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THE MAGIC LANTERN.

The Nutshell Series.



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THE MAGIC LANTERN.

By

JOHN ALBERT MANTON,

M.R.C.S.Eng., L.R.C.P.Lond.

President of the Sheffield Lantern Society.

Author of "Scandinavian and Russ," "Echoes from the Savory," "Lights and Shadows of a Doctor's Life," etc.



LONDON:

ILIFFE, SONS & STURMEY LTD., 3, ST. BRIDE ST., E.C

I dedicate this little book to my fellow members of the Sheffield Lantern Society, an unassuming organisation which has done much good in a quiet and unobtrusive manner.

PREFACE.

THE average person who becomes possessed of an optical lantern does not care two straws about the philosophy which tells him that his instrument is the lineal descendant of the dim and smelly toy-thing of the past—he recks but little of Roger Bacon and Athanasius Kircher—all he cares about is the present means of exhibiting his pictures to the best possible advantage. That is the reason why all reference to the history and evolution of the lantern has been omitted. This little manual is not designed for the expert, who would probably be bored to death by the recapitulation of much familiar matter, but for the *novice*, for schoolmasters who wish to combine the advantages of "Eye-gate" and "Ear-gate," those twin approaches to youthful intellects. In this book the graces of literary diction have been sacrificed to perfect clearness, and all instructions are written in the baldest, plainest English. Here and there the author has not hesitated to give utterance to a homely bit of slang, if his meaning can thereby be rendered the plainer.

J. A. MANTON.

Shrewsbury House, Norfolk Road,
Sheffield.

THE MAGIC LANTERN.

CHAPTER I.

THE optical lantern is simply a modified form of microscope whose function is to project on to a suitable surface an enlarged image of a brilliantly-illuminated transparency, the size of the picture being limited only by the size of the room and the power of the illuminants employed. Speaking broadly, projected lantern pictures of over sixteen feet in diameter are apt to be dim and grainy owing to the enormous magnification of colour marks and photographic deposits. Every lantern, from the simplest plaything down to the ponderous "three decker," consists of the following essentials:

(1.) A BODY to support and conceal the illuminant, which may be made of metal, or wood lined with metal.

(2.) A STAGE to retain slides in position during exhibition.

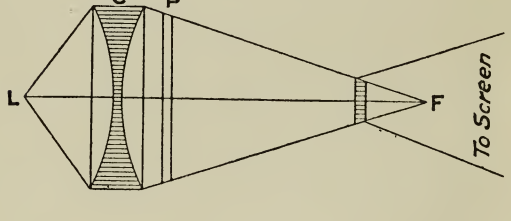
(3.) SUPPORTS for two sets of lenses—the FRONT LENS being termed the OBJECTIVE, the BACK one the CONDENSER.

(4.) The ILLUMINANT or RADIANT—oil, Welsbach, acetylene, lime, or electric light.

The optical principles involved in the "magic" lantern are shown in the simple diagram appended.

L represents the light emanating from the radiant being collected by the condenser C (which is here

represented as being of the usual type, two plano-convex lenses, with the axes of their convex surfaces almost touching). After being refracted, the rays transmit themselves through the transparent picture P, and, under ordinary circumstances, would come together at the point F, but the image of the picture illumined by the more or less parallelised



rays passing through the condenser is caught up and flung on the screen by the lens or lenses forming the objective. As a result of the optical law of refraction, inversion will take place, hence the necessity of inserting slides into the stage UPSIDE DOWN, unless we enjoy the spectacle of our sisters, cousins, and our aunts standing on their heads.

The types and shape of the lantern itself are of comparatively little importance — of course there are times when a little money can with advantage be spent on a mahogany body, and such extra embellishments as brass stages and brass-bound peepholes. The variety of forms is simply legion. The forerunner of the modern simple type of apparatus was undoubtedly the "Sciopticon," a two-wick instrument with an excellent optical system.

Most modern brass-fronted instruments have draw tubes to facilitate focussing the picture. In many

admirable instruments the brass tubing is replaced by an expanding leather bellows, which can easily be removed for demonstrations and scientific experiments.

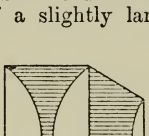
The stage is a clip, which may be either "open" or "closed" for clipping the "carrier," which, as its name indicates, is a contrivance for holding the slides in position against the front part of the condenser. Of all forms of apparatus, the simplest and best for ninety and nine amateurs out of a hundred is the ordinary to and fro so-called "lightning" carrier, some of the most up-to-date forms of which have ebonite shutters for obscuring the picture at the actual moment of change, and all sorts of little "fakes" to avoid fingering and to facilitate the removal of the exhibited slides. Whatever form of carrier be employed, I strongly recommend that it should be firmly wedged, or, better still, SCREWED into position, as nothing is more annoying to an exhibitor than to find his pictures wobbling all over the screen as a result of carelessness in this respect.

THE LENSES OF THE LANTERN.

The Condenser.

It is essential that this portion of the apparatus should be free from scratches and flaws, or they will be exhibited with the most painful plainness. A slight abrasion on the surface of the objective is of infinitely less importance. It is to be regretted that the standard size of the English condenser, 4in. in diameter, is somewhat too small, and the intending purchaser should by all means try and secure one of 4½in. diameter. The 4in. will illuminate the average CIRCULARLY masked slide, but if a cushion-shaped mat be

placed actually on the condenser face, there will be a little brownish tinge at the corners due to chromatic aberration. Now, the brasswork and the carrier, under ordinary circumstances, will advance the slide about half an inch more forward, with the result that the colour tinge will be still more marked—this difficulty is entirely obviated by the use of a slightly larger size of condenser. There



Simple form of Triple Condenser



"Herschel" Condenser

are other forms of condenser: the "Herschel," and various forms of the "triple," the former results in a LITTLE gain of light, the latter a MARKED increase. It is necessary, however, to have a suitable small back lens to accommodate the varying foci of objectives—this, of course, is unnecessary where the operator always exhibits at a certain definite distance, and with a lens of one definite focus.

The condenser should have one or two holes drilled in its circumference to permit the vapour of steamed lenses to escape, for on first lighting up one's apparatus dew is prone to collect on both slides and lenses. The lens itself should fit easily in its socket, and should be secured thereto by a bayonet catch.

The "Primus" condensers are perfect in this matter of ventilation.

MORAL.—Always, where possible, give apparatus and slides a preliminary warm.

The Objective.

Lantern objectives, like photographic lenses, may consist of single or compound achromatic* combinations.

Although good work can be done by achromatic single lenses, yet the majority of objectives are built on the line of the portrait lens, and consist of a double-achromatic combination. The lenses sent out with even cheap lanterns nowadays are of astonishingly good quality. Before you definitely purchase a lantern, try and secure a preliminary trial of the apparatus, and have an expert or a practical amateur to help you. If such an acquaintance is lacking, the author hopes that these few pages may render assistance and lead to a judicious choice.

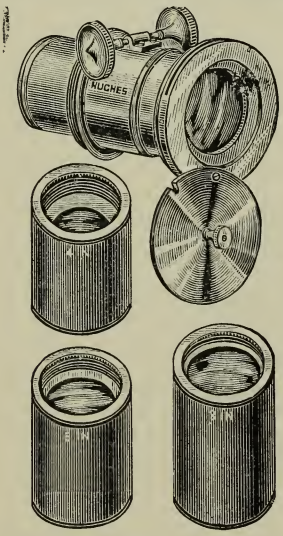
The Focus of the Objective.

Suppose we were to take our front lantern lens and mount it in an opening in a shutter, the rest of the room being in darkness, rays of light would stream through its combinations, and could be collected on a piece of white cardboard. The operator would soon find that by shifting the cardboard backwards and forwards a point would be reached where a sharply-defined image of external objects would be thrown on its surface; this point is the "focus"

*An achromatic lens is one that has been corrected for chromatic aberration, or colour fringing, such as may be seen round the edges of inferior opera glasses. The correction is usually brought about by cementing together, into "one harmonious whole," lenses formed of glass of different refractive powers, crown glass being usually combined with flint. For instance, a double-convex lens of crown-glass may be united by means of Canada balsam with a plano-concave one ground from flint glass, the resulting combination being a SINGLE ACHROMATIC LENS.

of the lens, and on this focus the utility of the lantern to each particular individual depends. Many and many a time disappointed novices have said to me, "How is it that my lantern has to be planked down in the middle of the front benches whilst Mr. So-and-so's shines right over the people's heads from the back of the room?" It is simply a question of focal length, and the study of the table at the end of the chapter will save much disappointment. (Mem.—Cut it out and paste it on the lid of your lantern box.) As a result of practical experience I find that my 6in. lens will give a ten-feet DISC at twenty feet distance from the screen, my 9in. lens gives the same sized circle at thirty feet, and the 12in. objective gives the same result at about forty-one feet from the screen. The usual commercial objective is usually of about 6in. focus, and is admirably adapted for household work and for demonstration in SMALL class-rooms and school-houses, but such a lens would be a nuisance in a large hall, for, in addition to being placed amongst the best portion of the audience, the lantern and the operator, as seen from the rear of the room, would be boldly silhouetted on the screen, and would conceal a large portion of the picture from the bystanders at the back of the room. I have been a peripatetic showman for many years, and as a result of many thousand miles of travelling and of many hundreds of exhibitions, I have come to the conclusion that, except for large halls, saloons, and assembly rooms, where long-focus objectives are essential, the 9in. lens is far and away the most useful, for by the employment of two screens, one seamless 9ft. 4in. square, and the other 12ft. square, you can almost always ensure a reasonable sized picture. My own preference is for a comparatively small but brilliantly illuminated disc reared well above the heads of the audience, but more on this subject anon.

