INTERLOCKING PLANT AT PACIFIC JUNCTION; CHICAGO, MILWAUKEE & ST. PAUL RY.

The track elevation work on the Chicago, Milwaukee & St. Paul Ry., within the city limits of Chicago, includes Pacific Junction, and the tracks at this point have not only been raised, but have been rearranged in such a way as to facilitate train movements, while the entire junction has been equipped with a new and complete signal and interlocking plant. The traffic is very heavy, and as no diversion could be allowed, the raising and rearranging of tracks and the installation of the interlocking equipment had all to be done with little or no interference with the traffic. The interlocking plant was put in service on March 20.

The junction is a complicated one, and is in the form of a diamond, with four curved sides and two diagonals. This is shown by the plan, Fig. 1. From the Union station to Pacific Junction there are four main tracks. Four tracks then turn west to the Council Bluffs and Omaha Division, while two tracks continue northward to the Milwaukee Division. The old Bloomingdale line runs eastward from the junction to North Chicago, and is a very busy terminal freight line, passing through a manufacturing district, while it also offers an alternative route to the Union station in case of any block on the main line south of Pacific Junction. The four-track curve to the west and the double-track line to the north are main lines; the others are freight and connection lines. The total distance between the outermost signals is about 5,150 ft. north and south and 3,470 ft. east and west.

At the center of the junction is a double-track grade crossing, and in addition to the regular interlocking signals there are semaphore block signals governing the crossing. Both the block and route signals must be clear before a train can start to pass over the crossing. These block signals have pointed ends, to distinguish them from the interlocking signals, as shown to the right in Fig. 2. It has been decided to put in electric automatic block signals between Pacific Junction and the Union station, but the type to be adopted has not yet been settled.

The interlocking machine has a frame for 108 levers, with 100 working levers and eight spare spaces. The distribution of the levers is as follows:

19 levers for 32 switches.
9 " " 11 derails.
2 " " 4 crossing bars.
5 " " 5 switches and 5 derails.
1 " " 1 high and 1 dwarf signal.
17 " " 32 facing point locks.
16 " " 16 dwarf signals.
31 " " 36 signals.

The locking frames are placed horizontally, on the main floor of the tower, behind the lever frame, and only the rods and wires to the lead-outs are beneath the floor. Two forms of lead-outs are used: (1) the usual arrangement of reciprocating rods or pipes, operated by bell-cranks and supported on roller carriers; (2) rocking shafts or tumblers, operated by cranks inside the tower and having outside crank arms to which the pipe lines are attached. Fig. 3 is a good view of the lead-out arrangement, and a group of ten rock shafts may be seen passing through the base-board of the tower. Another peculiar feature of the plant is the use of heavy box cranks for changing the direction of groups of pipe lines. One of these is seen at the left in Fig. 3, and a larger one is shown in Fig. 2. This latter view also shows the crossing block signals (at the right) and the long guard rail beyond the derail, which is intended to prevent a derailed train from wrecking the pipe lines and going down the bank. On the left is the terminus of the Humboldt Park branch of the Metropolitan Elevated Ry.

The views reproduced from photographs give an excellent idea of the amount of piping used, and Fig. 4 shows the form of subway construction used for carrying the pipes and wires underneath the tracks, so that repairs can be made without disturbing the tracks. Heavy timbers, 8 x 16 ins., and 8 to 10 ft. long, form the foundation for the subway, and upon these are laid lines of 9-in. I-beams 27½ ins. apart, the beams being spiked to the timbers. The track ties are laid upon these beams and bolted to them, and the pipes are laid in the spaces between the beams. The subway shown in Fig. 4 has 24 pipes and 10 wires.

All the signal posts are of steel, the larger ones being built up, while the smaller ones (carrying a single arm each) are of heavy pipe, like trolley poles. The large poles, shown in Fig. 5, were designed by the signal department of the railway company. The post itself is composed of four corner angle irons, connected by lacing bars, and the top carries a deep, stiff bracket frame in which are seated two or three pipe poles, on which the semaphore blades and spectacles are mounted. These posts are of very neat design, and are exceptionally stiff.

Fig. 5, which is a view looking northward, includes some interesting details. In the first place it shows the monolithic concrete abutments used by this railway in all its track elevation work, and shows also the solid floor of the plate girder bridges. Each rail is secured to an oak filler (protected by tie plates), laid in a 9-in. inverted channel by means of U-bolts, and no guard rails are used. It also shows how the pipe lines are carried across the bridges by means of cantilever floor beams riveted to the girders.

