

the extreme ampere demand within the limits of allowable voltage drop. It is a fact too little appreciated that the first cost of a line battery is often very much less than of copper feeders sufficient to secure anything like equivalent effect. As evidence of the extent of these economies it may be stated that the line batteries installed by the Gould Storage Battery Company have frequently saved their entire cost in less than eighteen months.

The requirements of a lead storage-battery plate, as

of finished plate and clearly indicates the character of the construction. The active material is formed out of the lead composing the contact surface between the ribs, filling the spaces with closely packed but highly porous active material. Expansion and contraction cannot cause loosening or falling out of the active elements, and the closest electrical contact is preserved.

Fig. 3 shows the double-conducting lug by means of which better distribution of current is secured.

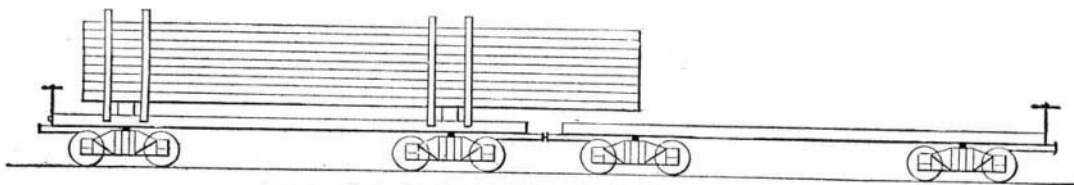


Fig. 1.—Twin Load with Both Bearing Pieces on One Car.

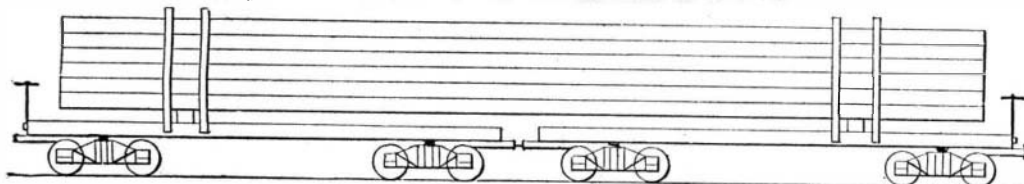


Fig. 2.—Twin Load with One Bearing Piece on Each Car.

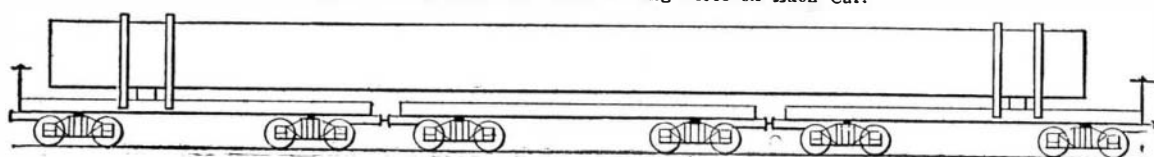


Fig. 3.—Triple Load with One "Idler."

given by Lamar Lyndon, M.E., in "Storage Battery Engineering," are substantially as follows:

1. Uniform resistance throughout grid to secure even current flow through active material.
2. Allowance for expansion and contraction of active material during discharge and charge.
3. Close electrical contact between active material and support plate.
4. Freedom from local or secondary action.
5. Provision for ample circulation of acid electrolyte.
6. Large surface of active material exposed to electrolyte.

The following brief description of the Gould battery plate and the accompanying illustrations serve to explain to how great a degree this plate fulfills the theoretical requirements as set forth above.

The Gould plate is of the Planté type, so called, in which the active material, lead peroxide for the positive and spongy lead for the negative, is formed electrochemically out of the lead composing the support plate or contact surface.

Fig. 1 is a fragment of a Gould plate illustrating the manner in which the large contact surface for active material is developed out of a sheet of rolled lead cut to the size and shape of the plate. This "blank" is placed between two shafts on which are mounted sets

Only chemically pure, densely rolled lead is used, so that secondary actions leading to "self-discharge" are impossible. The plate is absolutely integral; no lead is removed or added in making the plate—the blank is merely changed in form. There is ample provision for circulation of electrolyte and large contact surface for securing high efficiency and long life. In addition to batteries for power purposes the Gould company is manufacturing types for telephone, telegraph, and signal service, for train lighting, and for electric vehicles.

