tained unit and may be attached to any train on any line. Under the second class, where each car is not a separate unit but is dependent upon outside assistance, there are two general systems, the first where the car equipment consists of storage batteries alone, which are charged at suitable stations along the line, and second, where either an engine and dynamo unit driven by steam from the locomotive boiler or a separate boiler in the baggage car, or an axle-driven unit for the entire train is located in the baggage car. Where the simple storage system is used each car is dependent upon obtaining charged batteries at regular intervals and its travel is limited by this consideration. Where the baggage car equipment is used the train is the unit, and except for short intervals determined by the capacity of the battery installed on each car the unit must be maintained intact and the entire train must be wired, at least for the main conductors for through connection to the last coach. In the case of through trains, where the amount of disconnection is small during long runs, the batteries might be dispensed with and dependence placed upon the generating unit in the baggage car, or a single set of cells used in the baggage car or last car of the train to carry the lighting over the periods of disconnecting of the engine or baggage car.

As regards the initial cost of these several systems the writer, after a careful investigation of what has actually been done and what can be done at prevailing prices, has come to the conclusion that the order of cost is about as follows, beginning with the cheapest :

1. Engine and dynamo unit in baggage car without batteries.

2. Engine and dynamo unit in baggage car with batteries under each car.

3. Single axle unit in baggage car with cells under each car.

4. Battery equipments under each car with charging stations at intervals.

5. Separate axle units and batteries under each car.

The last two are not far apart in initial cost per car It may be pointed out, however, that allowance has been made for charging stations on the understanding that they are not used for other work, but in many cases the companies have lighting plants already established which are available for charging, which would diminish the cost of the charging station plan considerably. As regards reliability any of these systems to be commercially successful must be capable of being placed in the hands of the train crew, the supervision of experts being only available at large terminal points, and the expert supervision necessary should not be great even when available, and this will be secured by the use of the system which requires the least apparatus on the cars. This condition is best met by the charging station system where the batteries are inspected after each run and the charging apparatus is under competent supervision. The chances of failure are greatest on the systems employing the axle units for charging, but even in this case from the reports of several companies the failures are few. Regarding the comparative cost of operation of the various systems it is impossible to speak generally, as each is dependent upon the local conditions on the particular railway system under consideration. It may, however, be pointed out that the interest and depreciation accounts, if properly allowed for, will be the largest item in the cost, and the investment in the original instalation will to a large extent govern the annual cost per car for its operation. This acts against the charging station scheme because of the large number of batteries used, and on them the depreciation is larger than on the rest of the apparatus.

The voltage employed where batteries are used should be kept as low as possible with due regard to the wiring losses, to take advantage of high efficiency lamps and to reduce the weight and cost of the batteries as much as possible. In practice the voltages range from 24 to 60 and in many cases 2.5 watt lamps are adopted; the decreased life of these being compensated for by the smaller size of battery and charging apparatus. Where axle units are used the problem to be met approximates in a small way to that of street railway motors which are operating under the floor of a moving car and subject to the shock and disturbance of the motion, but the amount of attention which they will receive while operating is less than in the case of the motor.

To sum up the relative advantages of the several systems in a general way we may say that the system employing a steam unit in the baggage car without batteries is the cheapest and is very simple in operation, but when the locomotive is uncoupled the lights are extinguished, for which reason batteries under each car are a necessity unless the train is never broken. The batteries need, however, be but small. A single axle unit in the baggage car is in a good position for operation without chance of failure, but requires somewhat larger batteries on each car than the steam unit system to carry the lights while the train is stopped or running slowly. Each of the above systems requires that the train be wired throughout from car to car. The advantage of the separate axle unit under each car is that each is independent and no through wiring is necessary, but the initial cost is higher, and the necessary supervision greater than those previously mentioned. The charging station plan is simpler in operation, but its initial cost is high, and its operating costs probably higher than any of the others for the same conditions. It may be pointed out that where any road is contemplating the use of electric light the natural course is to proceed cautiously and invest as little as possible until success has been demonstrated, and for this reason the separate axle unit has an advantage, as only those cars upon which the system is to be tried need be fitted up, while with the other systems expense has to be incurred for wiring all cars or establishing charging stations.

These are merely general views and should not be applied indiscriminately to all cases, as the local conditions of each road will modify the above conclusions profoundly, each case requiring a careful study of existing conditions to ensure that the best system is adopted to meet the requirements Under the varied conditions of traffic each of the above systems has its place and with the possible conditions met by such varied systems it is not too much to hope that the train of the immediate future will be the electrically lighted.

THE EVILS OF INTERCEPTION TRAPS, ETC.

BY W. M. WATSON.

In the July issue of THE CANADIAN ENGINEER I gave an epitome of the sanitary experiments carried out by the authorities of the city of Cologne, Germany, that proved that it was both dangerous to the public health and in direct opposition to sound sanitary science, to place interception traps on private drains and useless vent pipes on the interior house plumbing arrangements.

Another paper on "Sanitary Excesses" in your September issue showed that the engineers and surveyors of Old London who had pressed the American drainage obstruction system on their employers, the public authori-