 1815 the size and character of dwellings, and in some cases the number of front windows, governed the water-service charge.

Progress has been made in framing water-rate schedules in Albany in a hundred years, but as only 45% of the services are metered flat rates are still paid by most of the consumers. Such rates at best are arbitrary, are likely to be unfair, and encourage water waste. It is not surprising, therefore, to find the Albany water expense and income in a constant race with each other, with expense sometimes in the lead—always, perhaps, if capital charges on the entire cost of the works instead of only on the unredeemed bonds were taken into account.

A hundred years after Albany joined the small number of cities—less than a score—provided with public water-supplies it again put itself in the pioneer class. This was by adopting sedimentation and slow-sand filtration, which resulted in a heavy reduction of typhoid in Albany. Water consumption and waste at that time was about 200 gal. per capita and despite the earnest efforts of some of the city officials it has remained substantially at that figure ever since, reaching 232 gal. last year. Had consumption been reduced to the figures obtained by other cities that have metered all their consumers the original filters would have been adequate

for many years, although perhaps seriously handicapped in times of freshet and high turbidity.

Whatever might have been, the fact is that Albany has successively adopted preliminary filtration, chlorination and coagulation in conjunction with the original sedimentation and slow-sand filtration plant, as stated more fully on p. 604. At times, some of the water from the preliminary (or mechanical) filters is bypassed around the slow-sand filters lest these be overburdened. Coagulation, for reasons of economy or in deference to remnants of the old prejudice against it, is not practiced the year around. Chlorination, the great water-insurance agency, is used on all the water. The purification works as a whole interpose a barrier against typhoid from the sewage-laden Hudson, but the water supplied is sometimes high in color.

Need for rigid economy probably explains some of the steps taken at the purification plant, both as regards new construction and daily operation. If the prejudice against full metering could be overcome and the objections to coagulation be broken down or ignored, Albany might be insured an ample, safe supply of water from the Hudson River at least until conditions warranted going as far afield as may be necessary for a relatively pure all-gravity supply. Metering would not only reduce consumption and waste; it would also distribute the burden of the supply equitably among consumers and make it easier than now to readjust rates to meet expenses. The water-works officials realize all this, but the water consumers do not. The campaign of education should be continued with unceasing vigor.

### Private Versus Government Ownership of Railroads

PROBABLY to most engineers the presentation by Colonel Wilgus and Mr. Lindenthal, in our issue of Sept. 11, 1919, of railroad plans predicated on Government ownership came as a great surprise. Both men are noted for the soundness of their views, both have long acted as advisers of great railroad systems. As we understand it, neither of them is personally in favor of Government ownership. They believe, however, that it is inevitable; and, so believing, they hold that it is the part of wisdom to help guide the inevitable into the best channels. Nor are they alone among eminent engineers in holding this belief; we could name half a dozen engineers, all nationally known, all with railroad-service records, who hold similar views.

*Engineering News-Record* believes that the railroad question would be solved best for the public by the retention of private ownership, but we appreciate the reasons that have led many to acquiesce in the acquirement of the roads by the public.

The regulatory efforts of recent years have placed the railroads—and, in fact, all public utilities—in a class apart from other industries. The independence of action usually associated with private ownership has been severely curtailed. Income is fixed by rate regulation; outgo by full-crew and safety laws and, latterly, by wage increases. From another quarter, the brotherhoods, have come further restrictions, through the weakening of the disciplinary power of earlier days. The railroads, in fact, for years before the Government assumed control, were under a quasi-public form of operation. Under that control their financial condition constantly grew worse.

Into this situation the war has injected no really new element, but certain factors previously operating to curtail the initiative, freedom and financial stability of private operation have been intensified. Quasi-public operation has given way to full Government control; labor's strength is much greater than it was. Railroad credit, weak before the war, is nonexistent today. The Government has the roads and cannot turn them back without facing widespread railroad receivership and wreckage, or giving assurance that revenues adequate for the restoration of credit will be allowed.