The interlocking plant was built by the Union Switch & Signal Co., of Swissvale, Pa., under the direction of Mr. W. H. Elliott, Signal Engineer, and Mr. C. O. Tilton, Assistant Signal Engineer of the Chicago, Milwaukee & St. Paul Ry. We are indebted to Mr. Elliott for the plans and photographs made use of in this article.

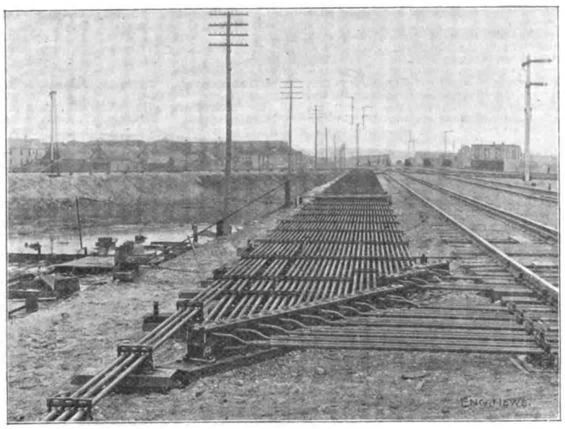

FIG. 2—BOX CRANKS FOR SWITCH AND SIGNAL RODS.

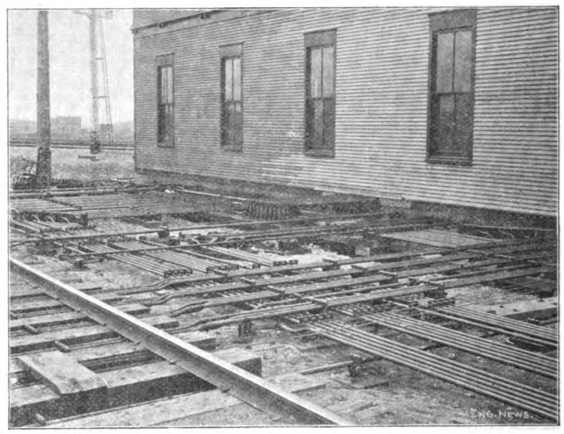

FIG. 3.—VIEW OF LEAD-OUT FROM TOWER AT PACIFIC JUNCTION.

SEWAGE ANALYSIS AND THE CHEMICAL TREATMENT OF SEWAGE.*

By Prof. Leonard P. Kinnicutt.**

Sewage has been aptly defined as the water supply of a city after it has been used, containing the refuse of man's habitations, the street-washings and the waste products of every branch of industry. In speaking of sewage it is customary to divide it into two kinds, domestic and manufacturing sewage: Domestic sewage being the sewage of a town or city where no, or very few, manufacturing processes are carried on; manufacturing sewage, the sewage of a town or city whose existence depends upon large industries. The disposal of these waste products so that they shall not become a nuisance either to the city where they are produced or to other towns or cities, is a problem which has caused more trouble to chemists and engineers than any other one question.

In a few favored localities sewage can be disposed of by carrying it into the sea, or into a large water course. This is, however, exceptional, and as a rule the sewage, to prevent its becoming a nuisance, has to be so treated that those substances which by their decomposition would produce a nuisance, are destroyed or removed. There are at present three ways by which this is attempted: Chemical Precipitation; Broad Irrigation; Intermittent Filtration.

In treating the question as to what is accomplished by each of these methods, it is necessary to have a clear idea of what sewage is. In domestic sewage we have a great variety of complex organic compounds, vegetable and animal, which by the process of putrefaction are broken up into similar substances, and which, during the process of decomposition, give off odors which are the cause of complaint. These substances may either be suspended in the sewage or in solution.

In manufacturing sewage we not only have the organic compounds that are contained in domestic sewage, but also other organic substances such as come from wool washings, tanneries, dye works, woolen and cotton mills, and other industries, also the mineral substances and free acids which are found in the largest quantities in cities engaged in any branch of the iron industry.

Besides the substances above mentioned, and which may be called dead matter, there is in all sewage living matter, the so-called micro-organisms, bacteria, moulds, or what in ordinary language are called germs. This living matter, as the name micro-organism implies, is not visible to the eye, but exists in very large quantities; or, rather, the number of micro-organisms in a given quantity of sewage is very large, one liquid ounce often containing 25,000,000. The greater number

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of these micro-organisms are not harmful to man, but in sewage there is, as a rule, and may be at any time, bacteria which, if they enter the human system, produce such diseases as dysentery, cholera, typhoid fever, and the other so-called germ diseases; and in a perfect treatment of sewage, although they are harmless, unless the sewage enters a water supply, their removal, as well as that of the decomposing organic matter, must be accomplished.

