MAKING AN ELECTRIC LOCOMOTIVE ENGINEER OUT OF A STEAM LOCOMOTIVE ENGINEER

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The human side of a big project is frequently quite as interesting as the technical aspect, and appeals have been received from time to time for information as to what the railroad man thinks of electrification. The author's narrative of his varied experience in the instruction of steam road engineers gives abundant testimony that the steam engineers are uniformly pleased with the electric locomotives now operating on the C. M. & St. P. Rwy.—Editor.

One of the important features of railway electrification is that of dealing with the men who are to run the electric locomotives, or "motors" as practical usage has it. This feature is often not considered until actual operation is to be started, which condition is largely necessary because little effective electrical instruction can be undertaken with practical steam engineers until the machines are actually available for demonstration.

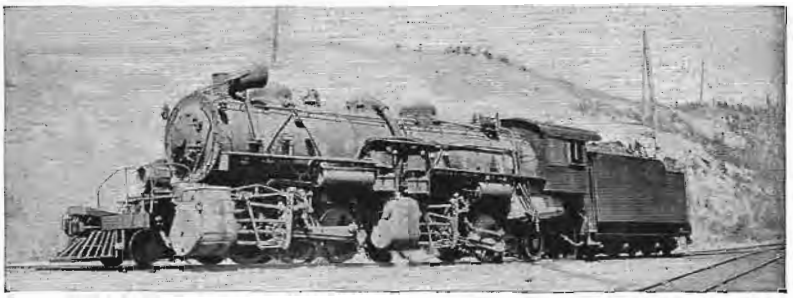
Scenic Profile of Electrified Portion of C. M. & St. P. Rwy.

Moreover, it is rare that any two railway electrifications will use machines which are in any way identical in practical details; and instruction books, wiring diagrams, and photographs which may have been made for a previous installation will not apply to the new equipment. It is rather difficult to write an efficient instruction book on a new type of machine working under untried conditions, and such a work while it could be generalized at the start would be much more applicable in its details if deferred until its author had acquired considerable practical experience with the actual operating conditions to be met.

Generally, the line work will first receive the close attention of the railway men and later the substations to a lesser degree. While these are being constructed the locomotive will be being built at the factory, so timed that the first few will just about be appearing in the field when power is ready to be put on the line. In the meantime the freight engine crews, through work-train line-construction service, will have become well acquainted with such details as come under their observation. They may also investigate the substations at occasional intervals when the opportunity presents itself; and by talking with the construction and line men they may gain the idea that electricity is some mysterious agent which will take them a lifetime to understand, and whose handling will require a deep technical knowledge of wire splicing, insulation, magnetic actions, and high-sounding terms. Up to this stage, the passenger crews will possibly be slower in acquiring such more or less confusing "knowledge." Their observations are more likely to be limited to the increasing difficulty of getting over the road with so many work trains out on the line and to the attendant increase in the number of train orders to be observed. There is also the possibility that a

new block-signal system may have to be installed and that the pole line for the trolley will obscure the vision from many order boards and signal posts, thus adding to their difficulties.

During this stage of the work, there will probably be many round-house and switch-shanty discussions pro and con about the prospective change, and various theories put forth as to what it means to the men themselves. Such discussions are quite likely to be founded largely on hearsay gained from some "boomer shack" or brakeman who has worked on many roads; and the men successful in electric operation will later look back on these ideas with amusement and wonder how they ever came to be entertained at all.

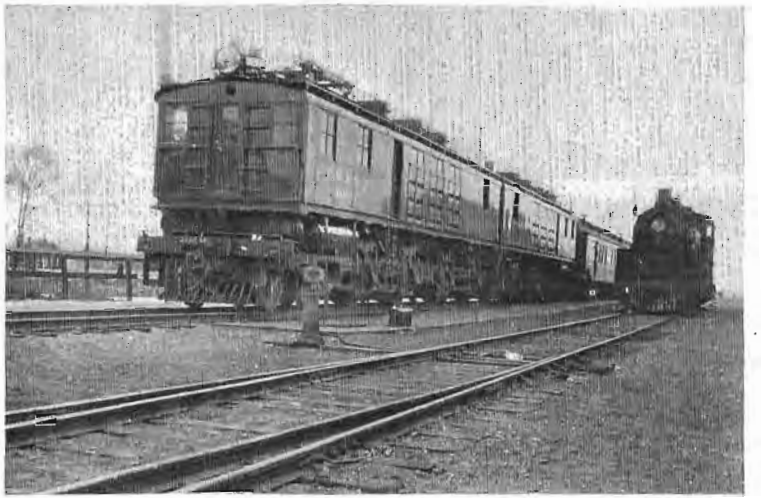


Mallet type of steam locomotive replaced by electric locomotives on the electrified zone of the C., M. & St. P. Rwy.