Under these circumstances the cry for Government purchase has naturally been strong. In fact, its strength is such that many believe it will prevail.

No one is able to say positively what the sentiment of the country is on the subject. We know where the railroad brotherhoods stand, and there is reason to believe that the entire membership of the American Federation of Labor will stand with them. At the other end of the scale, we have the recorded vote of the United States Chamber of Commerce, the business managers of the nation's industries, in favor of the continuance of private ownership. We know that the farmers are opposed to Government purchase. But where the great middle class of the cities stands, the salaried people, who in this instance probably hold the balance of power, no one can predict. We are inclined to believe that this group would at least split even, throwing the preponderance toward private ownership. Yet no one can say definitely what the result of a plebiscite would be.

The highest hurdle that private ownership finds before it is the guarantee. Many argue—and that argument has great popular weight—that rather than guarantee the securities of others the Government would better issue its own obligations; moreover, assurance of adequate rates is but an indirect guarantee. Will the public permit such a guarantee to be given? An adequate-rate guarantee would meet with the less objection.

In connection with guarantees, it must be remembered that in the end the people must pay their transportation bill—either through rates or taxation. This being so, the critical question is, Under what plan can transportation be manufactured most cheaply and satisfactorily? All available records force us to throw out the alternative of Government operation in such an inquiry; there would be left private operation under Government ownership and private operation under private ownership. With the money market as it is and under ordinary methods of financing, the one plan offers no greater economy than the other. Mr. Lindenthal proposes, though, a scheme that would reduce the cost of capital to the Government. That would tend to make the Government-ownership plan the more economical. Offsetting that, however, would be the inevitably greater interference in operation, an interference that would likely more than offset the 1 or 2% saving in the interest rate.

Whether such considerations can be effectively put before the public, though, is problematical. The mass of the people act on feeling rather than reason. The strike of the patrolmen at Boston and the threatened strike some weeks ago of the railroad shopmen have done more to bring sober thinking than could a large amount of oratory and printer's ink. Possibly such radical extravagances may help to stay the drift which Colonel Wilgus and Mr. Lindenthal feel is sweeping us to Government railroad ownership.

## The Albany Water-Works a Hundred Years and More Ago

Private Company Formed in 1800 Based First Rates on Number of Fireplaces, but Soon Changed—Pipe Priced at \$100 a Ton

AN OLD leather-bound volume in the possession of Wallace Greenalch, commissioner of public works of Albany, N. Y., contains the minutes of the Albany Water-Works Co. for the half century beginning in March, 1800. The company was incorporated in 1802 and continued in existence until the city bought the works for \$114,600 in 1851. The following notes and quotations were recently taken from the minute book by a member of the editorial staff of *Engineering News-Record*. The minutes are written in a clear hand, for the most part in concise and forcible English.

Naturally enough, one of the earliest of the meetings recorded was devoted to fixing water rates. This was a meeting of trustees held in August, 1800, at Lewis Inn. It was then provided that for "every house or building containing not more than four fireplaces there shall be paid [sum defaced] per annum," but that the charge against any one private house should not exceed \$10 a year. In addition, water rates were to contribute their proportionate part "forever thereafter" toward maintaining the works, except that portion "intended for the use of the city," the costs of which were to be a charge against the two-fifths ownership of Benjamin Prescott and his heirs. This plan was not long followed, for on July 30, 1801, it was resolved that the city should pay \$7 a year for the use of water at the city hall, in addition to the usual rates for dwelling houses.

### WATER-CLOSETS USED BUT NOT FAVORED IN 1803

On Sept. 8, 1803, it was "Resolved, that no aperture conveying the water into any water-closet heretofore constructed shall be larger than  $\frac{1}{4}$  in., and that the water shall not be permitted to run into said closets for more than two hours in every 24 hours, and that only in the night, and no water from the said works shall be permitted to be discharged into any water-closet hereafter to be constructed."