NOVEL HOUSE-MOVING OPERATIONS.*

By EDWARD H. CRUSSELL.

IN order to secure better grades when we were "double-tracking" a portion of our line a while ago some pieces of the old single track were entirely abandoned, and on one of these pieces of track stood a building that was to be moved. The distance from where it stood to the point where the old line joined the new was about $3\frac{1}{2}$ miles, and from this point it was to be brought back along the new line until it stood nearly opposite to its old location, but $1\frac{1}{4}$ miles further south.

One thing in our favor on the present job was the

ing of schedule trains is one of the worst offenses a railroad man can commit, and he does not do it often—at least not on the same railroad.

The writer has thought it would be well perhaps in the present article to go somewhat into the matter of loading long material on open cars in order to illustrate to the uninitiated some of the minor difficulties attending this method of house moving. In the first place, all material of whatever kind that is shipped in twin or triple loads—in other words, material that is too long to ship on one car—must have but two bearing places, as indicated in Figs. 1, 2, and 3. The object of this is to allow the cars to be free to adjust themselves to the curves in the track. Material loaded flat on the floors of two cars, for example, would either derail the cars by crowding them off the outside of the curve or unload itself by breaking the stakes that hold it on the cars. There is one exception to this rule of two bearing pieces, and that is in the case of long flexible material that is not stiff enough to be supported from the ends. In such an instance all bearing pieces, except the two end ones, must have two steel plates between them and the load. These plates must be well covered with heavy grease, so that they may slide easily one on the other as the cars move from side to side while the train is in motion.

Another important fact to be considered in connection with this class of work is the location of the bearing pieces on the cars, the proper position for which is midway between the center of the car and the center of the truck. Only one-half of the marked capacity of a car may be loaded, and in no case must the bearing piece be placed beyond the center of the truck toward the end of the car. Nearly all buildings are heavy enough to call for the "three-fourths capacity" position, but it is not always easy to divide them up so as to be able to place the timbers there. After all the cars for one load have been coupled together they must be jacked apart and have blocks fitted in between them, so as to take up all the slack in the springs of the couplers and prevent the cars sliding back and forth under their load. The cars must also be chained together to prevent them from pulling apart, supposing the couplers should fail while the cars are under way. Cars loaded as indicated in Fig. 1 need not be chained, but if one of the bearing pieces shown rested on the second car it would then be necessary to chain them.

Enough has probably now been said on the subject to show that there are many things to be considered, but before we start to load our building and having finished with them we will go back to the starting point and see how the loading is to be done.

The first work necessary in nearly all cases is the putting in of good, substantial sills. The method of doing this varies with local conditions, but generally the floor joists are supported on jacks and timbers just back of the old sills, which are then taken out one at a time and replaced with new ones. If the building is high enough to do it we place the carrying timbers under a jack and crib from under them until the structure is high enough for loading. If it is too close to the ground to get these timbers in place it must be

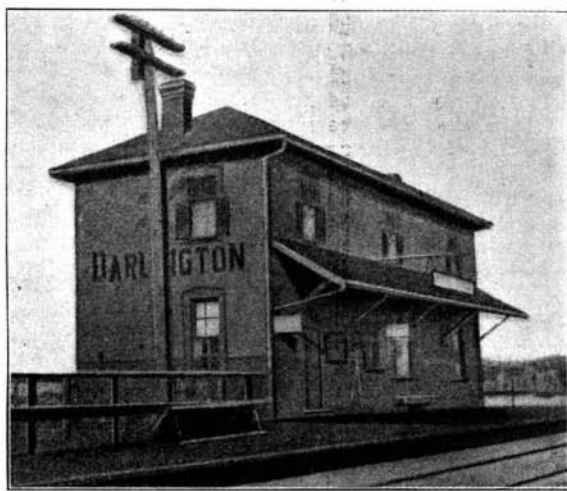


Fig. 6.—The Building in Its New Position.