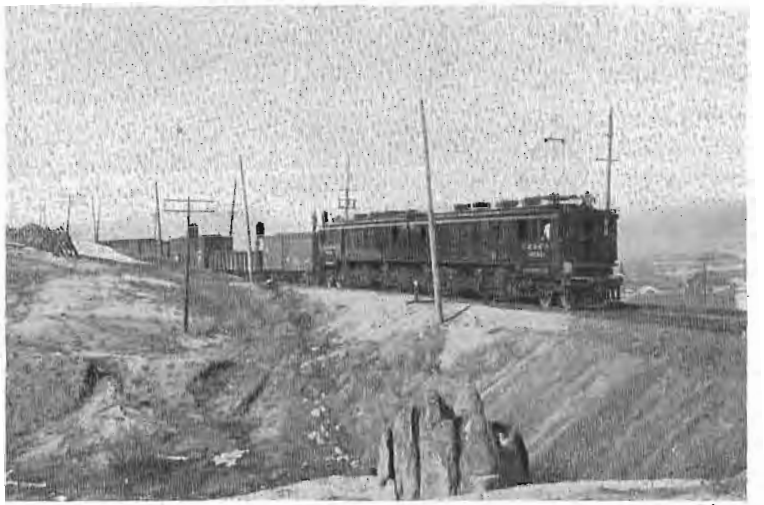
Among the rumors which always get out on a new electrification is the one that the manufacturing company will have to furnish electrical engineers to run the motors and that the steam-locomotive men will all likely lose their jobs. This substitution would be manifestly impossible for many reasons, especially on an undertaking of considerable size requiring some 200 men and it would have no precedent anywhere in the past. An electrical engineer would have some little study to become familiar with a new electric locomotive and would require an extraordinary amount of experience in train rules and operation and air brake handling. These latter features, which are more important than any others, have for years been a part of the steam engineer's experience; consequently he will be more efficient with a few days' training on an electric locomotive than any purely electrical man would be in months.

Freight train without helper on two per cent grade at Donald (Continental Divide)

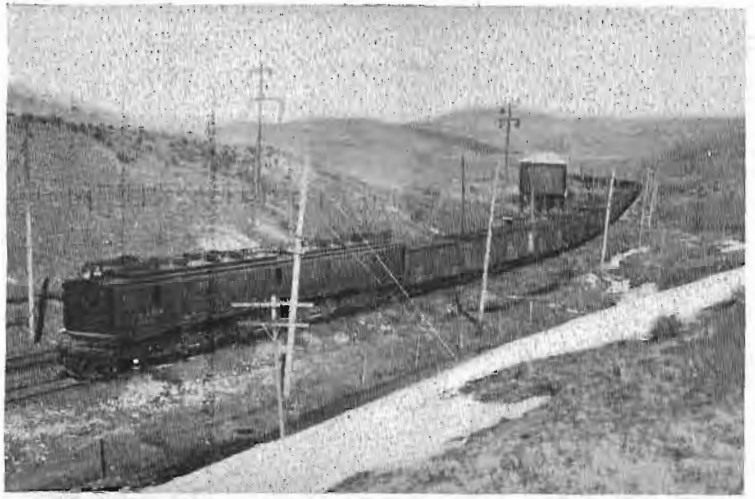
Another subject for discussion among the railroad men is the fact that the new motive power will haul so much greater tonnage per unit that the men well down on the engineers' seniority list will have to go back to firing, the decrease in the number of locomotives running requiring fewer engineers. This objection, while having some grounds, does not work out in practice to the full extent that the arithmetical figures on possible tonnage per train would indicate. Even on a large electrification, there will always be "caboose-hops" where a locomotive will have to run light from one terminal to another as occasioned by the direction of the main freight traffic, work trains, and light local traffic, usually steam. Moreover, on roads where the basis of pay is made on the tonnage rating of the motive power used, the men "firing" the heavy motors will possibly average more per month wages than when running the lighter steam engines; and the more satisfactory working conditions on the electric make up for the slight difference in wages for the heavy work involved in handling steam locomotives of the Mallet type.



