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GORDON'S DYNAMO ELECTRIC MACHINE.

The first steam locomotives were crude machines compared with those which were constructed in the course of a few years after their first introduction. Just so, no doubt, will be the case with dynamo machines. The first dynamos were little more than models, and we are only now beginning to realize the fact that it is more economical to construct a dynamo which will absorb 100 horse power than it is to construct one to absorb a single horse power. Then, again, new uses require new designs. The design of a pumping engine differs from that of an express locomotive; so the design of a dynamo to supply the electric current for a large number of incandescent lamps differs considerably from that designed to supply a large number of arc lamps. A few years ago the success of incandescent systems was scouted by many and doubted by others. Time has proved that their fears were groundless, and that incandescent lighting is not only an actual fact, but it is the system toward which almost all eyes and efforts are directed as the great work of the immediate future. Directly incandescent lighting became practical and no longer merely an incident of the laboratory, attention began to be directed to its introduction upon a large scale. Gas was already in possession of the field, and usually changes are not made unless the evidence of gain is very strong. There is, however, a stronger incentive to gain than mere economy, and that is fashion.

The electric light seems to have become fashionable, and this in addition to its inherent merits as a light. It is said to be, when used on a large scale, as economical as gas and as much under control. This being the case, it was to be expected that machines would be designed to supply the current on a large scale. Under the usual conditions, arc lamps have hitherto been arranged in series, that is, one after the other upon the wire joining the two terminals of the machine. Now, as each lamp opposes the current with a certain resistance, the adding of lamps in series increases the resistance in proportion to the number of lamps. If the resistance of one lamp is represented by x, the resistance of the lamps in series is represented by $n\,x$. A certain electromotive force is required to overcome the resistance, x; but n times that electromotive force is required to overcome the resistance, $n\,x$, the current being constant, and, of course, the more constant the current the better for the lights. Putting this into the familiar symbols of Ohm's law, $C = \frac{E}{R}$, we know at once that to retain C constant when R becomes n R, we must make the numerator n E.

The feature of machines required to supply the current to a number of arc lamps in series is high electromotive force. To a certain extent quite an opposite condition holds when a large number of incandescent lights are under consideration. These lamps are generally arranged in multiple arc, or each lamp provides a path for the current from terminal to terminal; or say two large main wires are taken from the two terminals of the machine, the lamps are strung between these two wires. In the case of the arc lamps, with one lamp we require, say, a current of 20 Ampères; the machine is not asked to supply more current, though 100 lamps are in the circuit. It still sends 20 Ampères through the circuit. But taking one incandescent lamp as requiring 1 Ampère, by the arrangement adopted 100 such lamps require 100 Ampères—that is, 1 Ampère through each branch wire and lamp. Hence the machine has to provide quantity in one case and electromotive force in the other. In the latter case, E, represented in the formula $C = \frac{E}{R}$, is constant, and C is increased by diminishing R.

From these remarks it will be seen that a large amount of knowledge, talent, and ingenuity may be brought into play in designing dynamos for different purposes. Besides, however, the electrical matters to be considered in such designs, there remain the purely mechanical details, such as the proportion of parts, the strains, etc., to be brought into play, and these present some curious problems when taken in connection with the electrical requirements.

The latest and most important development of the dynamo electrical machine we illustrate this week. It is the invention of Mr. J. E. H. Gordon, and has been constructed from his designs—in the preparation of which he was aided as to details by Mr. Clifford and Mr. Lucas—by the Telegraph Construction and Maintenance Company at its works at Greenwich. Before proceeding to describe the machine more minutely, it will be well to explain the principle on which it acts in general terms. The central armature is an iron disk, on which are arranged a series of wire coils, the wire being coiled in the same plane as the disk. The wires are united in a ring on the central axis, against which ring bears a gun-metal contact lever, into which is sent a current of electricity from two Burgin machines which act as exciters. The armature revolves between the two sides of a frame of cast-iron, which carries a number of electro-magnets; that is to say, of cores covered with insulated wire. From these the currents developed in them are led off to the lamps. Thus it will be seen that the field magnets are attached to the armature, and move, while the equivalents of the armature coils are at rest. There is no commutator, the machine being of the alternating current type.

This machine can, with sufficient power, light 6,000 Swan lamps, but this is not at present available, the engines used to drive it being a pair with horizontal cylinders, 20 inches stroke, and 16 inches diameter, making about 140 revolutions per minute. They were used for some time on board the Calabria for picking up cables. On Wednesday night about 1,300 Swan lamps of over 20-candle power were in use, lighting up every department of the large works. It will give some idea of the dimensions of the system if we state that there are about 8 miles of wire leads in use.