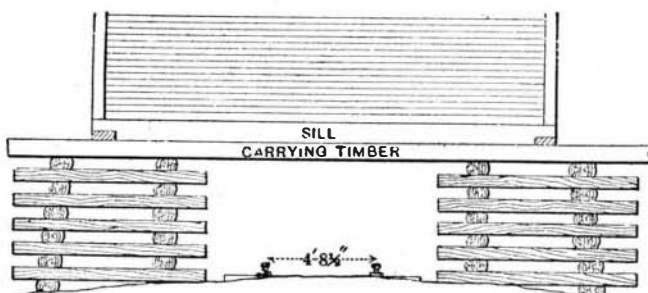


Fig. 4.—End View of Cribbing and Lower Portion of the Building, Showing Latter Ready for Loading.

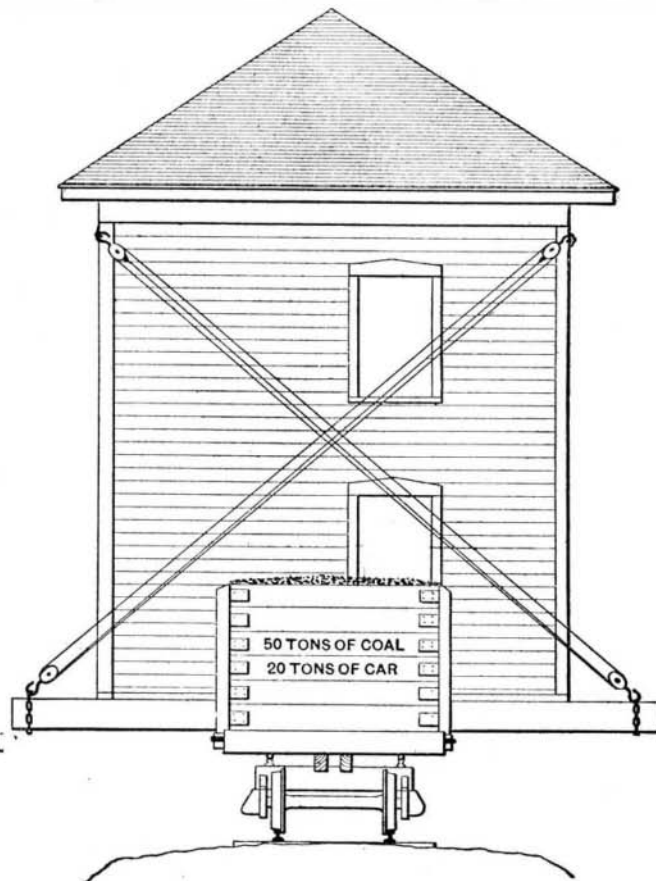


Fig. 5.—Building Loaded on Cars and Anchored to Coal Cars.—Scale, $\frac{1}{8}$ In. to the Foot.

NOVEL HOUSE-MOVING OPERATIONS.

of rapidly revolving steel disks with spacing washers. These disks are pressed against the plate and moved to and fro, working into the lead further and further and spinning the metal between the knives up into thin parallel ribs.

Fig. 2 is a longitudinal section of a fragment of a plate, and shows the web of metal left as a central conductor and also the diamond-shaped cross conductors and current-distributing bars.

Fig. 4 is a perspective drawing of a small fragment

fact that we had the old line entirely to ourselves, as, of course, no trains were running on it. For the first half of the moving we were, therefore, not pressed for time. Besides this, as the curves in the old line were sharper and more frequent than those in the new, any mishap likely to occur would in all probability happen on it, where we would be able to cope with it without the worry and danger of delaying trains. It may be remarked for the benefit of the reader that the delay-

* Carpentry and Building.

jacked from under the sills until there is sufficient room. We use for cribbing sawn cedar railroad ties whenever we can get them, and in nearly all cases we use 10-inch by 10-inch by 28-foot Georgia pine for the sills. Of this last material we always have a quantity in stock, as it is our standard double-track bridge tie.

The use of so stout a timber for sills enables us to use hydraulic jacks for raising the building, as these are quicker and easier to work than screw jacks. It also assists us materially in the spacing of the bearing

pieces, as, of course, it will permit of a longer span than would a smaller sill.

In the case of the piece of work under consideration it may be stated that the land where the building stood was considerably lower than the surface of the track, and to have raised the building there to the proper height for loading would have required a cribbing at least 9 feet high. However, as the track was not in use we drew the building over first and raised it afterward, leaving the cribbing clear so that the cars could be run under and the building lowered onto them. In Fig. 4 is an end view of the cribbing and the lower portion of the building, showing the structure ready for loading and before the cars were placed under it.