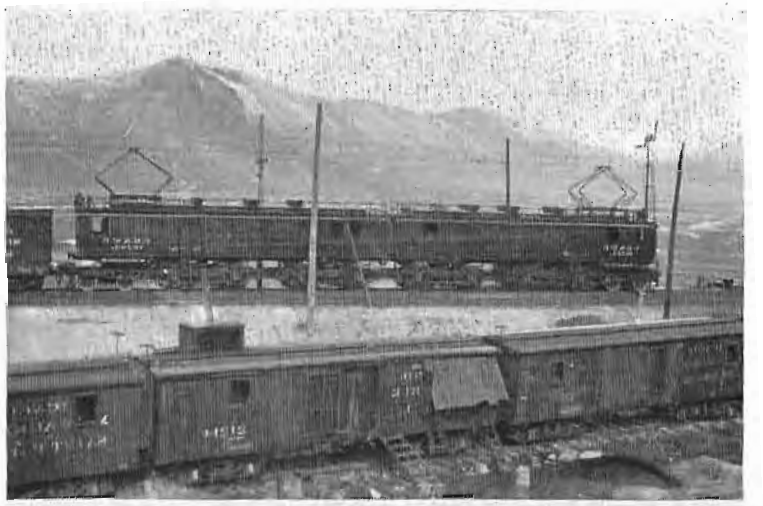
Changing motive power on passenger train on entering electrified section



Freight train ascending 1.6 per cent grade east of Butte



Freight train ascending Belt Mts. east of Summit



Regenerative braking down west slope of Rocky Mts.

The old steam railway men who run a motor will not consent gracefully to being called "motormen"—this sounds too much like street-car work; and the old steam firemen will not generally be termed "helpers" or "assistant engineers" even though perhaps they would not object to these terms. As an old "electrified" passenger engineer says, "The fire-boy fires the train-heating boilers and is not much help or assistance anyway. You electrical men are going too far with these 'helper' and 'assistant' names when applied to ordinary tallow-pot smoke-makers."

"Electrified" steam locomotive engineer

Electrical instructor

However, as soon as the electric locomotives are in operation all objection by the *engine* crews to heavy trains ceases, there being no difference in their work whether they have forty or one hundred cars in a train; but this objection is taken up by the *train* crews with increased vigor. The "car-captain's" or freight conductor's car records, termed "hard" or "soft" lists, get as large as a dictionary, and the work of setting out cars at stations and the mile walks from the rear to the head-end of the train total quite a little at the end of a day's work. To lessen such difficulties, various expedients are often lightly suggested, such as sky-rockets and smoke bombs to signal from the caboose or "crummie" to the engineer; a telephone system along the train with a portable attachment which can be plugged in on any car; a smooth run-way on top of the cars so that roller skates can be used by the train-men; and a smooth foot-path along the sides of the track so that at any stop the men could ride bicycles when making car inspections and in carrying train-orders up to the engineer.

Under steam operation methods where the locomotives may be changed every division of 110 miles, it is also customary to change the caboose as well. For this reason every freight conductor will have his own "private car," homely it is true but his very own, and will have it fitted up with the necessary culinary utensils and sleeping equipment according to his bachelor ideas. In fact, some of them get so that even when at home terminals they would rather be aboard the old "crummie" than at home tending to the garden or helping out in domestic roles.

But when the motors take hold of a train, they stay with it for at least two divisions and

the respective crews make a "main-line change" at the intermediate division point. The train is not broken up and the caboose goes straight through; all the paraphernalia of the one crew being thrown off and that of its successor being put aboard. The running time over the old divisions may be shortened from twelve to eight hours, and so, everything considered, even the train crews may look favorably on the motors. Among the best boosters for electric operation may be found railroad men's wives, who somehow find their husbands' home time about doubled.

Many of the train operating men are skeptical about their chances of escape in case of a wreck when the trolley wire may get down on the ground or cars and electrocute the whole personel thereon, leaving the train to run wild. This condition looks easily impossible to the electrical engineer, but it is not easy to explain away from the minds of men who have never had any experience with electricity. From this standpoint alone, the old operatives are preferable to men who have had a little experience with low-voltage circuits, just enough to be fool-hardy with higher voltage. The steam men know nothing about "juice," they admit it and are ready to go to extreme precautions before undertaking the handling of any electric apparatus whether energized or not.