The Chemical Analysis of Sewage.

Having thus seen, in general, what sewage is, is it posible, by any method of analysis, to tell exactly what any given sewage does contain? Roughly speaking, it is possible. It can easily be determined by chemical analysis the amount, by weight, of the total organic and inorganic matter present in a given volume. Also what kind and what amount of mineral matter, including free acids, the sewage contains. Further, particular dye-stuffs can often be identified, and it can be told whether or not there is in the sewage refuse from tanneries, woolen and cotton mills, and other well-known industries.

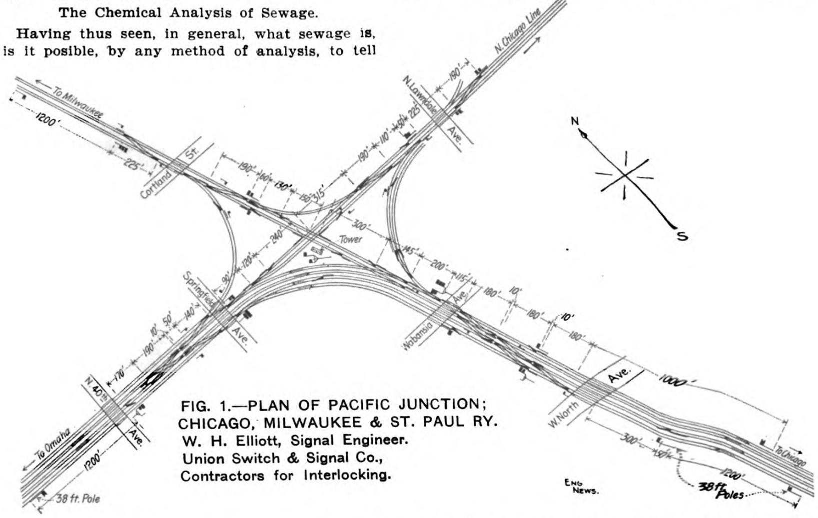

FIG. 1.—PLAN OF PACIFIC JUNCTION; CHICAGO, MILWAUKEE & ST. PAUL RY.
W. H. Elliott, Signal Engineer.
Union Switch & Signal Co., Contractors for Interlocking.

As regards the greater part of the organic matter, it is not yet possible to say what substances are present, although it can be told whether or not the organic matter is such as will readily undergo putrefaction, and what stage such decomposition has already reached.

The chemist, in making an analysis of sewage, besides determining the total amount of solid matter and the amount of mineral matter, makes certain other determinations which are called Free ammonia; Albuminoid ammonia; Total Nitrogen; Nitrogen as nitrites; Nitrogen as nitrates; Oxygen consumed; Chlorine.

What do these terms signify, and what deductions are made from their determinations? Organic matter contains, as a rule, four elements: Carbon, Hydrogen, Oxygen, Nitrogen, united in the most varied and complex manner, most of the nitrogen existing in compounds which more or less resembles albumen, a substance familiar to us in the white of an egg.

When the sewage undergoes putrefaction these complex compounds are first broken up, simpler substances being formed, carbon dioxide and ammonia escaping. The ammonia which is thus formed remains in greater part in the solution of the sewage and the amount when determined is called the free ammonia, which shows the amount of putrefaction which has taken place.

When the first process of decomposition has taken place, and which is brought about in nature by a class of bacteria called anaerobic, living best in the absence of light and air, a second process of decomposition takes place. The simpler organic compounds formed by the first process are further broken up, this being accomplished in nature by another class of bacteria called aerobic, their life depending upon the presence of oxygen, which they obtain from the air. By this second process, called nitrification, the nitrogen of the simpler organic compounds is changed first into nitrites and then into nitrates. After this change is complete, all the organic matter in the sewage is destroyed and there is left only mineral matter, and the sewage is now no longer sewage, but a mineral water, water containing only mineral or inorganic substances.

The chemist determines the amount of nitrogen that exists in the sewage both in the form of nitrites and nitrates. If any quantity of nitrogen as nitrites is found it is a sign that the second stage of decomposition has begun, and as in this stage very little odor is given off, it is also a sign that very little trouble may be expected from the sewage by the giving off of foul gases. It much of the nitrogen exists as nitrates it shows that this second stage is well advanced, and if all of the nitrogen is found in the state of nitrates and none as nitrites, the purification is complete, all the organic matter having been changed into mineral matter.