A word with regard to the diameter of the objective lenses. "The larger the window, the more light," is a very good maxim in its way, but it certainly does not apply to lantern matters. I have seen men lugging about and pointing with pride to heavy brass-mounted lenses of huge diameter, all blissfully unconscious of the fact that they were simply carting about so much waste glass and metal. All that is wanted is a lens large enough to transmit the whole of the light cone without loss or obstruction. There is absolutely no advantage whatsoever in having lenses above 2½in. in diameter.



The Mounting of Objective.

Few lenses are sent out nowadays without some

arrangement for focussing. The old sliding mount has been replaced by a rack and pinion adjustment, which enables the projected image to be sharpened with the utmost precision. The better forms of lenses have double pinions, enabling "focussing" to be done from either side of the lantern, thereby avoiding any awkward reaching over the apparatus. The highest class of mounts possess "flashing shutters" for projecting and shutting off an image quickly (nothing silences a rowdy audience sooner than to suddenly eclipse the picture). Behind the shutter there is often a slot for tinted glass. Those who can afford the additional expense of a battery of lenses will find it a great convenience to have the brass jacket so arranged that each combination in its cell can be simply slipped out of its place and another one substituted at a moment's notice. Such an arrangement is shown in fig. 3, and one sees at once that, instead of carrying about the heavy brass-work of three lenses, we have one mount and three lens cells.

Recapitulation.

If your object be simply to exhibit and admire your own slides, and to please your own and neighbour's children, a cheap form of lantern and lenses, say from £2 2s. upwards, will answer every purpose.

For mission-room, schoolroom, and educational work, a lantern with removable bellows front, 4½in. condensers, and 9in. focus objective, is recommended. For high-class lecturing in rooms of varying size, lantern as above, *4½in. condenser, a Herschel, or, better still, a triple condenser with interchangeable back lens, double racked mount with interchangeable lens of 6in., 9in., and 12in. focus.

*Bellows will be found lighter in weight than the thinnest of brass tubing. The working of the limelight and biunials will be dealt with in subsequent chapters.

SIZES OF DISCS.

(From the "Handbook to the Lantern." Iliffe, Sons & Sturmey Ltd., 3, St. Bride Street.)

The following table gives the distances from the screen at which the lantern should be placed to obtain the certain size disc required, the foci of the lens being known. It is calculated for foci from 3ft. to 12ft., and for each size of disc from 3ft. to 12ft. Larger sizes are as nearly as possible proportional, thus sixteen feet is very nearly double eight feet:

Enlargement.	12 times.		16 times.		20 times.		24 times.		28 times.		32 times.		36 times.		40 times.		44 times.		48 times.	
Disc.	3ft.		4ft.		5ft.		6ft.		7ft.		8ft.		9ft.		10ft.		11ft.		12ft.	
Focus. in.	ft.	in.	ft	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft	in.	ft.	in.
3	3	3	4	3	5	3	6	3	7	3	8	3	9	3	10	3	11	3	12	3
4	4	4	5	8	7	0	8	4	9	8	11	0	12	4	13	8	15	0	16	4
5	5	5	7	1	8	9	10	5	12	1	13	9	15	5	17	1	18	9	20	5
6	6	6	8	6	10	6	12	6	14	6	16	6	18	6	20	6	22	6	24	6
7	7	7	9	11	12	3	14	7	16	11	19	3	21	7	23	11	26	3	28	7
8	8	8	11	4	14	0	16	8	19	4	22	0	24	8	27	4	30	0	32	8
9	9	9	12	9	15	9	18	9	21	9	24	9	27	9	30	9	33	9	36	9
10	10	10	14	2	17	6	20	10	24	2	27	6	30	10	34	2	37	6	40	10
11	11	11	15	7	19	3	22	11	26	7	30	3	33	11	37	7	41	3	44	11
12	13	0	17	0	21	0	25	0	29	0	33	0	37	0	41	0	45	0	49	0

CHAPTER II.

ILLUMINANTS.

SPERM, colza, and silber burners are practically extinct as far as lantern illumination is concerned. The same also applies to the Argand burner. These illuminants were practically "killed" by the advent of lamps with two, three, and four burners consuming mineral oil, and giving a light ranging from thirty to close on one hundred candle power. A grain of salt must be taken, however, with makers' statements; it is obvious that a lamp which might easily give one hundred candle power, as shown by the grease-spot photometer, would yet give a very different result when tested side by side with a standard light on the screen. We have not far to seek for the reason, for owing to an optical principle, which need not detain us here, a portion only of the large luminous surface of the flame ends is available, the remainder being wasted; the same disadvantage also applies to the Welsbach light. The limelight is an almost perfect light for the lantern, as the rays emanate from a tiny point of intense incandescence, and comparatively little light remains uncollected by the condenser. A good time will be coming for the lanternist when electricity is laid on as freely as water, and in all probability in the future all that the operator will be called upon to do will be to connect up with the main, arrange his resistance, and "focus."

The Incandescent Gaslight.

Though spoken of highly by a few, the majority of experts and amateurs are discontented with the performance of this light. The light, though bright and

beautiful, for reasons explained above, cannot be utilised to its full advantage. The mantles, too, are very fragile, and are generally broken up at the end of each entertainment, and, owing to their delicacy, are utterly unfit for practical everyday work. There is a good deal of difference between the cost of a threepenny lime cylinder and an expensive mantle. For fixed, enlarging, and domestic lantern, it may occasionally be found useful. This form of apparatus can be used with the pin and tray of the ordinary limelight apparatus.

Mineral Oil Lamps.

Mineral oil lamps, despite the whimsical, manifold, crackjaw, and Greek root names bestowed upon them by their proud patentees, have a strange uniformity of construction. In all cases they practically consist of a metal box, one end being closed by a reflector, and the other windowed with a piece of toughened glass or mica. Within this chamber project the tips of broad wicks—three, four, or five, as the case may be—sometimes arranged parallel-wise, sometimes W fashion. The edges, however, invariably face the back surface of the condenser. The floor of the box is so arranged as to cause currents of air to impinge on the flames; the roof of the box conducts into a tall chimney, the resulting air-draught causing vigorous combustion and intense illumination. I have no wish to praise one firm's goods at the expense of another, but as a result of practical experience, I strongly recommend that form of lamp where the length of the chimney is adjusted to a nicety by turning a key.

How to Work an Oil Lantern.

For the purpose of initial experiments, place the lantern, which presumably has been well dusted,

and whose lenses have been carefully polished, on a table at about seven or eight feet away from a temporary screen,* made by hanging up FLAT against the wall a white bedsheet or tablecloth, abstracted from the family linen press (your better-half will probably object, but you will have your compensation later on). Withdraw the lamp, pick any little loose fibres out of the wicks, give them a dry in the oven, fill the reservoir about three-quarters full with the VERY BEST PETROLEUM that money can purchase—bad oil means bad light, bad smells, and bad temper. Don't try and doctor up an inferior oil with camphor, as not only does it spoil the cogs of the wick, but, unless you are careful, it will result in your shirt front, cuffs, and, indeed, your whole person, being smothered with peculiarly adhesive smuts. Trim the wicks carefully and light them, having them well turned down at the beginning, put on the chimney, leave things alone for a few minutes, then gently turn up the two outermost lights, and a sort of suction action will be created, which will draw the inner flames up to their own height. If this does not take place, assist matters by gently turning up the middle flames; leave again a few minutes, and at the end of that time make the final adjustments, peeping through the blue glass of the reflector, and racking out the chimney to the most suitable height. The great majority, but not all, oil-burning lanterns have a longitudinal slot which permits of these adjustments being made actually OUTSIDE the body of the apparatus. In those cases where this slot is absent, just let a glimmer burn in the wicks, shut down the lamp top, put on the chimney, and proceed as above. After two or three trials you will become quite expert in these little details. Now

*The screen and its supports will be found fully dealt with at page 56.

glance at the screen. Matters will probably appear hazy and unsatisfactory. Screw the rack of the objective backwards and forwards; if the result be still hazy, gently pull forward the sliding brass tubes or the bellows of your new found plaything till a clearly-defined disc is visible. Manipulate the lamp by pushing it hair's-breadth by hair's-breadth to and fro until an expanse of bright white light is seen, insert a slide—UPSIDE DOWN, mind you!—sharpen the image, *et voilà tout*, you've learnt your first lesson in lantern manipulation.