It was necessary to use four carrying timbers or bearing pieces for this building, the two center ones being provided with steel plates, as mentioned in connection with flexible material, and this, coupled with the comparatively slow rate of speed at which we moved, was sufficient for the purpose.

Our greatest difficulty was to keep the building balanced. The standard railroad track gage is only 4 feet 8½ inches, and the ball or top of the rail is 2¼ inches wide, so that at the very outside measurement we had only 5 feet 1 inch as a wheel base. With the bearing pieces on the cars the sill of the building was nearly 5 feet from the rail, the walls were 20 feet to the eaves, and, as before stated, the building was 19 feet wide. When we consider that some of the curves in the old line had as much as 3 inches elevation, it is evident that something had to be done to prevent the building toppling over into the fields. After several schemes had been proposed and abandoned it was finally decided to anchor each end of the building to a loaded coal car. For this purpose 8 x 14-inch timber outriggers were fastened to the ends of the cars, extending a short distance beyond the width of the building, and from the ends of these outriggers a threefold tackle was taken across and made fast to the upper opposite corner of the building. Plates of iron with rings in them were bolted to the corners of the building, and the upper blocks of the tackles were hooked into the rings, the lower blocks being fastened to the outriggers with chains.

Our standard coal cars have a capacity of 50 tons of coal and weigh about 20 tons themselves, so before this building could fall over it had to lift a weight of 140 tons. In practice we were glad to find that this was more than sufficient for our purpose. In Fig. 5 is an end elevation of the cars and building clearly showing the arrangement which we adopted.

An accurate record of the time required for executing the work was not taken, for, as before mentioned, we had all the time we wanted on the old track, but as near as can be remembered, we were about 3½ hours on the new track. Of course we had the rollers to put under this time before we could move the building off the cars. The picture in Fig. 6 is from a photograph of the building in its new location and as it appears at the present time.

SOME RECENT DEVELOPMENTS IN PLANT GROWING.*

By G. CLARKE NUTTALL.

THERE is an element of uncanniness about some of the recent developments in plant-growing. The honorable profession of gardening, coeval, we are led to believe, with man's own origin, is being lured down strange by-paths in these latter days, straying far from Nature's obvious course that has sufficed it for so many ages, and it is difficult to see yet the precise bourne at which it will arrive. All through the centuries, till now, man has been content to rear his plant children out of Mother Earth, trusting to pure water and fresh sunshine to ensure their healthy development; the ordinary routine of day and night, and the natural course of the seasons, summer and winter, seed-time and harvest, have been their share, and he has been satisfied with the offspring that have resulted from this upbringing. But nowadays the adventurous impulse of the times is leading him to experiment in many various ways, and in the spirit of many a modern ardent educationist he is bringing all sorts of previously unheard-of influences to bear—electric force, electric light, colored lights, germ inoculation, anæsthetics, and what not—in the hope of raising a product superior to anything that has gone before. The days of experiment are yet too young for any of the most modern developments of plant growing to have become an integral part of horticulture; and gardeners of all men, with a fixed routine ingrained in them through countless centuries, move slowly and are apt to regard innovations very dubiously. Still a considerable measure of success, that argues a probable future, has been accorded to some of them, and they claim a definite place in our notice.

For instance, electricity, that great force which the latter part of the nineteenth century harnessed to the uses of man, has not, in its victorious career, left untouched the domain of the plants, and now electroculture, or the application of the electric current in plant-growing, is fast becoming a recognized development in up-to-date agriculture and horticulture. To Prof. S. Lemstrom, of Helsingfors University, we owe much of our knowledge in this matter, for he has been experimenting for a considerable number of years on the effect of passing a current of electricity through growing plants, and he has come to the conclusion that in the large majority of cases, crops grown in an electrified atmosphere are far above the average both in

quality and quantity. During the years 1902-1903 he had experimental fields in England near Newcastle in connection with the Durham College of Science, in Germany near Breslau, and in Sweden at Alvidaberg, where he grew many plants under electrical treatment. The results were very remarkable. Thus strawberries in electrified fields showed an increase of 50 per cent to 128 per cent over those grown in normal fields. Corn showed an increase of 35 per cent to 40 per cent; potatoes 20 per cent, beets 26 per cent, and so on. And since in many of these cases the treatment was tentative and varied for experimental purposes the results will be largely improved when only the most satisfactory method is employed. In fact, Prof. Lemstrom believes that under this treatment one may safely reckon upon an average increase of 45 per cent over the normal for all crops grown on land of ordinary fertility. It is worth noticing that electricity is of no use on poor land, and it will not help poor farming. Just as "to him that hath to him shall be given," so it is on fertile and well-cultivated land that the greatest increase is shown under electroculture.