Apparently, the water rates generally were based on apertures at this time, for at a meeting of stockholders held at the city hall Sept. 15, 1803, it was resolved that the rates previously established should be continued for three years for apertures exceeding  $\frac{3}{8}$ -in. diameter with \$1 additional for each  $\frac{1}{8}$  in. additional size. It was also resolved to charge \$2 additional for water from any aperture into any water-closet heretofore connected—"it being the opinion of the stockholders that no water be taken for the use of any water-closet hereafter to be constructed."

A printed broadside pasted into the volume of minutes contains a resolution of the trustees dated Sept. 30, 1815. This was addressed to both stockholders in the company and subscribers for water, and appears to have had the double purpose of reassuring the former as to dividends and stimulating the latter to contribute to them, besides establishing a new schedule of rates. The document recites:

"That the Company was chartered on the 17th day of February 1802, with capital stock of \$40,000, and a train of Wooden Conduits then laid from the Fountain-

head into and throughout different parts of the City, which from the increasing expense necessary to keep the whole in repair Dividends to the stockholders have been irregular, and from the lowness of the rates totally inadequate to the advance."

Reference is made to a "General Meeting of the Stockholders," held Jan. 26, 1813, at which the trustees reported "that the wooden conduits were in many situations in a decayed state" . . . and that legislative authority had accordingly been secured for an increase in the capital stock of the company. With money so raised, a 6-in. cast-iron conduit had been laid to the reservoir at the head of Steuben St., "affording, without a wanton waste, an abundant supply, and from thence to every part of the city; and the highly essential object of furnishing this City with an ample supply of Water, remarkably soft and pure, and of a cold temperature, perpetuated in all probability for centuries to come, is now fully and completely effected." Because of this, the broadside declared, the stockholders have a right to look to the trustees "for a competent Dividend" and citizens for a supply of water for both domestic and fire purposes. To this end, rates from Nov. 1, 1815, were thereby established "which will, without the least hesitation, be punctually and cheerfully paid by every subscriber to the water who shall choose to continue taking it." These rates, in part, were as follows:

	Per Annum
1st Class dwelling houses, Every 3 story double house	\$16
2nd Class dwelling houses, Every 3 story house with three windows in front on the lower floor, or two front rooms, with an L.	14
3rd Class dwelling houses, Every 3 story single house and 2 story double house.	12
4th Class dwelling houses, Every 2 story house with two front rooms and an L.	10
5th Class dwelling houses, Every 2 story single house (of two rooms on first floor) of brick, or fronted with brick.	8
6th Class dwelling houses, Every other dwelling house of whatever description.	6
Every additional one family in any house, to \$3 (or the house to be debarred water)	3
If more than one additional family in any house, each such additional family to pay.	2
Every store, or store house, not otherwise rated.	6

In addition, rates were given for various special purposes.

Interesting light on prices of cast-iron pipe and the lengths in which it was then offered is afforded by the minutes for May 1, 1813, when the trustees opened sealed bids for "cast-iron conduits," as follows:

1. From Thomas Trenor of Bennington, \$128 per ton, of 3-ft. length.
2. Eliphalet Sturtevant, New York, \$140 per ton of 3-ft. length or \$120 for two-foot.
3. Holly & Hoffing, of Salisbury, Conn., \$100 per ton "in joints of one length of 2 ft. each."

The contract was awarded the same day to the last named and lowest bidder, but with the proviso that the bidder supply 200 joints, "carefully cast, as a fair sample of the work, agreeably to a description laid down on paper by the superintendent and enclosed to them [the bidder] in order that a fair experiment may be made of the strength of the pipes according to the proposed dimensions, and that this Board will be ready to enter into a contract on the subject at any day when the parties will attend." Apparently the low bidder gave satisfaction, for on Oct. 4, 1813, the trustees resolved to contract with Holly & Hoffing for 150 to 170 tons additional of cast-iron conduit delivered on the dock in Hudson by Nov. 1, 1814, at \$100 a ton.