When your night's work is over, empty all oil out of the reservoir and drain thoroughly, rub off the charred parts of the wick with a piece of rag, lay the burner and cottons on a piece of blotting paper on the top of the oven to dry as much as they will do, and clean every portion of the lamp most carefully, otherwise the horrible odour of incompletely-burnt paraffin compounds will manifest itself at your next entertainment.

Acetylene.

A scientific gentleman whose name I have forgotten, whilst operating with lime and carbon in an electric furnace, found a greyish mass resulting from his experiments, and he threw what he looked upon as waste material into a bucket of water—result, effervescence, and a strange unholy odour which at once compelled attention. The greyish mass was calcic carbide, a chemical compound which, placed in water, at once yields a plentiful supply of acetylene, C_2H_2, a mixture of carbon and hydrogen. Burnt in the smallest possible burners, a peculiarly brilliant light results, many times more powerful than the best gaslight. If burnt in too large a burner, smoke as well as smell results.

An acetylene apparatus, as used for lantern purposes, generally consists of the BURNER, composed of one, two, and sometimes three, tiny coal gas burners screwed or soldered on to a metal pipe in connection with a GENERATOR. The flame should be flatwise to the condenser, and, if additional burners are used, they should be about half to threequarters of an inch apart. The pipe bearing the jets can easily be mounted on a contrivance similar to a pillared lime tray. Generators are, to all intents and purposes, miniature gas-holders, within whose bells are metal cages for containing calcic carbide. In first charging such appliances, matters are so arranged that the carbide either dips into water or is sprayed upon or dripped upon by water. Provision is generally made, in order that when a sufficiency of the gas has been evolved, that the dipping and wetting processes shall automatically cease. It is advisable in the selection of an apparatus to avoid one where water slops on the floor, or surplus gas escapes into the surrounding atmosphere. Acetylene gas, be it noted, has an extraordinarily penetrating garlicky stink, the odour that struck Hans Breitman's music dumb being mild in comparison. As a result of the decomposition of calcic carbide (a chemic blend of lime and coke) in the presence of water, in proportion as acetylene is evolved so a powdery deposit of lime is formed. Here it is necessary to give a caution—acetylene easily forms explosive mixtures with the atmosphere; therefore clean these appliances in the open air, and as far as possible away from lights and fires. It is advisable to have but little brass or copper work in connection with generators, as acetylene, under certain circumstances, forms certain explosive acetelides somewhat akin to the fulminates of mercury and silver. The writer has experimented with four forms of apparatus, and it is manifestly

impossible for him to dogmatise on the merits and demerits of the legion of generators now on the market, and for prominence to be given only to those particular instruments which he has had the opportunity of examining would be a flagrant act of injustice. Therefore, good reader, if you want to know anything more about this most "coming" of lantern illuminants, you must consult the appendix, the pages of the photographic journals, or a well-informed dealer.

On commencing to "light up," there is often a slight hissing at the jet, and the issuing gas does not ignite; this is simply due to the expulsion of air and warm aqueous vapour; the light, when it does appear, is at first of a pale blue colour, and then becomes dazzlingly bright, and although inferior to the limelight is, to my mind, infinitely better than the best oil light, and most admirably suited for minor exhibitions in drawing rooms, mission rooms, and small schoolrooms. Here, in a sort of post-script, I might mention that an acetylene bicycle lamp (particularly that form where a water dripping lamp wick wets the carbide), when the wind shield and other top-hamper is removed, forms a very effective lantern light.

Regulations and Conditions with regard to the Sale and Storage of Calcium Carbide.

As this little book may be read by dealers, it has been thought advisable to include the following Government regulations with regard to the storage and sale of a ticklish compound:

(1.) That carbide of calcium which contains impurities liable to generate phosphuretted or silicuretted hydrogen, so as to render the gas evolved liable to ignite spontaneously, be not kept under this license.

(2.) That carbide of calcium, which contains impurity causing the gas evolved to contain notable quantities of ammonia, be not kept under this license.

(3.) That the licensee be required to obtain with each consignment of carbide of calcium a guarantee that the article supplied to him is in accordance with the above requirements. Failing this he will be required to give facilities for a representative of the Corporation to take samples from his stock from time to time, with the view of ascertaining the practical freedom of the carbide from the aforesaid impurities, and to refund half the fee which may be paid by the Corporation for analysis of the samples of carbide taken.

(4.) That carbide of calcium be kept only in dry and well ventilated rooms or buildings.

(5.) That carbide of calcium be sent conveyed, and kept, only in strong metal vessels, so constructed and closed as to prevent the admission of water or atmospheric moisture, excepting when being actually used in generating acetylene gas.

(6.) That every such vessel, when containing carbide of calcium, shall bear a label stating in conspicuous characters the words "Carbide of calcium. Dangerous if not kept dry," and with the following caution: "The contents of this package are liable, if brought into contact with moisture, to give off a highly inflammable gas," and also the name of the owner or vendor.

(7.) That only one vessel containing carbide of calcium be opened at one time, and then only for the time necessary for the removal of any required quantity of carbide, or for the refilling of the vessel.

(8.) That not more than 112 lbs. of carbide of calcium be kept in any one vessel.

(9.) Every vessel of a greater capacity than two pounds shall be provided with a lock, or be placed in a locked receptacle, so as to prevent unauthorised persons gaining access to the contents.

(10.) That carbide of calcium be not sold except in hermetically-sealed vessels; every such vessel shall bear a label stating in conspicuous characters the words, "Carbide of calcium. Dangerous if not kept dry," and with the following caution: "The contents of this package are liable, if brought into contact with moisture, to give off a highly inflammable gas," and also the name and address of the vendor.

(11.) That fire, or any such artificial light as would ignite inflammable gas, be not taken into or near the building or place where carbide of calcium is kept or used in quantities exceeding 2 lbs.

(12.) That any residue of carbide of calcium on being removed from a gas-making apparatus be at once mixed with at least ten times its bulk of water.

(13.) That a book be kept by the licensee in which shall be recorded the date and amount of every purchase from him of carbide of calcium, and to which shall be appended the signature and address of the purchaser, and a similar record shall be kept of the sale of any apparatus for the manufacture of acetylene from carbide of calcium.

(14.) That every authorised officer of the Council be at all times allowed free access to the premises

of the licensee, for the purpose of ascertaining if the above conditions are properly observed, and for taking samples, if necessary, and that the licensee do, by himself or his representatives, give any assistance which such officer may require.

Insurance Companies and Acetylene.

The following are the regulations with reference to the use of acetylene gas which have been adopted by the Associated Fire Offices, viz. :

(1.) That the storage of calcium carbide, liquid acetylene, and/or acetylene gas, and every apparatus, whether portable or otherwise, for the generation of such gas, must be only in a building detached at least ten feet at the nearest point from every other building.

(2.) That suitable valves or devices for controlling the pressure of the gas must be placed inside the detached building, and a cut-off provided between such building and the building supplied with the gas.

(3.) That in addition to the above the piping in the building in which the gas is used must be provided with a pipe outlet into the open air controlled by a safety device so arranged as to let the gas escape outside the building whenever the pressure of the gas exceeds four ounces to the square inch.

The apparent over-caution of the insurance companies is understandable when we remember that acetylene gas free from any admixture of air and oxygen is safe up to a pressure of one and a half atmospheres; at two atmospheres of pressure it becomes dangerously and capriciously explosive.

The Oxy-incandescent Gaslight.

In this form of light, compressed oxygen, in conjunction with coal gas taken from the main, is employed. The two gases pass through separate tubes, which unite at the actual burning points. The intensely-heated gases play upon little slips of composition, rendering them brilliantly incandescent. It is stated that this light has a future before it for lantern and cinematographic work. The agent's name will be found in the appendix.

The Hydro-incandescent Gaslight.

The sheets of this little book were undergoing revision when I was asked to witness a demonstration of the hydro-incandescent gaslight, and as I consider that this illuminant does away with many of the drawbacks of the old Welsbach system, and has an excellent future before it for both household and lantern use, I hope I may be pardoned for the belated and abrupt interpolation herewith inserted. In previous paragraphs it will be noted that I did not gush over the old fragile mantle with its nuisance of a chimney. In the new form of light the chimney is dispensed with altogether, and the mantle simply suspended over a very carefully-designed Bunsen burner. The ordinary pressure of the gas at the main is greatly increased by a kind of water injector, which drives the condensed gas with great force to the nipple of the Bunsen; its outrush sucks up an unusually large amount of air, and, as a necessary corollary, very perfect combustion and intense incandescence of the mantle threads results. A light of four hundred candle-power is obtained without difficulty. It is quite startling to see a steady dazzling flood of one thousand to fifteen hundred candle-power radiance emanating from a mantle

somewhere about the size of a lime-cylinder. The light surface is, of course, too large for complete utilisation in the lantern, but much might doubtless be done with small specially-constructed "baby" mantles. The system is being exploited by the Welsbach Co.