It is significant that in a recent large electrification only a few serious accidents have occurred and that none of these have happened to the men operating the trains; the very men, in fact, who had never handled electric energy before and who perhaps have the major part of this work to do in actual operation. Pantographs have been wrecked and tangled in the overhead work, steam locomotives have caught and torn down the wire, snow slides have taken out long stretches of pole-line, and, in rare instances, the wire has broken and dragged on the roofs of the steel passenger cars, yet with all these troubles nothing more than a slight scare of the witnesses has occurred.

In one instance at the beginning of electric operation, when the passenger trains were still equipped with steam locomotives, a broken wire on a severe curve hung down and struck the train, throwing out fire at every contact. The engineer, following a life-time practice for all kinds of accidents, immediately stopped the train. The dining car came to rest under the broken place and amid the sputtering and flashing it is said that one of the colored waiters knelt down between the tables and prayed, "Oh, Lawd, make this coon a better niggah." However, no great damage was done and the engineer learned a new feature in electric operation for future practice, i.e., if a stop cannot be made before reaching wire trouble, to keep on running through until entirely clear of it.

In fact, it was a little difficult for the engineers to realize just how important the trolley wire and pantographs were, until they had an accident or two involving these equipments. In the early stage of their learning, they were intent on the operation of the locomotive only, and if they were headed by a careless switchman into a track which had no trolley wire, it was ten chances to one that they would take the signal and back right into it only to discover that they had a dead motor and couldn't get back to the wire again or the pantograph had been caught and smashed against the overhead span wires. However, with a little experience of this kind it soon became second nature for the men to watch the trolley wire almost as much as the track. This, on electrified roads, will evidently require a slight change in the rendition of that old "Casey Jones" song wherein the "hog-eye" engineer is supposed "to keep his hand on the throttle and his eye on the track," to include the trolley work as well.

At present on this electrification, wire and pantograph trouble is almost eliminated excepting that which comes from shifting or settling track or change in the outer rail elevation on curves. The men have been instructed never to go on top of the locomotives or to open any covers over electrical apparatus in the locomotive with either of the pantograph current collectors up against the wire. Each locomotive is equipped with a long pole hook and dry rope which can be used to pull a pantograph out of a wire entanglement, and in rarely bad cases the power is cut off at the substations by request from a portable set attached to the despatcher's telephone circuit and the line grounded at the motor. Since there are two pantographs on each machine, it is comparatively easy to disconnect one which is damaged and to use the other one in operation. The trouble from this cause rarely occasions a delay of more than thirty minutes.

Another viewpoint, from the human comfort side, was that before the electric locomotives were put in operation and for some time afterward the men operating them thought they were extremely cold affairs in winter time. This was perfectly natural for

men who had been accustomed to work with their knees up against a hot boiler head and with leaking steam all around. This complaint was easily overcome by placing a small electric heater in front of the engineer's operating position, and with the much drier working conditions many old chronic cases of rheumatism and winter sickness among the men have disappeared with consequent fewer lay-offs and winter vacation trips to warmer climates.

With this type of motor the engineer is located at the "front of things" and many of the men at first wondered what would be left of them in case of a head-on collision. For quite a while, one of them in pusher service persisted in using the rear-end operating cab for fear that the cars up ahead might smash through the head end of his motor. Several accidents, which with steam engines the men admit their chances would have been slim, have demonstrated that the electric locomotive cab construction and arrangement takes very good care of them in such emergencies. The unobstructed front view not only gives the men a chance for earlier warning and more time to apply air brakes at the prospect of a coming collision and so minimize its effect, but also they can take steps "to unload" themselves and get out of danger. There have been cases where these machines have run into landslides and rolled down embankments not injuring the men at all. The pantograph in such cases immediately leaves the wire and the machine is electrically dead. There are no steam pipes to burst, red-hot fire boxes with gas and smoke to overwhelm the men caught in the cab, nor tender with flying coal to crash up into the cab. With a steam engine, as one old timer said, "It's not the first smash I'm afraid of so much as the hell let loose afterward, especially if I get caught in the cab and can't get out."

The operating men on this electrification regard the whole arrangement as a success. The shorter working hours, the cleanliness of the surroundings at work, little on the locomotive requiring close attention, less danger involved, no anxiety as to whether they have enough coal or water to reach the next supply, increase in pay and confidence in the equipment through a thorough knowledge of its operating details, etc., has won many friends to the electric locomotives from the men who use them and who, it is admissible, could make or break the success of any type of motive power.