The method of applying electricity is as follows. A wire net is first stretched across the field a little above the surface; this net is then connected with an electrical machine stationed in a shed or building without the field, and the current traverses the net. As the seeds sprout and the little plants begin to grow, the net must be raised, as on no account must it touch the plants; but the raising need only be done once or twice during the summer. On rainy days it is quite useless to apply the electric current, as through the damp the wire net loses its electrical charge directly. It is also injurious to the crops to have the machine working during brilliant sunshine.

Now, when we come to inquire why the electric influence should cause so marked an improvement in the crops, we are on somewhat difficult ground. But it can probably be accounted for in two ways. In the first place the positive current passing from the points of the wire net to the earth causes the production of ozone and nitric compounds which are beneficial to the plant. In the second place the negative electricity passing up from the earth to the points of the net tends to draw up with it through the plant the sap from the root, and thus the increased circulation of the juices gives increased energy of growth. Of course, in the application of electricity, as in the use of all good things, there must be moderation, and individual plants require individual treatment as to the exact strength that is best for them.

But in all matters such as this the mundane and first question asked by a practical farmer is, "Will it pay?" Or will the cost of the apparatus swamp the increased profits? For the commercial aspect is perforce the one that appeals to him most. To this inquiry Prof. Lemstrom asserts that he can give a most satisfactory answer—it will pay. Thus take the case of wheat, for example, and suppose a hectare (24.7 acres) is put under electroculture. The initial cost of setting up the apparatus he estimates at about £108, the annual upkeep at £23. Now, reckoning wheat as giving 34 bushels to the acre, an increase of 45 per cent due to the electric current will give an increase of 383 bushels for the field, and 383 bushels at 3s. 6d. give £67 profit. Deducting for the upkeep of the machine we have a net profit of £44 for that one field, or more than four-tenths of the whole cost realized in the first year. The larger the area worked the greater the profit, since the cost of working does not increase in the same ratio.

It is interesting to learn that Prof. Lemstrom was led to take up this line of research through his voyages to the Polar regions. He saw there that the plants showed a rapid development far surpassing that of plants in more southern climes; he saw, too, great differences in the size of wood rings in different years, and he noted the pointed needle leaves of the pines and the spikey beards of the corn. Then, with the keen eye of the man of science, he realized that the largest rings in the wood and the greatest harvest occurred in the years when there were more sunspots, when the aurora played more vividly, when, in fact, the air was largely charged with the electric fluid, and he comprehended the reason of the spikes, leaves, and beards. And from this vantage ground he was led through years of study to the conclusion that electricity must be numbered among the principal factors in plant life, a factor that, up to the present, has been practically overlooked, but which, nevertheless, plays a most important, though subtle, part in it.

Other workers, both French and English, confirm the above, and in some respects amplify it. Thus Dr. Cook found that if he electrified seeds he not only produced more successful plants from them, but a greater percentage germinated. It is as though life in some of them was flickering but faintly, and would have gone out altogether had not the electric stimulus fanned it into flame.

French men of science working at electroculture have been largely devoting their energies to trying to utilize the electricity of the atmosphere. If this could be done a practically unlimited source at nominal expense could be obtained. And their experiments show that the idea is feasible. For instance, by setting up a geomagnetifere—practically a lightning conductor—in the center of a field, and connecting it with a network of wires running through the soil of the field, an increase of 50 per cent was secured in a potato crop, while an even greater percentage of improvement showed in tomatoes, peas, and other plants experimented upon. In fact, we may conclude that on all counts electricity stimulates growth and development

in the plant world, and that electroculture has an undoubted future before it.