The Limelight.

The limelight, which is essential for all better-class exhibitions, exists in the following forms:
(1.) The oxy-spirit light.
(2.) The "blow-through" limelight.
(3.) The oxy-hydrogen light proper.
(4.) The oxy-ether light.

The Oxy-spirit Light.

This light is produced by directing a fine stream of oxygen gas through the flame of a peculiarly-shaped spirit lamp on to a lime cylinder. The cotton threads are separated slightly V fashion, in order to prevent the wicks themselves being consumed. The best form of jet undoubtedly is that manufactured by Messrs. Wood, of Cheapside.

The "Blow-through" Light

owes its origin to the nervousness induced by the mishaps which happened with the limelight in the early days of its employment as a lantern illuminant. A glance at the simple diagrams on page 29 will at once explain the method of production. In both cases it will be seen that a jet of oxygen under heavy pressure is driven through a flame of coal gas, drawn direct from the main; a partial mixing of the gases results, evolving one of the most fervent heats known to science. A piece of lime placed at the

point where the heat is greatest becomes instantly incandescent, emitting a flood of dazzling white radiance equal in intensity to a light ranging from one

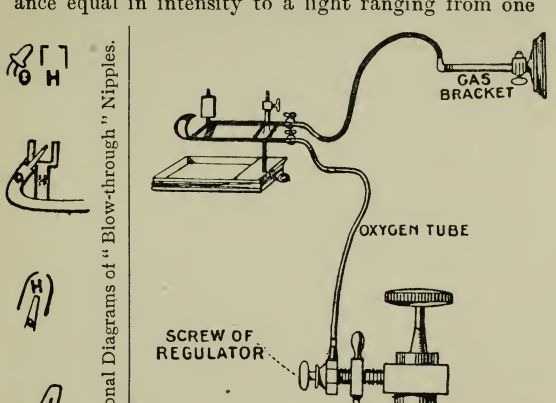


Diagram of Method of connecting up a "Blow-through" Jet.

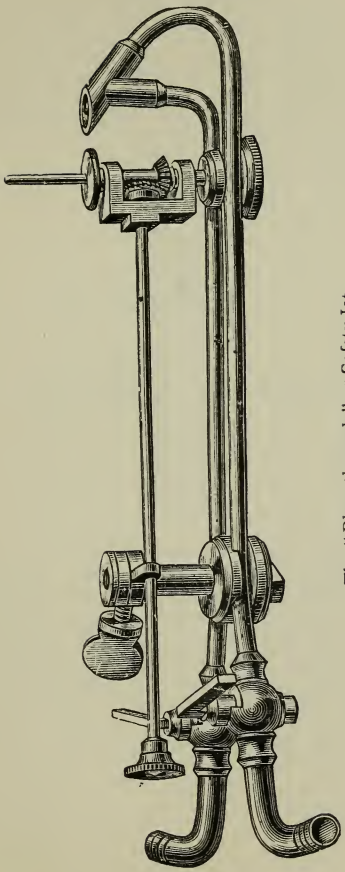
hundred to two hundred standard candles.* The necessary oxygen may be supplied from a wedge-shaped airtight and waterproof bag, formed of black twill and vulcanised indiarubber, fitted with a brass stop-cock. Gasbags, like the dogs in the adage, have

*A jet has recently been placed on the market where the outrush of the issuing oxygen is so arranged as to increase the pressure of the coal gas derived from the main. A light of four hundred candles is said to be easily obtainable by simply using coal gas from the main. When, however, the coal gas is under pressure, it is claimed that the illumination runs up to 1,000 or 1,200 candle-power.

had their day, and have almost entirely been replaced by the more convenient steel bottle containing compressed oxygen. Such a bag will cost about 40s., and will require a > -shaped arrangement of boards with a shelf on the upper limb of the > to support a couple of 56 lb. weights, and having straps attached to the unhinged portions to keep up pressure on that part of the gasbag which would otherwise be bellying out of its free ends. The directions given below for producing the blow-through light by means of a bottle of oxygen apply equally well to those cases where a gasbag is employed, except that a regulator is unnecessary. The making of oxygen gas is fully dealt with in the appendix.

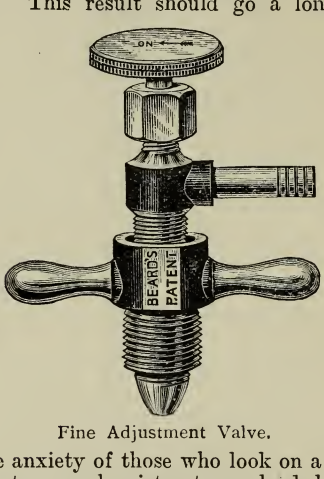
How to Use the "Blow-through" Jet.

Having got your lantern and sheet in position, and the "blow-through" jet itself screwed on to the upright rod of limetray, and with its nozzle about three and a half inches from the condenser, connect up parts as shown in the diagram. Open your lime-tin and select a suitable cylinder; if it won't fit on the lime-pin, ease matters with a small penknife blade, turn on the tap of the gas-bracket, and the H tap on the jet, and light the issuing coal-gas, and allow it to play on the lime, which should previously have been adjusted at a distance of about a quarter of an inch from the nipple—the distance varying with each jet. Experience alone will teach you how to get the best results. Turn the light down a little, turn the lime round slowly a few times, until both it and the whole apparatus are thoroughly warm. Whilst this warming is taking place, let us learn something of the oxygen bottle and its fittings. Gas bottles are made of mild steel, tested to stand an enormous pressure, and, to use a vulgarism, are "as safe as houses." During military operations



The "Blow-through" or Safety Jet.

they have fallen over lofty precipices without injury. They have been purposely bent and dented by heavy masses of fallen iron, and their brasswork has been fused during a conflagration without an explosion. This result should go a long way to



Fine Adjustment Valve.

disarm the anxiety of those who look on a gas-bottle with almost as much mistrust as a loaded rifle. On the neck of the bottle will be found a recess for a key, and an exit tube. When the key is turned the gas rushes out with a hissing noise and great velocity. This outrush can be easily checked and controlled by a simple regulating valve, exhibited in the almost self-explanatory woodcut. The collar is slipped over the gas-bottle neck,* and the "bull-nose" joint adjusted and screwed home to a recess

*The appliances of the various oxygen gas companies vary in form though not in principle, and the fittings suitable for one company won't always do for another.

on the bottle neck. Screw the spindle well, but not violently, home. Now to business. Turn on the coal-gas flame till it is about the size of a large cigar, turn the bottle key until the valve is felt to freely yield, see that the O cock on the jet is about half on, and then proceed to gently turn the spindle of the regulator. Soon a little bluish speck will appear at the nipple of the jet. Keep on turning until a vivid bright light is produced. Now turn the jet cocks up and down till you get the best effect, which, to a great extent, can be judged by the reflection from the back surface of the condenser. If there be hissing, it generally means that an excess of oxygen is present. Remedy: Cautiously reverse the regulator handle. A big flare of flame is best corrected by reducing the coal-gas supply. The maximum amount of light is generally given when on each side of the lime there is a small orange-coloured wing of flame on each side of the lime cylinder.

"Centring" the Light.

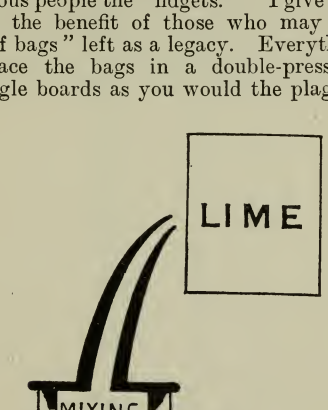
It is quite possible that, although floods of light may be issuing from the jet, the screen may be almost in darkness. Manipulate the jet, BACKWARDS and FORWARDS by the sliding tray, UP and DOWN and from SIDE to SIDE by means of the upright rod and screw. Take pains to achieve the best result, and, having got it, screw the apparatus up. A judicious file mark or two will assist future operations. There are many ingenious contrivances for facilitating this somewhat fiddling operation, a few of which are alluded to in the appendix. Now proceed as directed for the oil lantern. At the conclusion of the entertainment, TURN OFF THE O AT THE REGULATOR, then at the bottle—if you turn out

at the jet first your tubing will expand to sausage-like dimensions, and will either burst or be blown off; of course, no harm is done, but the prudent operator will avoid such a disagreeable *contretemps*. A 6ft. bottle of oxygen should last about an hour and a half. In most large towns, bottles can be hired, charged ready for immediate use. I, in common with many of my friends and pupils, prefer to buy my bottles outright, and send them to a central depot to be recharged. In order to judge of the contents of a partially-used bottle, and to prevent your working "literally in the dark," some sort of a gauge is necessary. I find a little spring pocket gauge quite sufficient, although others may prefer instruments on the lines of the steam-pressure indicator.