From this viewpoint, that the ultimate success of electric operation finally depended on the men themselves, the railway officials were especially lenient with them for all electrical detentions and every effort was made to give the best opportunity for becoming familiar with the motors at the start. The men were in turn very receptive of all instructions given them and were able to remember and willing to observe such instructions with very little repetition.

The first division was put under electric operation as soon as several motors arrived from the factory. Men were sent out by the manufacturer as instructors to ride with each and every new engineer when his turn came to go out on a motor until he should be sufficiently qualified to operate alone. These factory men were variously termed "experts," "instructors," "inspectors," and in some cases "slickers" by the facetious. They were called out by the regular call-boy who summoned the train crews to duty, and many an hour's "terminal-delay," which gives double-pay to the crew called if the train does not pull out of the terminal within an hour after it is supposed to, was occasioned by the call-boy who often forgot that a motor crew consisted of three men instead of the usual engineer and fireman. Lists of men who were "qualified" by the instructors were posted in all conspicuous places, and there was some friendly banter coming to the men who were a trifle slower than the average in "getting hep" to the new machines. It cannot be said that the younger men were exclusively able to qualify quicker than the older ones but such was generally true. However, from an instructor's point of view, when one of the older men did express his confidence in himself and showed sufficient progression, there was no need to worry about him later, while the boys who had lately been "set-up" from firing were likely enough to call for help over the dispatcher's telephone when out in the middle of their run. It always gave the older men a great deal of satisfaction to be able to help them out of some such minor difficulty if they met on the road.

Since the airbrakes were practically identical to those used in steam practice, this feature tended toward greater confidence in the engineer who almost invariably said to the instructor on the first run, "Well, you may have to start her up but I know how to stop if necessary."

One young engineer after successfully hauling a long train up to the summit of the

worst grade on the road, said to the instructor, "Here, *you* take her down the grade. I've only been running as engineer for a short time and have never been down here before even on a steam engine." Here was something of a quandary. The instructor had never been down the grade but a few times himself and then had not handled a train and was in nowise anxious to figure in a runaway. But considering the great confidence given the factory men at the start by the Railway, it was imperative that something should be done to warrant it for the future. The train was safely brought down the hill, regenerative braking making it easy. Here, in the engineer's charge, the train was "made-up" to ninety cars with a dead mallet locomotive on the rear end. This was an ideal train for even an expert to handle and the engineer proved his right to be "set-up" by pulling into the terminal without a mishap. The next week he was qualified for running a motor.

On the succeeding three divisions, instruction work was much easier. The men would talk over the new machines among themselves and their various experiences with each particular feature, so that much instruction work could be briefly passed over. The Railway Company placed a caboose at the instructor's disposal at terminals for an instruction car, and the men after being out on the road were very willing to drop in for a few minutes to talk and become acquainted with the motor blue-print wiring diagrams and learn just what operation details were necessarily required. Later, instruction books were prepared and distributed to each engineer for home study, and to their credit it may be said that the books proved to be a valuable aid to the instructors who it seemed at first had tackled an endless job. By these means, the period of actual road instruction per man was cut down from one to two weeks to a maximum of five days and in many cases to only two days. In each case, however, as work on a new division was about to be started, the men who had already qualified in electric operation would honestly offer the assurance that the men on the next section would "take a year's time to learn anything. We all had to go over there and show them how to use the oil-burners"—or mallets, or some other new motivepower innovation that the Railway Company had installed in times past. This friendly rivalry between the divisions always inspired the newer men to extra effort. In fact, on the last division to be put under electric operation, it was not uncommon for the instructor who was called to go out on a run with a new man to find him already coupled up to the train, the air tested and merely waiting for orders to go.

Passenger engine crews were given more work in learning than the freight men since on through-runs there was little opportunity to show up the "fine" points to be learned. These men usually had a half-day off every other day and came to the round-house where an instructor would purposely remove fuses on a spare locomotive, put match stems in the relays, and cause a multitude of troubles for the engineers to locate and remedy. Due credit must be given to the Railway Company's regular travelling engineers who took hold of this line of electrical instruction and becoming proficient themselves, were able to offer valuable assistance in getting their brotherhood into the game at an early date.

Here, as in all lines where teachers deal with some new phase of instruction, they often learned more than those they were supposed to teach. The different methods used by the men in handling long trains and short cuts in switching, hand and lantern "short-hand" signalling, and many other practical details, all of which are slightly different in railway practice than as taught in the rule books, were of educational value.