This is not the first machine made by Mr. Gordon. Mr. Gordon's present machine is an improvement upon an earlier

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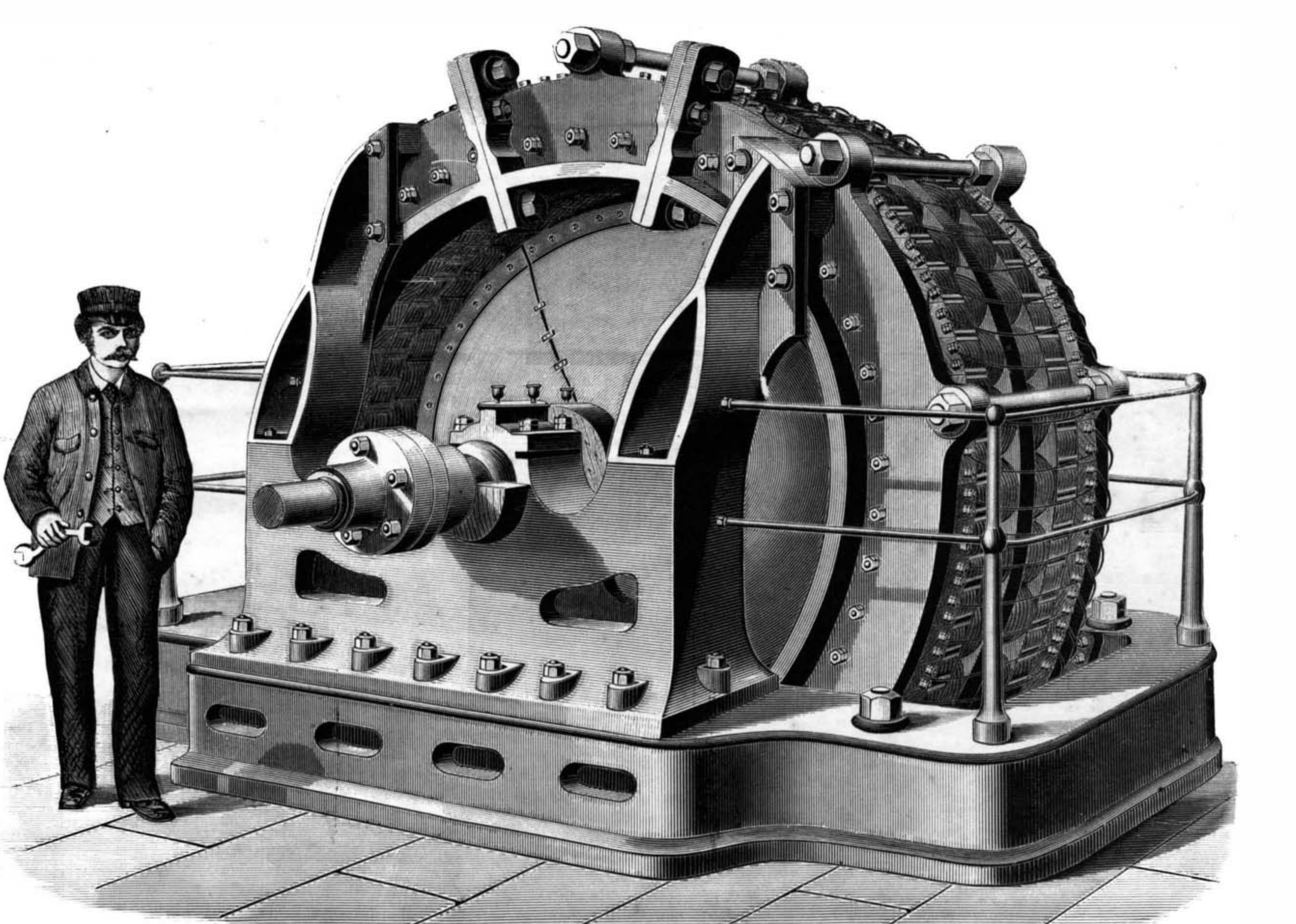

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(*Continued from page* 1.)