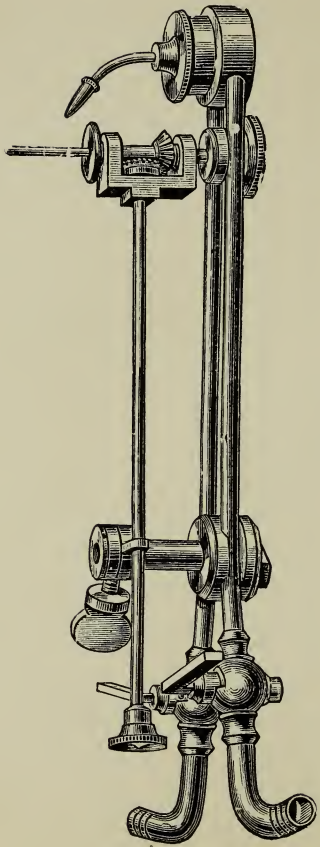
"Oxy-hydrogen" and its Management.

The author hopes that the rough little sketch will render the principles of the oxy-hydrogen "mixing" jet perfectly clear. Two little tubes containing oxygen and hydrogen under pressure respectively are led into a little brass box technically known as a "mixing chamber." From the roof of the box a narrow curved pipe, topped by a nipple, with a pinhole orifice, conducts to the lime cylinder. First of all the hydrogen (or coal gas, as the case may be) is ignited and allowed to warm the lime; the oxygen is then gradually turned on, the necessary adjustments made, and a blinding effulgence of four to six hundred candles results. Buy the best jet your pocket will permit of from a good maker, and you probably won't be bothered with the nuisance of "whistling." If you are, you may learn something from an article I contributed to the 1893 PHOTOGRAPHY ANNUAL, page 254. I most emphatically recommend the tyro NOT to use gasbags. I

find that small boys are apt to experiment with them, and many a puzzling leak has been due to a mischievous and, in some cases, a malicious pin prick. Added to that, they are ugly, cumbersome, and apt to give nervous people the "fidgets." I give these brief notes for the benefit of those who may have had a "pair of bags" left as a legacy. Everything being ready, place the bags in a double-pressure frame (shun single boards as you would the plague), strap



them up, and weight with 56 lb. weights well secured, turn on the H cock on the bag, and then turn on the H tap (generally marked H) at the jet, go through the usual warming operations, adjust the flame till it is more or less trumpet-shaped and about 2½in. long, the thickness of a pennypiece intervening between the lime and the nipple. Turn on cock of oxygen bag, turn on O tap of jet gradually, opening

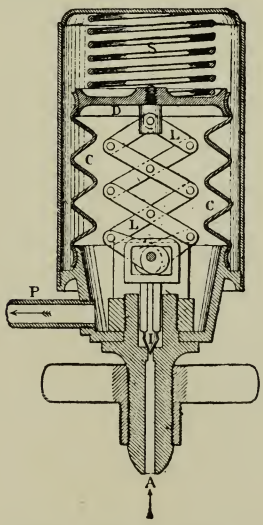


Mixed Jet.

it wider till the best effect is produced. Adjust taps, and modify the H supply if necessary. Then centre your light. At the end of the entertainment turn off the O tap at the jet, then the H, then cut off supply from bags BEFORE you remove the weights.

The "Mixed Jet" and Bottles.

Perhaps the best plan of all would be to describe the method adopted by the author for years past.



Interior of Beard's Regulator.

I have two 20ft. bottles—one painted red for H, and the other black—fitted into a neat case for railway journeys, and for travelling backwards and forwards

to the refilling depot. Each of these is fitted with a regulator. If you are using a single lantern, the little contrivance already mentioned at page 32 will answer admirably. If your ambitions soar in the direction of biunials, a "Godwin," a "duplex," or some form of bellows regulator, such as Beard's, becomes a necessity.

To Light Up.

Screw your regulators on to your bottle necks, attach tubing to the jets and bottles, and see that your jet taps are open.

(1.) Turn on the key of the hydrogen bottle, gently unscrew the regulator, light, warm, and adjust flame to right size with the jet tap.

(2.) Turn key of O bottle, and gradually admit a little oxygen to the jet till the little pip of bluish light brings about vivid incandescence.

(3.) Gently manipulate taps till the light is at its maximum of brilliancy and is silent. A humming noise is no importance, but is apt to disturb the audience.

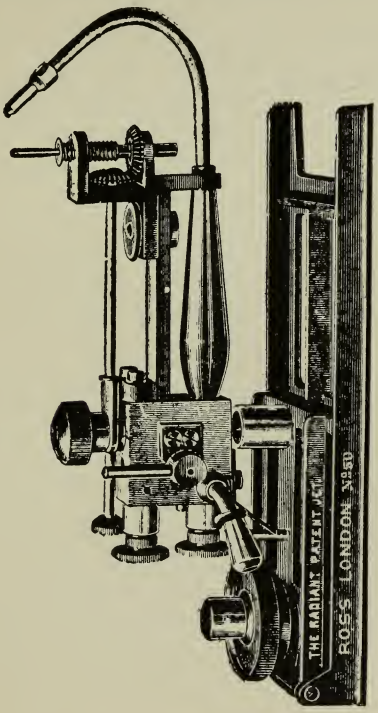
(4.) Turn the lime frequently, say at intervals of three or four minutes, otherwise a fractured condenser may result.

(5.) At conclusion of entertainment turn off O at regulator, then at bottle. Repeat process with H regulator.

A New Jet.

There is no finality even in lantern matters at the eleventh hour. Just as this little book was about to go to press I was called upon to report on Messrs. Ross's new "Radiant" limelight jet, of which a woodcut is appended. Its great and novel departure

is the mixing chamber for the gases. The point of originality is that the chamber is cut up by a series



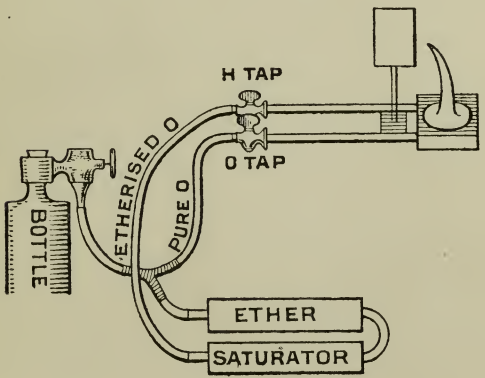
of plates at regular intervals with apertures from one to the other of varying size. The purpose is to

get regular pressure and a thorough mixing of the gases. A great advantage in the jet is the luminous spot, which is smaller than usual in area but greater in intensity. Mr. Barton used the jet in a lantern, and showed it in use with two nipples. The first of these gave a magnificent light, but the second, of smaller aperture, gave a much better light, and one in every way fully suitable for the average lantern exhibition. There is one charm about this jet that will at once make it a general favourite, and it is the factor of silence. It is a most valuable piece of apparatus for the exhibitor, and a very powerful jet. It is made in two forms—No. I., powerful enough for nearly every purpose, and No. II. for use with extremely large screens. The price is £4 4s., but without vertical and lateral motions, for use in any ordinary lime tray, £3 10s.

The Ethoxo-limelight.

In this ingenious and beautiful light, the hydrogen is replaced by oxygen SATURATED with the extremely-volatile vapour of ether. A jet of ether-saturated oxygen burns; if imperfectly saturated it explodes. This sounds alarming, but if care be taken, there is absolutely no danger in its employment. By its means we are able to produce a light little, if at all, inferior to that produced by oxy-hydrogen at its best, and far surpassing the performance of inferior jets. We can take a small bottle of oxygen to remote country villages, and be quite independent of both coal-gas and hydrogen. Personally, I prefer the original form of saturator introduced into this country from America, which consists of two parallel brass barrels, within which are stuffed close-fitting rolls of absorbent flannel rolled round a spiral coil of wire to preserve an open gas passage. The nozzles are screwed off,

and about half a pint of methylated ether poured into the apparatus, five ounces to each side. The nozzles are screwed on again, and the ether allowed to thoroughly soak into the apparatus. At the end of a quarter of an hour or so, unscrew one of the caps, and allow the surplus to drain out. In a new apparatus I like to accelerate matters by attaching a piece of india-rubber tubing to one nozzle, and blowing any superfluous ether through the other nozzle into a bottle or a basin, taking care to be as far away from a



light as possible. If these precautions be neglected, little bubbles of free ether are apt to make their appearance at the jet, and to cause hissing and unsteadiness. The apparatus is connected, as shown in the plan above.

To Light Up with Ethoxo.

