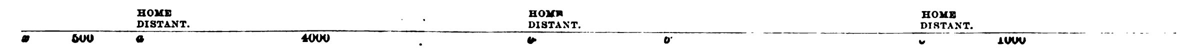
4,265 sq. ft., of which 5½ per cent. is in the fire-box. From theoretical considerations the design appears to be ideal for oil burning.

It is suggested that the use of oil may increase the danger from fire in case of accident. The danger would seem to be in the scattering of oil over the wreckage and thereby accelerating the burning when once started. Against this argument it can be said that the use of oil diminishes the liability of starting fire by this much: when the connection between the tender and engine is broken, the fire goes out. It is true that the fire bricks are hot enough to set fire to wood or other imflammable material, but it is improbable that they would be thrown from the fire-box. There are many records of disastrous fires having been set by the scattering of the hot coals from the fire-box of a wrecked locomotive.

The Overlap.

Overlap is the term used in automatic block signaling to designate the arrangement by which a train does not clear the home signal at *a* when it passes out of the block section at *b*, but does clear signal *a* when the train passes *b′* (600 ft. to 3,000 ft. beyond *b*). This is accomplished by arranging the track circuit relay at *b* so that the track circuit *a b* is kept open until the train passes *b′*.



The strong argument offered at the last meeting of the Railway Signaling Club in favor of having an overlap in automatic signaling is that English practice with manual signals amounts to the same thing; that is, they show a red signal at *a* until the train is well into the next block at some point *b′*. The Board of Trade inspectors censure a road that fails to allow such leeway to the following train. The overlap was originally designed for American automatic block signaling practice with home signals only, and as a cheap substitute for the more costly distant signals. The English overlap is used with the distant signal.

The American Railway Association's rule No. 319, for manual block signaling, that *b* must not tell *a* that section *ab* is clear until the train has passed a considerable distance beyond *a*, is plainly using the overlap idea, but this rule was made years ago, when distant signals were few. A common distance for this leeway is 300 ft. The sum of the arguments of those at the Club meeting in favor of the overlap was that the engineer is, like all human beings, fallible; that he might run by one signal without noticing it, and that the overlap would give him a second chance.

The overlap is unscientific, because it gives inexact information to the engineman of a following train. The signal at *a* may be against him, but he may have reason to believe that the preceding train is not in the block ahead of him; it is probably in the overlap. Because of the indefiniteness of the overlap, and because he must make his time, he takes chances. After long experience he finds that he has always correctly guessed when it was safe to run by and when to stop at a red signal, and his state of mind is ripe for a rear-end collision; for one of those inexplicable cases where a trained man with a splendid record "runs" a signal and crashes into a train ahead.

Those opposed to the overlap evidently thought that if the division superintendent would watch and rigidly discipline his enginemen, their alleged inability to maintain a vigilant lookout for all signals, and to invariably stop where stop is indicated, would vanish. To put a stop signal at one point, when the arrangement of apparatus is such that the actual stop may possibly be made at a point farther on, is to weaken discipline. The advocate of the employment of discipline instead of the overlap is likely to have the constant aid of the man or men who make the appropriations. The introduction of the overlap increases the cost of apparatus and of maintenance, and an officer may wisely prefer to spend that money —if any additional money is needed—in enforcing discipline.

Again, the opponent of the overlap objects to it on account of the difficulty of making it simple and uniform. It is confessedly unnecessary when all trains run at moderate speed, and so the question of speed is considered when deciding whether to use or not to use it. But different trains run at different speeds and precise rules are difficult. To make long overlaps on descending grades and short ones on ascending is only an approximate adjustment.

The overlap is an addition to the practicable length of the block sections, and this decreases the capacity of the road. With block sections 4,000 ft. long and distant signals 4,000 ft. back of the homes a fast train must keep 8,500 feet behind a preceding train; for the distant signal at *a* is not cleared until the foremost train has reached *c*. The following train must have notice at *x*, for the engineman needs 500 ft. in which to see the signal at *a*. The time interval between the trains, which measures the capacity of the road, corresponds to the interval between their respective engines. This is 8,000 ft., + the length of the leading train. We may assume the length of the train to be 500 ft. If, now, we add an overlap of 1,000 ft., the former capacity of the road is decreased by the ratio of 9,000 to 10,000, or practically 10 per cent.