one. In the former machine the revolving rings each carried the same number of magnet coils as the fixed rings carried armature coils, and it was found that an injurious inductive action militated against the efficiency of the machine. If a certain number of lamps were maintained by one coil, and the circuit of the next coil was then closed, there was a reduction of light in the lamps of the first circuit by some 20 or 30 per cent. The cause of this was in the current circulating in opposite directions in the contiguous coils. In the present machine the armature coils are twice the number of the magnet coils, hence the magnets act on alternate coils. For example, at the instant when the 32 magnets are acting with their maximum effect on the alternate coils 1, 3, 5 . . . 63, the other alternate coils, 2, 4, 6 . . . 64, are practically idle, and although the coils 1, 3, 5, etc., do not act upon each other, it is with far less effect in there being comparatively a long distance between them, so that the effect is inappreciable. Our illustration of the general view of the machine, as seen at Greenwhich, will give a better idea of the machine than mere description. Its total weight is about 18 tons. The weight of the revolving magnet wheel is 7 tons The space occupied by the bed-plate is 13 feet 4 inches by 7 feet, while the diameter of the magnet wheel is 8 feet 9 inches. With 1,300 Swan lamps in two circuits, the 128 coils are arranged 4 in series and 32 in quantity. The number of revolutions is 140 per minute, which gives a velocity of a little over 60 feet per second to any point in the revolving wheel. The revolving magnet coils are magnetized, as we have said, by the current from two Burgin machines—one would in reality suffice—conveyed in the usual way by brushes making contact with rings. The rings are usually of phosphor bronze, and are separated from the iron collars by an insulator. The current in the magnets is 19 Ampères, with an electromotive force of 88 volts. The current in each armature wire is 27·5 Ampères. Each coil is wound with wire 0·185 inch in diameter, its cross section is 0 0269 square inch, and the total cross section of the 128 coils of wire in quantity is $0·0269 \times 128 = 3·44$ square inches.

The coils may be coupled up in almost any way desired. For example, if the full 5,000 lamps were placed on this machine, the 128 coils would be all coupled together for quantity. The number of revolutions would be raised to 200, with a current of 48 Ampères in the magnet's coils, giving the same electromotive force as before, and the same current—24·25 Ampères—in the armature wire. The armature wire will take a current of 40 Ampères easily. The core of the coil is of wedge shape, and made of a piece of boiler-plate bent upon itself, so that the angle forms the thin end of the wedge, and the free edges, which do not quite meet, form the thick end. A wedge-shaped head of a T-piece is inserted into one end of the folded plate and welded to it; the stem of the T being turned and screwed is passed through a hole in the fixed ring, and secured by nuts. A German silver flange is riveted on a shoulder cut on the end of the core. This flange has cut into it slots as nearly as possible in a direction at right angles to the currents which may be induced in it. The connection of the outer ends of the cores of the coils is made by prolonging the cores outward from the magnet coil, and securing them to a fixed iron ring-shaped plate, which forms their support.

In order that power may not be wasted in inducing currents in this plate, it is set back some distance, the cores being correspondingly prolonged. The space between the wire of the coils and the iron plate may be filled up with wooden plates or blocks, which form the second flange of the coil. The thickness is such that the algebraic sum of the magnetic potentials, induced by the magnetic poles at any point of the fixed iron ring, is as nearly as possible zero. The wheel consists of two central disks, and of two cones whose bases fit upon the central disks, and through whose apices the main shaft passes. The disks and cones are made of segmental pieces of boiler plate, so cut that the grain of the plate is radial to the wheel at the center of each segment. The segments are riveted together with butt strips in the way usual in boiler making. The disks are kept apart at the center by a cast iron distance piece. At the rim they are kept apart by a wrought-iron ring. The cones are of less diameter than the disks, so as to leave a space of flat disk all around exterior to the cones. The cones and disk are separated at the center by massive cast-iron bosses, turned square to the shaft where they butt against the disk, and conical where they butt against the cones.

The flat outer portion of the wheel receives the magnet cores, which are 32 in number. Each magnet consists of a cylindrical iron core, of two bobbins of brass or other metal other than iron, containing wire, and of two pole pieces. The core passes right through a hole in the disks and wrought iron ring, and is fixed so as to project equally on both sides. The brass bobbins are then slipped on, one at each side of the disk, and the pole plates being fixed on hold the bobbins in their places. The pole plates are of iron, preferably wrought; their sides are not parallel, but form radii of the magnet wheel.—*The Engineer.*

Longest Line of Railway Under One Management.

The New Orleans extension of the Southern Pacific Railroad is nearly ready for business. When it is completed, the Southern Pacific will have a road from tide water at San Francisco to the Gulf of Mexico, twenty-five hundred miles, the longest continuous line of railway under one management.