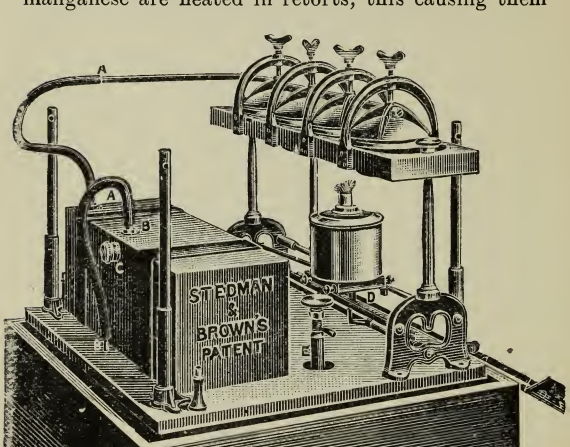
See that H jet tap is open and O jet tap closed. Turn cylinder key, then give regulator a few turns. When you smell ether, take off chimney of lantern, and after waiting a few seconds apply a light. Don't be alarmed at a big flame. Turn it down by the regulator till there is an inverted cone of burning vapour of about two and a half inches in length. Warm lime as usual, then gradually turn on O tap at the jet, and adjust just as you would with a blow-through or a mixed jet. In turning out CLOSE H (THE OXYGENATED ETHER) FIRST. Nothing now blows on the lime, except cold oxygen. I prefer this form of ether light for the SINGLE lantern, but it is quite unsuited for dissolving, as the ether vapour has a tendency to condense in the indiarubber tubing and cause disagreeable pops. It is true that these drawbacks may be modified to some extent by special dissolvers and short lengths of metal tubing, but still for all that. I recommend you to leave well alone. What I do recommend for ether dissolving is the Lawson biunial saturator. For the single lantern there are many forms of saturator which actually go inside the lantern body, and, being warmed by the heat of the radiant, steady evaporation is secured. I have not the faintest wish to give gratis advertisements, but I think that the Timberlake, the Gridiron, and the Lawson saturators are likely to meet the requirements of "funky" operators, and those unaccustomed to lantern manipulation.

CHAPTER III.

OXYGEN AT THE LANTERN SIDE.

AS a result of a couple of fatal accidents due to the employment of unsuitable steel in the manufacture of gas bottles, and also to an unfortunate admixture of oxygen and hydrogen in a single cylinder, an access of terror seized the railway companies, and they declined to carry gas cylinders by passenger train, and only by goods trains on condition that they were completely muffled in hempen casings. This decision caused an infinity of inconvenience to lecturers and entertainers. Some wandering showmen resuscitated a tank apparatus that used to be very popular about ten or twelve years ago; others again had a long brass tube closed at one end filled with "oxygen mixture" (chlorate of potash and manganese oxide). The free end of the tube was connected with a small gasbag, compressed by a sort of weighted drawing board fastened by temporary hinges to the floor; two or three inches of the brass tube would be heated in a Bunsen burner, and the resulting gas collected in the bag; as the bag emptied, another section of the pipe would be pushed into the flame. This was all very ingenious, but woefully bothersome; the average lanternist, particularly if he is doing a bit of lecturing as well, has got quite as much as he can manage without undertaking the charge of a contrivance that is only a little less manageable than a lighted Roman candle. For the benefit of such sorely distressed gentry, Messrs.

Stedman and Brown have devised a dainty piece of apparatus, which will neither scare the most nervous of old ladies, nor arouse the officialism of the most militant of railway guards. In this generator cakes composed of chlorate of potash and black oxide of manganese are heated in retorts, this causing them



to give off oxygen which passes through a tube connecting the covers of the retorts, thence through a check-valve into a tank of water, and from there out again through another pipe into a bag at the bottom of the apparatus where it is stored, ready to be drawn off for use as required. As shown in the illustration herewith, there are four retorts, each containing an "oxygen cake." The heating lamp is

shown in position under the right-hand retort, and as the gas is made faster than it is used, the bag rises until the cake in this retort is exhausted. If the gas is continued to be used, the bag then commences to sink until it is level with the box, when a mechanism is automatically operated to move the lamp under the second retort. The bag thereupon rises again till that retort is exhausted and falls again till the lamp is moved under the third retort, and so on. In this way a constant supply of gas is maintained until the whole four retorts have been exhausted. The lamp cannot move until the bag is nearly exhausted, and if the gas is not being used the apparatus stops making. The bag in which the gas is stored is situated under the water tank, which can be seen in the illustration. The whole apparatus is contained in a strongly made box 21in. by 18in. by 10in. The oxygen cakes can either be made by the operator himself, according to instructions given, or they can be purchased ready made at 2s. 6d. per dozen. To charge the apparatus only occupies about two minutes, and once the apparatus is started it will automatically give off gas at a uniform pressure, without any attention being required, for about one and a half hours. If more than one light is being used, or if it is necessary to use the gas for more than one and a half hours, the retorts can be re-charged again in two minutes while the light is still burning in the lantern.

An oxygen-making apparatus is made by Messrs. Riley, of Bradford, but as I am unacquainted with its method of working, I must content myself by chronicling its existence.

Electric Light as a Lantern Illuminant.

The lanternist and the electrician have taken sweet counsel together with eminently satisfactory result.

Thanks to the extension of private installations and the putting down of mains by energetic and enterprising electric light and power companies, the electric light bids fair in a few years to be *the* illuminant for the optical lantern; then our limelight jets and saturators will probably be relegated to the position now held by the oil lamp. The cost of a good electric hand-fed arc lamp and accessories suitable for a single lantern is far less than that of the average oxyhydrogen "fitment," with its costly cylinders, regulators, limes, jets, and tubing. Many large works nowadays are lit by electric light produced by the firm's own dynamos, or supplied from the nearest street main. A lanternist suitably equipped, exhibiting in a room or hall belonging to such an institution, could produce a magnificent illumination with an infinitesimal amount of trouble at about a third of the cost of limelight. There are mentioned in the appendix sundry forms of lamps or "regulators," some more expensive than others, but all thoroughly workable. The essentials of an arc lamp for the lantern are: (a) Two grips for carbons, capable of mechanical adjustment; (b) suitable mechanism permitting of the radiant being raised, lowered, adjusted, and "focussed" at a proper distance from the condenser. Then we require, in addition, a "resistance" apparatus and a fuse. These two little matters are generally supervised by the company's electrical engineer. The object of the resistance is to modify within definite limits the superabundant energy (enough for a dozen or more of such lamps) flowing through the wire. This checking is brought about by attaching the supply wires to coils of "platinoid" wire. Platinoid, be it understood, is a silvery looking alloy, through which an electric current passes but tardily. By modifying the amount of resistance we can increase or diminish the light to any required

extent. The safety fuse is a length of metal which would at once melt with the high temperature resulting from an excess of current. Similar fuses are attached to the house mains.

The current itself may be of two kinds:

(1.) Direct where it always flows in one direction.

(2.) Alternating where the current changes from pole to pole with great rapidity.

Both these currents are suitable for lantern use, but the direct has the advantage that a crater is formed at the end of one carbon, and, by dexterously tilting the incandescent points, this bowl-shaped depression can be made to act as a natural reflector. The light produced by the alternating current causes a slight humming or buzzing noise, not, however, worse than the "roar" of a high-pressure jet.

In some of the highest and most expensive class of electric projection apparatus the case is round, and has somewhat the appearance of a vertical boiler. Around the circumference are placed the ordinary lantern stage, spectrum apparatus, and lantern microscope, which can be shifted into position almost by a touch of the finger. The "regulator," under such circumstances, is entirely automatic, the "Brockie Pell" lamp being particularly suitable.

I had almost forgotten to say that carbons are of two kinds—cored and uncored. The former should be used with the alternating current. With direct currents, however, the negative pole should be cored and the positive plain.

It may not be out of place to point out to those who are unacquainted with the practical working of the appliances that, in order to produce the light, the carbons must be made to touch one another; on their separation for about a quarter of an inch an arc of intensely illuminated particles is produced. This is termed the "striking" of the arc.

For stage illumination and the lighting of tableaux vivants the arc light is simply perfection. When travelling in Russia and the northern capitals I found that stages, both indoor and outdoor, were illuminated by white or tinted electric light thrown from parabolic mirrors placed at the rear and high above the heads of the audience. In the Entertainment Gardens in St. Petersburg, the operators, in order to prevent their being frozen, were placed in pigeon-cote-like boxes perched on poles about thirty feet above the ground.

The ordinary form of loop filament electric lamp is almost useless for lantern purposes. There has recently been introduced a lamp having the carbon thread wound in a flat spiral, giving a light outside the lantern of one hundred candles; inside the lantern a good deal, but not the whole, of this light could be utilised.

One of the best little articles that has appeared on this subject will be found in Mr. Baker's essay on page 742 of the "British Journal Photographic Almanac" for 1896. A series of recent essays in the *Lantern Journal* are also very informing.