But electricity provides yet another means of jogging Nature's arm, though in this case it is not the direct action of the force, but its power as an illuminant, on which is based a second important and recent development in plant growing. As long ago as 1881 Sir W. Siemens experimented upon plants with electric light, but the light was costly, and the matter fell through for some years. But at the end of last century the question was taken up again in both America and France, and most interesting possibilities were disclosed. The American experiments simply arranged for a number of plants to be kept in cool glasshouses and the electric light to be turned on for some hours, brilliantly illuminating them when night fell, and thus shortening the time of darkness, but not abolishing it altogether. In neighboring cool glasshouses similar plants were grown under normal conditions of day and night. The result was that the plants with the longer period of light thrived better and developed earlier than the others. Lettuces, radishes, beet, and spinach all improved, but the lettuces in particular. A few plants, such as cauliflowers, like some people who cannot do with their hours of sleep curtailed, did not come up to the standard, but they were in a small minority. Violets, daisies, and other flowers bloomed more freely and better, though they, in common with other plants, are apt to feel the reaction and be more exhausted than the normal, just as a man feels additional fatigue after a spurt of hard work. Still, this eventual exhaustion of a plant is a matter of minor consideration to a florist if he can get his blooms earlier on the market, and larger and more richly colored into the bargain. And therein comes another peculiarity and virtue of the electric light stimulus; it leads to increased brilliancy of color both as to the green of the leaves and the hue of the flowers, and this discovery suggests another line of development in plant-growing which has yet to be worked out.

The French experimenters were not satisfied with treating the plants under consideration to a few hours of electric lighting. They went the whole length and left them no rest. Even the change to sunlight was denied them. Day and night unceasingly they were exposed to the full glare of the electric arc. In fact, one may compare the American treatment to the case of a man who takes alcohol occasionally in moderation, the French treatment to a man who uses alcohol as his sole nourishment, for the results are analogous. In the American method and the moderate man the stimulant is effective and not evil; in the French method and the intemperate man the outcome is stunting, disfigurement, and degradation. After some six months' continuous subjecting to the light, a common pea had a fat, twisted stem with tiny, undeveloped leaves, and other plants showed similar abortions. The green color was, however, emphasized. Everything was intensely green, thus carrying the heightening of hues a stage further from the brightness observed under the moderate electric light treatment. All this, too, is comparable to the brilliance of tints under an Arctic summer, when the days are very long and the nights are very short. And this possibility of a development of intensity of color is a line of research that might easily be taken up by many well-to-do amateurs who, in these days, have electrically lighted conservatories in their houses.

A third development in recent plant-growing is known as radioculture, and is curious and somewhat sensational. It consists in growing plants in differently colored glasshouses; that is to say, instead of the glass being clear white as is usual in greenhouses, in one case it is red, in another green, and in yet another it is blue, care being taken that in every case the color of the glass is absolutely pure. A series of experiments on these lines was first conducted by the eminent French astronomer, M. Camille Flammarion, and they proved very suggestive. He took a number of the seedlings of the Sensitive Plant (*Mimosa pudica*) (choosing this plant because of its peculiar sensitiveness), and divided them into four similar groups; one group he placed in an ordinary greenhouse, a second he placed in a blue house, a third in a green house, and a fourth in a red house. Then giving to each the same care and attention, and arranging that the intensity of the light should be the same in each case, he awaited eventualities. At the end of a few months he made an exact comparison between them, and found striking differences. In the blue house the little plants were practically just as he had put them in; they were alive and well, but they had not grown or produced new foliage or development in any way. Like the Sleeping Beauty in her castle they had seemingly fallen asleep on the day they went into blueness, and remained unchanged as in a trance. In the green glasshouse the seedlings had certainly shown considerable energy in growing, more so than their contemporaries in the ordinary glasshouse, but, on the other hand, their growth was not really satisfactory, for, though tall, they were inclined to be weedy and poor. But in the red house there were wonderful happenings. The seedlings had become positive giants, and well-nourished and well-developed ones, too. They were fifteen times as big as their sleeping fellows in the blue house, and four times as big as the normal control plants. Moreover, they had produced little round flower balls, which none of the others had even attempted; but, more remarkable still, their sensitiveness had increased to an amazing extent. It is well known that if the sensitive plant is shaken or touched all its leaves immediately fold up and their stalks droop, and it is only by degrees and slowly that it recovers from

* Fortnightly Review.