Mr. Sperry said that to go without the overlap was to declare a strong confidence in our discipline. Conversely, to adopt it is to admit a weakness in the discipline. If we adopt it we are not in accord with the action taken by the American Railway Association a few years ago when it abandoned the five-minute allowance for possible variation of watches. That allowance was meant for variation in the mental capacity and habits of the men as well as for imperfections in the mechanism of watches; and doing away with it meant an increased confidence in the discipline. That increased confidence appears to have been justified.

These seem to be the chief scientific and economic elements of the question of using or not using an overlap in automatic signaling where home and distant signals are provided. It is the sort of question that needs to be settled almost entirely by discussion, because the evidence obtained by practical use is uncertain. Only two important roads appear to have put the plan in use. The New York Central's Fourth Avenue tunnel has 800 ft. overlaps, and trains run 24 miles an hour. The Chicago, Milwaukee & St. Paul has 1,000 ft. overlaps for blocks 2 to 3 miles long, and 600 ft. blocks of 1½ miles. Both examples, therefore, indicate a disposition to make the overlap as short as practicable.

"Small Unit, Direct Transit."

This is Mr. John Brisben Walker's descriptive name for his method of carrying passengers in great cities, applicable alike to Chicago, New York, London and small towns. He is president of the Mobile Rapid Transit Company, and he tells the New York Rapid Transit Commissioners that the subway, now only about half done, is already antiquated, and asks them to advance $10,000,000 for putting in service automobiles, each seating 14 passengers. Every part of the city could be served because the carriages would not have to keep to certain lines of tracks and "the daily journey down or into town instead of being a horror, composed of bad air, indecent crowding, stopping and jamming at every corner, and clinging to straps will become a pleasure trip and be looked forward to as the most delightful event of the day. The time is as surely coming as you are sitting here when this method of transit will become universal." He estimated that 5,000 "Mobile" carriages will bring in a profit of 114½ per cent. on the investment, the fares to be from 3 cents to 10 cents, according to distances.

In 1885, Jacob Sharp, a promoter with a creative imagination, but an insufficient distaste for corruption, substituted surface cars for omnibus "units" on Broadway, New York. Right minded citizens were moved to indignation at his methods and an enormously increasing number of all kinds were moved to destination by his achievement, while at the same time street congestion was relieved. It is not easy to recall any fact in the art of transportation more clearly and repeatedly demonstrated than that an orderly procession of vehicles on a track, or of men on march, has greater capacity than any movement of uncontrolled units. One familiar with upper Wabash avenue and State street, in Chicago, or with any avenue in New York between 5 and 6 in the afternoon, needs few figures to picture the results of substituting automobile stages for the existing means of riding, or of adding automobiles to the present systems. Nevertheless an application of the antiquated forms of arithmetic and horse sense may help in the details of the picture.

The subway may reasonably be expected to carry three-quarters of a million people a day on long trips up or down the island. Mr. Walker's 14-passenger automobile will do well to make four such trips a day, "weaving in and out and not keeping to certain lines." It is easy to see that 13,000 automobiles are needed and that the cost of them would be something like $40,000,000—nothing to frighten one, as things go nowadays, but still it happens to be about the estimated cost of the tunnel and all of its local and express equipment. But the tunnel takes none of the present street room, while Mr. Walker's solvent, packed solidly together with no leeway for movement, is about five miles long.

The really attractive feature of the proposition to the Rapid Transit Commission is the 114½ per cent. profit, which, like all gall can be divided into three parts: 4½ per cent. for interest, 10 per cent. for promotion, and the rest for the idea.

March Accidents.