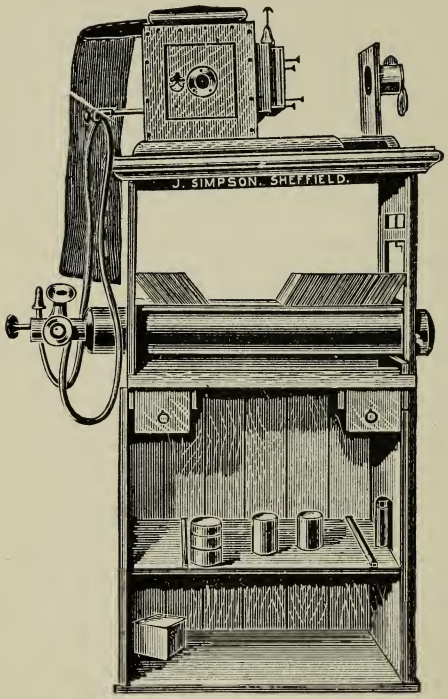
Stands, Portable Apparatus, etc.

Most lanterns are sent out packed up in cases which, when turned upon their sides, act as supports for the apparatus, but the case, in the majority of instances, being only ten inches to a foot in height, requires in its turn to be supported on something else, such as a piano, or a table top. Tripod stands are sold at reasonable figures by all dealers in optical apparatus. The travelling case of most biunial and triple lanterns is fitted with a false lid, which can be canted to accommodate the varying angles of the sheet, but the occasions when the lantern can be worked from the height of these comparatively

lofty packing cases, as they stand on the floor, are unfortunately very few and far between. The question of supports and portability is an extremely important one, and, as I have given the matter much thought, I shall perhaps be pardoned for quoting an abstract from a paper which I communicated to PHOTOGRAPHY ANNUAL for 1893:

"'I suppose you use a triple?' is a question often put to me. No; I don't. I formerly employed a massive three-decker, resplendent with gilding, mahogany, and brass. I now use a severely simple and practical apparatus. John Bull has outlived his taste for 'effects,' and even the rising generation are quick to detect the *deus ex machina* of the meretricious showman. Show a good picture, light it well, and replace it deftly with another—there, in a few words, you have the secret of a good lantern show. The almost self-explanatory woodcuts appended will give a good idea of the apparatus which I have used so far to the satisfaction of my audiences and myself. We are told that 'great souls think together.' I fondly imagined that the design of my lantern was practically original. I now find the market flooded with app'iances of a similar type. The lens-bearing front is borne on a sliding base, capable of great extension. It will be noticed that the whole of the space between the condenser and the objective is open. 'Oh!' says the theorist, 'you will have a great amount of diffused light thrown into the room.' As a matter of fact, the diffusion thus produced is infinitesimal. The rays of light cone themselves most beautifully into the front lens, and just afford sufficient light for the operator to see whether his slides are the right way up or not, and give an operating lecturer a chance of referring to notes, without the audience being even cognisant of the fact that he is in possession of MS. Personally, I prefer a triple condenser, and

carry with me habitually across country lenses of six, nine, and twelve inches focus, a couple of



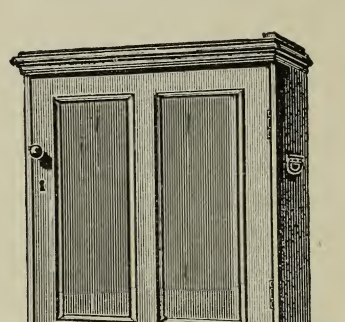
bottles, with regulators, an ether saturator, a mixed jet, and also a 'blow-through.' I am now prepared for any emergency, and am equal to exhibiting in

the smallest country schoolroom, or the largest hall. The carrier is Archer's single 'Ideal,' minus the dissolving apparatus, and having the holes in the central portion blocked up. The rapidity of change is something marvellous—very different, indeed, from the old panoramic or lightning form of carrier. The top is of Russian iron, and is made of squat shape. The O and H jet cocks in all cases have been replaced by Noakes's screw taps. I find Staniforth's simple jet clip indispensable. The gas bottles in their turn are fitted with Suiter's regulators, and screwed to the bottle-necks are the wonderful contrivances for turning on the gas introduced by Messrs. Brin,* which do their work so exceedingly well that, if necessary, adjustment at the jet taps can be dispensed with altogether. With these little appliances, a 'cut-off' is superfluous, as the light can be turned up and down to any degree at a moment's notice. It will be noticed that we have almost unlimited control over the affluent gases—the light can be adjusted to a nicety, and maintained unwaveringly at maximum intensity for hours. The case contains the lantern, and in the lowermost compartment are packed the sheet, slides, and other impedimenta. The door, being hung on casemen' hinges, takes off instantly, and affords easy access to the interior. The sheet having been satisfactorily erected, a picture can easily be thrown upon its surface within five minutes, and at the close of the entertainment you are ready for the next performance without any tedious readjustments.

"In the second illustration, we have a representation of the apparatus as packed for travelling. Mr Hepworth, in his fascinating 'Book of the Lantern,' alludes with pride to the iron legs which he uses

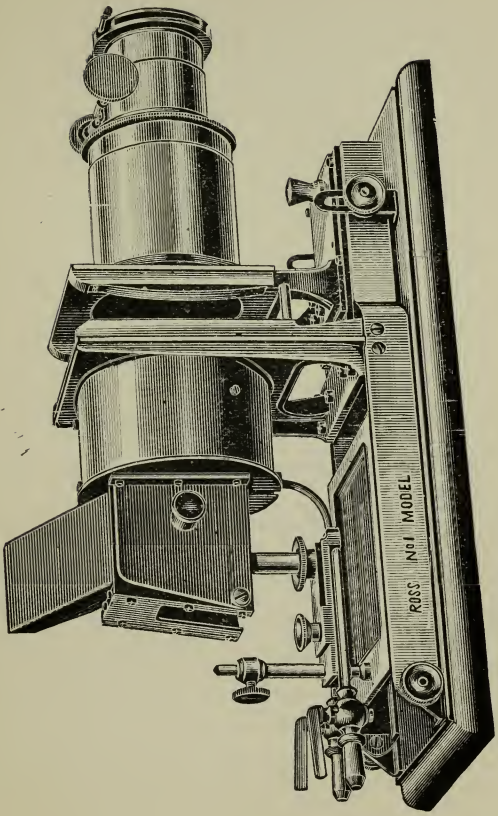
*I find the teeth of these appliances wear somewhat quickly.

for the purpose of adding height to the lantern box. Thanks to the dexterity of that ingenious Sheffielder, Mr. Simpson, I am rendered independent of tables, harmoniums, and other adventitious supports; my



'legs' are an integral portion of the whole concern, and cannot be lost or mislaid. Remove the lid of the lantern case; lying snugly underneath, you will find two H-shaped supports, which can be raised by a touch of the finger to a vertical position. The loose top is now fitted on to these props, attached to the foremost of which will be found a rack and pinion adjustment for raising or lowering the lantern to any required angle, the screen, of course, being tilted to correspond."

Amongst portable apparatus we ought not to omit mention of Messrs. Ross's "No. 1 Model Limelight Lantern"—a marvellously compact instrument, rigid, and simple in all its parts. The construction of this lantern, it appears, so far as the lighting


ROSS No I MODEL

arrangements are concerned, was suggested by the ordinary table lamp. In such a lamp certain portions are very hot, but which we easily avoid at such times as it becomes necessary to adjust the light. In a similar manner, therefore, this new lantern can be worked with considerable convenience, and with no more danger from heat than from the table lamp, and there is actually less heating in the other portions of the lantern than in instruments constructed with bodies of the usual pattern; the condenser, for instance, does not get nearly so hot as is usually the case. It is doubtful if a more convenient limelight lantern for all ordinary purposes could possibly be had.

CHAPTER IV.

THE SCREEN.

THE pictures thrown by the lantern are received on a large, flat, white surface, technically known as the "screen." Clergymen and mission-hall lecturers generally will probably be glad to hear that, provided the lantern can be well lifted up above the audience, and so arranged that its objective is exactly at right angles to the projected image,* a neatly-plastered end wall, limewashed, is the best possible receiving surface. At Firth College, Sheffield, the electric lantern is placed in the gallery about seventy feet away from the platform, the back wall of which is covered by a thick coat of a special kind of paint, manufactured, I believe, from zinc white. Sheets are made from linen or "union." The latter, in addition to being fairly cheap, is quite good enough for all everyday purposes. Calico and linen are quite porous to light, as you can easily see for yourself by standing at the back of the sheet during an exhibition. Opaque sheets, faced with a peculiar white washable material, have been designed in order to prevent this light loss. Whilst strongly recommending them to those whose pockets permit of luxuries, I would point out that they want "taking care of," and cannot be handled in the

*If the sheet be vertical, and the lantern tilted, the most unpleasant distortion will result. If it is necessary to tilt the lantern upwards, the screen must be tilted forwards through a corresponding angle.

same rough-and-tumble fashion as the ordinary sheet. With regard to size of the sheet, a cloth 10ft. square is ample for most amateur requirements. Each extra foot of surface means so much extra trouble in putting up and taking down. See that the join or seam is placed horizontally. At a sale some years ago I was lucky enough to pick up a seamless sheet 9ft. 4in. square. That little sheet has been a god-send to me, as by its means I have been enabled to exhibit in the pokiest of low-ceilinged schoolrooms. Don't despise a small sheet. I have often smiled at the huge expanses of canvas toilsomely erected on creaking, bulging frames by aspiring (and perspiring) exhibitors. A 10ft. picture, well lit, is infinitely more acceptable to the average audience than a 20ft. circle of parti-coloured dimness.