Albuminoid Ammonia.—This is the measure of the nitrogen that is united to the carbon, hydrogen, and oxygen, in compounds similar to albumen, but which, as decomposition proceeds, will be changed into ammonia, into nitrites and nitrates. It signifies the amount of organic matter that remains unchanged, but which will go through the two stages, putrefaction and nitrification. The larger the amount of the so-called albuminoid ammonia obtained by the chemist, the greater is the amount of putrescible matter.

Total Nitrogen.—This is the nitrogen contained in the albuminoid substances, in the free ammonia, in the nitrites and nitrates. If from the total amount of nitrogen, that which exists in the free ammonia, in the nitrites and nitrates be deducted, the exact amount of nitrogen existing in the albuminoid and other decomposable substances is obtained. It is a more exact measure of the decomposable organic matter than the "albuminoid ammonia." It is, however, comparatively speaking, a tedious and difficult determination, and the common measure of organic matter in sewage is still the "albuminoid ammonia."

Oxygen Consumed.—As the name implies, this denotes the amount of oxygen necessary to burn up or destroy the organic matter. Its determination is fairly simple, and in domestic sewage the results show the relative amount of organic matter. But in the manufacturing sewage the results are much less trustworthy. In testing the purity of treated sewage, the determination of the oxygen consumed is of importance and takes equal rank with the determination of albuminoid ammonia. The English test for sewage satisfactorily purified is that it does not contain more than 0.1428 parts albuminoid ammonia in 100,000 parts, and that 100,000 parts does not absorb over 1.428 parts oxygen in four hours.

Chlorine.—The chlorine in domestic sewage comes mostly from urine, and its determination serves chiefly in domestic sewage as an index to the total amount of impurity. It is not changed by any process of sewage treatment and the same amount of chlorine should be found in the treated and untreated sewage. Its determination, consequently, serves the useful purpose of showing whether the sample of treated sewage analyzed corresponds to the sample of crude sewage taken.

In fresh sewage, as can be seen from the above statements, albuminoid ammonia, free ammonia, chlorine, are found, but no nitrogen as nitrites or nitrates. As sewage undergoes putrefaction and nitrification, the albuminoid ammonia and free ammonia decrease; the nitrogen as nitrites and nitrates increases, and in perfectly purified sewage all the nitrogen has been changed into nitrates excepting the nitrogen of the free ammonia, which as ammonia gas has escaped into the air.

The strongest sewage is the one which contains the most albuminoid ammonia and consumes the largest amount of oxygen. The sewage which contains the greatest amount of nitrogen as nitrates and consumes the least amount of oxygen, is the one which approaches most nearly to pure water.

The amount of purification, therefore, which has been accomplished by any process of treatment, is calculated, by determining the percentage of albuminoid ammonia removed, the difference in the amount of oxygen consumed before and after treatment, and in the amount of nitrogen found as nitrites and nitrates.

In America the amount of albuminoid ammonia found in the sewage after the suspended matter has been removed by filtering the sewage through filter paper, is often determined. From the results so obtained an idea is gained of how much of the polluting substances are in suspension and how much are in solution, and this may be of decided importance.

It is now evident that from the results of the analyses of sewage of various cities conclusions regarding the comparative amount of polluting matters in each can be drawn; and from the an-

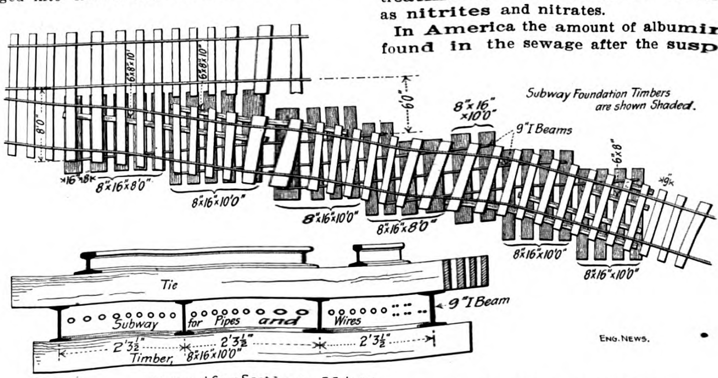

FIG. 4.—SUBWAY FOR SWITCH AND SIGNAL RODS AND WIRES.