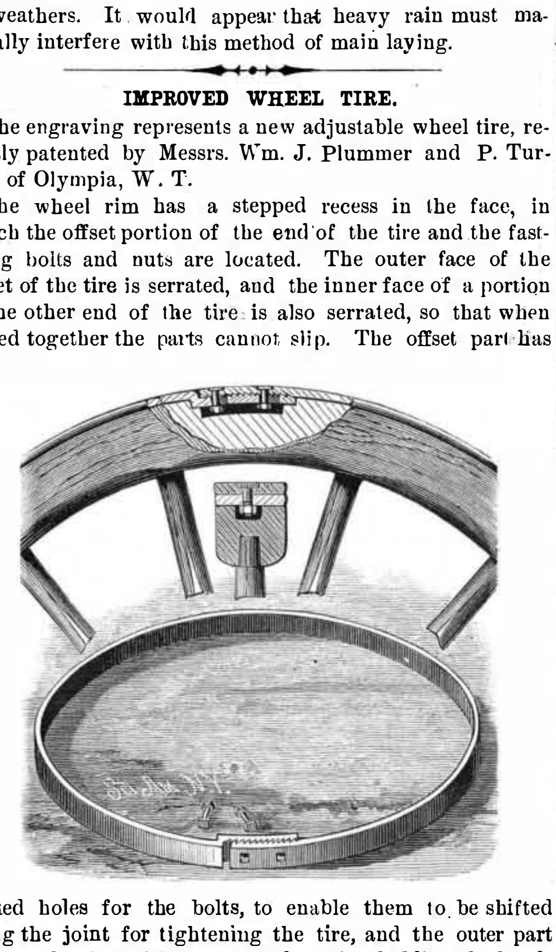
Sheet Iron Gas Mains.

During the past few months the Paris Gas Company have been engaged in reorganizing a portion of their distributing plant for the purpose of connecting the trunk mains in the principal central streets with their new station at Clichy-la-Garenne. All the main thoroughfares of the city have been affected in this operation. From the Place de l'Opera to the Courcelles gate, and thence along the national road to the works, the new main is one meter in diameter, and is made of bitumenized sheet iron. The pipes are laid in a bed of hot bitumen mixed with fine gravel—a pitch concrete, in short. This composition is said to acquire very great consistency and strength in cooling, and to protect the sheet iron so well that it does not at all deteriorate or oxidize, even in a soil saturated with damp. The pipes in the streets are placed underneath the pavement. It is worthy of notice how Continental gas engineers appear quite converted from cast to wrought iron mains, even to the size mentioned in the present example. With regard to the protective qualities of the bitumen, on which so much reliance is necessarily placed, it is not stated whether the work is carried on in all weathers. It would appear that heavy rain must materially interfere with this method of main laying.

IMPROVED WHEEL TIRE.

The engraving represents a new adjustable wheel tire, recently patented by Messrs. Wm. J. Plummer and P. Turpin, of Olympia, W. T.

The wheel rim has a stepped recess in the face, in which the offset portion of the end of the tire and the fastening bolts and nuts are located. The outer face of the offset of the tire is serrated, and the inner face of a portion of the other end of the tire is also serrated, so that when bolted together the parts cannot slip. The offset part has



slotted holes for the bolts, to enable them to be shifted along the joint for tightening the tire, and the outer part has round holes with square sockets for holding the heads of the bolts when screwing up the nuts.

To apply the tire to the wheel, it is first adjusted to the size of the wheel when tightened thereon, and bolted together. Then it is to be heated and shrunk on, in the same manner as other tires are. Afterward, when the wheel shrinks, the tire can be shortened and reapplied, as before, without the aid of a blacksmith.

Fig. 1 shows the tire; Fig. 2, a section of the wheel rim; and Fig. 3, a transverse section of the tire joint.

Drainage and Ventilation of Houses.

At a recent meeting of the Society of Medical Officers of Health, London, a paper was read by Mr. Rogers Field, M.I.C.E., on "Certain Less Recognized, but Highly Important, Points in the Drainage and Ventilation of Houses," of which the following is an abstract:

Three sanitary principles govern house drainage. These are:

1st. All refuse matter must be completely and rapidly removed from the house.

2d. There must never be any passage of air from the drains or waste pipes into the house.

3d. There must be no connection between the drains and the domestic water supply.

These, although so simple, are very frequently neglected. The first goes absolutely to the root of sanitation; for were it strictly complied with, there would be no leaky drains, no polluted subsoil, and no production of foul gases in the drains from decomposing organic matter. There cannot be a greater mistake than to assume, as is commonly done in investigating drainage, that if water runs away with freedom this is all that is required. Numerous cases are on record where the sewage from houses has apparently run away freely for years, but where the greater portion of it has really been leaking out of the drains into the ground under or close to the house. In illustration of this point, the author quoted two cases in his own practice: one in which the connection with the sewer was actually found to be blocked with shavings, which had been left in when the house was built three years before; the other that of a school in which the drainage from the lavatories had leaked through disused drains under the floor of a large portion of the building, and where, although there was a mass of filth in some places seven feet deep, no leakage had been suspected. If the drains are exposed, and found clean and jointed with cement, this is not sufficient; the tops of the joints may be good and the bottoms bad. The only safe method is to actually test the drains by plugging them at the lower end and filling them with water. Very few house drains, indeed, stand this test.