The condensed record of the principal train accidents which occurred in the United States in the month of March, printed in another column, contains accounts of 37 collisions and 22 derailments. Those which were most serious, or which are of special interest by reason of their causes or attending circumstances occurred as follows:

*9th, Olean, N. Y. 31st, Waterbury, Conn.
*†26th, Lacosti, Tex.

The cause of the break-in-two at Olean is not reported, and apparently was not discovered, so the terrible list of fatalities can only be classified in a general way. As the explosion occurred some seconds after the collision the Superintendent will probably think that he is particularly unlucky to be obliged to charge the deaths to the train-accident record at all. But, without knowing the cause, there is no difficulty in naming the preventive; it is the use of the automatic air-brake throughout every train. The killing of 15 persons will accentuate the need of the universal use of the air-brake, but the existence of the need should already be familiar enough, from the common knowledge of the way the bills for damage by break-in-twos increase year by year. According to the Government report for the last fiscal year (Accident Bulletin No. 4, page 11) nearly half a million dollars was charged to this class of accidents in that year, to say nothing of the deaths and injuries and the large sums of money paid out on account of them.

The rear collision of passenger trains at Lacoste belongs to a class which is so familiar that no reader of these columns will need an essay on the causes at this time; but it will do no harm to look again at the fact that the rear car of the foremost train was *not* the one that was wrecked. The oil in the tender and the burning of the bodies of the passengers killed are other significant features of the report. Another feature, which has appeared a number of times in recent accident reports, is the empty rear car. To adopt an Hibernicism, several hundred passengers have saved their lives by not riding in rear cars; that is to say, railroad horrors have been considerably lessened in the last few months by the lucky chance that certain careless enginemen were running behind passenger trains which happened to have an empty car at the tail end.

The wrecking of a handcar by a locomotive is an accident which occurs every now and then, but is not included in these reports. In March there was an accident of this kind (near Ithaca, N. Y.,) which was out of the ordinary in that the occupants of the hand-car were passengers, who had to leave their train because of a landslide. The locomotive was running fast, there was a dense fog, and one passenger was killed and another fatally injured.

The number of electric car accidents reported in the newspapers in March was 15, in which two persons were killed and 59 injured.

Electrical Reduction of Iron.

[Students will be interested in G. Garnier's account of all the processes, and references to the literature of the subject, published in full in the March, 1903, issue of *Le Mois Scientifique et Industriel*, Paris.]

Electrolysis in a highly heated solution is possible by a method similar to that used in the production of aluminum, but Mr. Gin shows that by this method the production of one ton of iron will require 20,000 h.p. hours! He believes these figures to be well grounded.

There only remains the possibility of reducing the ore in the presence of carbon, using the electric current to produce the necessary heat. It may be assumed that the production of one ton of iron requires 2,300,000 calories, which, allowing an efficiency of 75 per cent. for the apparatus, means an expenditure of 3,800 kilowatt-hours. At first sight this appears to reduce the problem to the question of obtaining the current at a sufficiently low price. Account must, however, be taken of the cost of the electrodes which are consumed and which amounts to from $3.40 to $3.80 per ton of iron produced, and further it must be borne in mind that coke is necessary for the reduction, and that this is rarely obtained cheaply in mountainous countries offering favorable hydraulic conditions for the cheap production of the electric current. It may be estimated that the three prime factors in the cost of production will be approximately as given below for each ton of metal produced.

Electric power, 5,092 h.p. hours at .112c	$5.70
Coke, 880 lbs. at $7.60 per ton	3.04
Electrodes	3.61
Total	$12.35

Without going further it may be concluded that the direct production of iron or steel from the ore by the electric process can only have a future in a country barren of mineral fuel and lacking transportation facilities, but blessed with water power and ore; while it is not commercially practicable in a civilized country producing coal and offering means of transport.

Although the direct production from the ore appears to be out of the question, it may be practicable to employ electricity for the heating of open-hearth furnaces for the production of steel. The conditions under which this can be done are not difficult to determine. The current will be used only for melting the pig iron and maintaining the bath at a high temperature during the conversion from