The technical terms used by the electrical engineer for apparatus and electrical quantities are readily taken up by steam man where they are not confusing or where one term for the same thing is strictly adhered to. It is easy to explain the difference between kilowatts and kilowatt-hours to the beginner, but the various indefinite distinctions *drawn* by technical men between potential, tension and voltage—for example, when referring to electric pressure—are not readily received by operating men who are told that such pressure is measured in *volts*, and who, therefore, are prone to conclude that the proper term should be "voltage" and that exclusively. While water and air pipe analogies are useful in explaining direct-current actions, they fail on practical hearers when alternating current is dealt with. Steam, water, and air valves when *open* permit the flow of current while electric switches and contactors permit the flow of current when *closed;* so the old steam man must be excused sometimes if he wonders what a set of instructions or wiring diagrams mean if these terms are used indiscriminately or if they sometimes allude to contactors as *switches* or relays as *regulators* depending on

the purpose for which they are utilized. He can only judge from the external appearances when beginning, and if such a piece of apparatus on the electric locomotive is called one thing in one location and a similar affair is called something entirely different when in another location, it can only mean an extended length of time before the steam locomotive engineer can become qualified for electric locomotive operation.

A CASE OF SEVERE THIRD DEGREE BURNS TREATED WITH AMBRINE

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The new and radical treatment described in this article has to date been practiced principally upon the horribly severe burns received in modern warfare. The reports that have been made of its wonderful healing properties induce us to recommend that the medical profession consider its possibilities in treating electrical burns. In the article Dr. McMullen describes the technique of the treatment and reports the progress of healing in a particular case. The appendix very interestingly summarizes the literature on the paraffin treatment of burns.—Editor.

The letters by Miss Edith May, published in the *Outlook*, August 2, 1916, excited a somewhat skeptical interest in the use of ambrine as practiced by Dr. Berthe de Sandford at Issy-les-Moulineaux in France. The caustic editorial of Dr. Simmons in the Journal of the A. M. A., August 12th, still further confirmed my skepticism. In February, 1917, at the Meeting of the Third Conference of Physicians, Department of Labor and Industry at Harrisburg, Pa., after hearing Dr. Sherman's paper on the Carrell Dakin technique, in the discussion of which paper Dr. Sherman made some very commendatory remarks about the ambrine treatment, my real interest in the subject was aroused. The atomizer and apparatus necessary to carry out the technique were purchased at Philadelphia, and a supply of ambrine was secured through the efforts of Mr. A. L. Rohrer of the General Electric Company.

I had under treatment, at this time, a patient who had been very extensively burned about the face and hands by a hydrogen gas explosion, and more deeply burned about both thighs and legs from the ignition of his clothing. He had been under treatment since February 5, 1917. The burned tissues of the legs were sloughing and he was having considerable constitutional disturbances as the result of absorption. Large boric packs were used until the sloughs had separated, which took place on the 21st, sixteen days after the burn was received.

At this time the use of ambrine was begun. The patient was somewhat skeptical about "experiments," and hesitated about having us use the new treatment. After the first application of ambrine, he was fully converted, and the comfort experienced while wearing the dressing and the absence of suffering while the dressing was being changed was exceedingly gratifying to both patient and myself.

I expected of course that several operations of skin grafting would be necessary in order to cover such extensive surfaces. The very remarkable advance of epithelium and the small autografts developing from time to time, which also developed with the same rapidity, obviated the necessity of grafting. The daily dressings were continued until May 30th, when the patient was discharged from the hospital. The extent of the burns, the progress of the case, and the manner of healing are shown by the accompanying illustrations. Ambrine or similar paraffin dressings are infintely superior, as regards the comfort of the patient, to any method of treating burns known to the writer.

Its remarkable efficacy as regards rapidity of growth of newly formed epithelium is, I believe, due to the fact that this dressing does not in any way interfere with the delicate layer of advancing epithelium.

The granulations never become exuberant; therefore it is never necessary to use escharotics to destroy them.

The period of convalescence is shortened one-third to one-half, and the scar tissue is unusually soft and pliable and, as yet, this case has shown no tendency to contractures.

Regarding the technique, the first coat of ambrine is best applied with an atomizer, even a soft camel's hair brush is somewhat painful. An atomizer with a hand bulb is not satisfactory, however. An electric com-