Even if the drains are outside the house, it is a mistake to assume that it is unimportant whether they are sound, for not only may sewage leak out of faulty joints and percolate under the house, but foul air may be drawn into the house. It is important to realize how small an amount of deposit will create mischief by decomposing and generating foul gases; a mere irregularity of the joints, even when the drain has a good fall, is sufficient to cause this. There is no better test of the condition of the drains than the amount of smell emitted from a ventilating opening, for, if drains be properly laid, and in thorough working order, practically no smell should exist. Examples were given. Faulty forms of traps and water closet apparatus were strongly condemned by the author, and diagrams descriptive of good and bad closets were exhibited.

The principle that there should never be any passage of air from the drains or waste pipes into the house was then considered, and the means of isolating the house drains from the public sewer, the necessity of keeping the drains outside the house, their ventilation, as well as that of the soil-pipes, the position of the water closets, the disconnection of the sanitary fittings inside the house from the drains, were referred to. It was insisted that the danger should be guarded against of trusting too much to those parts of the drainage of a house which are visible, as an index of the condition of other and important parts which are concealed; and an instance was mentioned of a house the drainage of which had been recently reconstructed, and where all the sanitary arrangements appeared at first sight to be perfect, but where a subsequent examination of the drains which were under the house showed that the joints were in many places defective, and at one point the pipes were not jointed at all, but a space left large enough to put a hand in, though it was stated that special care had been taken to make the drains water-tight. Old drains, which had no outlet connected with gullies, were found beneath the passages and rooms; the housemaid nearly died of typhoid fever, and beneath the room she occupied was found an old drain, with a large amount of foul deposit. A long list of other defects was described, leading to the conclusion that the drainage, instead of being very good, was really so radically defective throughout, that it was necessary to reconstruct the whole of it.

Another instance was given in which a lady and her cook were attacked with erysipelas and blood poisoning shortly after occupying a house. Various alterations were made in the drainage in the absence of the family, but, on their return, the lady was again attacked with erysipelas, and shortly after other members of the household. Again alterations were made, and again the lady was attacked with erysipelas, and the housemaid with typhoid fever. An examination of the house by the author showed that an old stoneware drain in the scullery, into which the sink formerly discharged before it was disconnected, had not been removed, and though stopped with cement, the stopping was imperfect, thus allowing the air of the drain to enter the house. The author next considered the various ways in which foul air from faulty drainage inside the house passes to different parts, and pointed out the opportunities which were given for the passage of air from one part of a house to another, depending chiefly upon windows and fires, the latter, of course, mainly acting by drawing air through passages, staircases, and doors. But other channels must also be borne in mind, and an interesting account was given of the passage of foul air along bell wire tubes, the proximity of the bell pull to the fireplace giving an increased opportunity for air to be drawn from a distance to this part of a room. Channels for gas pipes and for hot water pipes also not uncommonly give facility for the admission of foul air. In connection with this part of the subject a remarkable instance was given of a particular bed in a school, the occupants of which were constantly the subjects of slight attacks of pneumonia with tendency to typhoid. In this case the foul air was conducted from a lavatory, where there was defective drainage, up a staircase, and, impinging on the ceiling of the dormitory, was reflected on the bed where the sickness occurred.

An interesting account is given of the cause of the Duchess of Connaught's recent illness. Defective drainage was found in the basement of the house, and after numerous experiments the means by which the foul air entered the Duchess' bedroom was discovered. These showed that it was only when occupying certain positions in the room that she would be exposed to the influence of the foul air, while in bed she would escape. As a matter of fact, in twenty-four hours after sitting on a sofa in one of these exposed positions, her Royal Highness' symptoms fully developed themselves. These two cases were illustrated by diagrams. The necessity of a thorough disconnection between the drains and the domestic water supply was then dwelt upon, and the mistakes most commonly made in this particular pointed out.

THE simple decoction of onion peel is said to produce upon glove-leather an orange-yellow superior in luster to any other. It is also said to be suitable for mixing with light bark shades, especially willow bark, and as a yellow for modulating browns. The onion dye is said to fix itself readily, even upon leathers which resist colors, and colors them well and even.