Silver-faced Screens.

An enormous gain of light is produced by projecting the picture on to a screen coated with silver leaf, but this gain is only apparent as long as the picture is looked at directly in front; seen at an angle its brilliancy rapidly falls away; other disadvantages are unevenness and a queer unpleasant tone. Silver powder dusted on to a suitable surface gives a result little better than a distempered opaque surface. After endless experiments, Messrs. Anderton and Lewis Wright have produced a peculiarly striated silver screen, coated with a tarnish-preventing lacquer, which I find has none of these drawbacks. Screens made on this principle may be had from Messrs. Field and Co., 142, Suffolk Street, Birmingham.

The Screen and its Supports.

A screen may be either suspended by means of cords, or stretched by means of tapes to a light

wooden frame. A lanternist who travels much will have occasion to adopt both plans. Have a broad hem along the top of your sheet tightly containing along its whole length a piece of well-made sash cord—there must be no sagging or creases—leave a few inches out of each end of the hem, and make a sort of eyelet by doubling and binding. Down the sides fasten small curtain rings about eighteen inches apart. In the roof or in the walls insert a couple of screwed hooks, run a length of sash-cord through each, attach to the hempen eyelets alluded to above, and pull up the sheet just as if you were hoisting sail, and secure the free ends tightly to nails or screweyes fastened in the floor. By lacing a piece of picture cord, zigzag fashion, alternately through the rings at the side of the sheet and round the cords, the whole contrivance can be braced up as taut as possible. Mr. Hepworth is great on this subject of the sheet, and I don't think I can do better than to refer the reader to Chapter VI. of his "Book of the Lantern." Those frames which are built up in sections have the great advantage that, by removing one or two of the rods, they can easily be adapted for varying sized sheets. Added to this, the frame can be built up section by section on the floor of the room, and then lifted into position by a couple of boys. By means of the straps fastened to the feet the attached sheet can be bent forward to any reasonable angle.

Small transparent screens for lecture-table experiments can be made out of the largest sizes of tracing paper gummed on to a slender wooden framework.

CHAPTER V.

LANTERN SLIDES.

THE earliest slides were delicate paintings on glass, sometimes almost a foot in diameter. The cost of such a series of transparencies was enormous, and titanic condensers had to be used for their projection. The application of photography to lantern-slide making soon brought both apparatus and slides within manageable and purchasable limits. Nowadays, slides of excellent quality are turned out by the thousand, and, thanks to the advent of the gelatino-bromide plate, the schoolboy even is able, by means of the camera and his "Aladdin's lamp," in the shape of the optical lantern, to give delight to his seniors.

Photographic Slides.

Although this little book is not a treatise on photography, perhaps a few words on photography in general and lantern slides in particular may not be out of place. Those readers who are already amateur photographers, and, as such, "highly superior persons," are advised that these few lines are not intended for them, and are recommended to skip them.

A single achromatic lens *(vide* page 13) of an inch in diameter, modified by certain pieces of metal perforated in the centre, called "diaphragms" or "stops," if placed in the hole in the shutter, would probably give a delightfully crisp image

of external objects on a piece of white cardboard placed at a distance of about six inches. Now, we will block out the light streaming through this lens, and, by means of a red lantern, adjust at precisely the same "focus" a gelatino-bromide plate, that is, a plate whose surface has been covered by gelatino-bromide. "Gelatino-bromide? What on earth's that?" cries the impetuous enquirer. "A marvellous light-sensitive salt broken up into infinitesimally small molecules, evenly distributed through melted gelatine, which, when dried into a film or pellicle, still retains the light-sensitive molecules." We will uncover the lens for one second only, and a bright, sparkling image of the neighbouring landscape falls on the primrose-yellow surface of the plate. Close the shutter again, bring the red lamp, and scrutinise the plate. You can't see anything, but, for all that, a subtle change has taken place in the molecules of the light-struck plate. Place it in a developer—a queer mixture of pyrogallic acid and very weak ammonia. Soon the sky comes out as a broad, black band, soon we see the trees outlined in white against a dark background, soon we have that joy of all photographers—a developed plate. What has happened? Everywhere that a light ray has touched, the molecules have been brought into a developable condition. This dainty image that you see is formed of metallic silver in a marvellously-fine state of division. But what about the part that hasn't been acted upon by light? You said it was primrose hued. Quite so. Just give the plate a wash, and dip into "hypo"—the chemist's abbreviation for a solution of hyposulphite of soda. The yellow, creamy film clears, and we have a brilliant REVERSED replica of our landscape, every subtlety of tone being represented by the blackish grey of reduced silver. When well washed and dried, our NEGATIVE is ready for the production of a POSITIVE

or unreversed image. Now suppose, in our dark room, and under the glow of the red lamp, we press another "dry plate" into contact with the film of our negative, and expose for an instant to daylight, the same process is repeated. The chemical rays of the sun, striking through the clear parts of the negative, and proportionately through its half-tones and partially-obscured portions, would act on the sensitive film beneath. Were this film now dexterously developed and fixed, a transparent positive, a lantern slide, in fact, would result. There are hundreds of cameras on the market, and myriads of brands of plates for the manufacture of both negatives and positives. Buy a simple manual, and experiment for yourself.

The negatives once secured, lantern transparencies—beautiful little photographic pictures on slips of glass 3¼in. square—can be made in two ways, either by REDUCTION or by CONTACT. In the former case, the negative is again photographed on a reduced scale, and the resulting picture, when washed and dried, is masked and framed, so to speak, by a piece of opaque paper, and then protected from injury by a cover-glass of exactly the same dimensions. My photographic energies for years past have been devoted to the production of "contact slides," that is, light-printed slides produced by actual contact with the original negative. "Quarter-plate," which gives an oblong picture 4¼ x 3¼, is an extremely popular size, and, although, in a great number of cases, an artistic picture can be got from a portion of the negative, yet it must be obvious that there are occasions when, despite the utmost care in selection, we can only secure an unsatisfactory result. In order to obviate this difficulty, some five years or so ago, Messrs. Swift specially ground for me a lens on the lines of their "Detective Paragon" series, giving a 3¼ x 3¼ lantern size negative

sharp to the edges. The lens can be adapted at a moment's notice to either my hand or stand camera, and by its aid I have secured home-made lantern slides of scenes of everyday life all over the world.

Preparation of Lantern Slides by Non-photographic Methods.

A lecturer may have occasion to exhibit at very short notice diagrams containing figures or drawings. If a blackboard effect be required, take a small piece of camphor, and, after igniting it, allow the smoke to coat a 3¼in. x 3¼in. slip of glass. A black opaque film results. This film can be very easily removed by means of a sharp-pointed pencil, leaving the matter in clear white lines on a black background. By means of a vertical projecting apparatus, or Mr. Hughes's drawing slide, this effect can be produced on the screen, and the drawing actually made before the eyes of the audience. Any design or drawing can easily be painted on plain glass by means of well-diluted Brunswick black. Similar drawings can also be made on spoilt gelatine plates with ordinary Indian ink in which a pellet of bichromate of potassium has been dissolved. After drying in daylight the plate is dipped into the ordinary fixing bath, washed and dried, and is then ready for use. Ladies and gentlemen possessed of a little artistic talent can easily produce the most dainty pictures with a minimum of trouble. The finest possible ground glass, similar to that used for focussing scenes in high-class photographic apparatus, affords a most delightful surface for the pencil, and drawings can be executed with as much facility as on cartridge paper. The drawing on the semi-transparent glass is rendered completely pervious to light by means of ordinary copal varnish, poured in a pool into the centre of the slide, allowed to flow to the corners, and then drained off. The plate is then allowed to

dry, and if necessary is coloured. Striking advertisement and electioneering slides can be produced by printing on thin gelatine tissue—"Plump for Blufkins," or "Buy Twist-'em-up's Pills." Installed in a corner of my laboratory I have a beautiful little printing office, and I often set up the matter of a "title" or "notice" slide in letterpress, using a film of gelatine or a clean celluloid film instead of paper. The ink lines are immediately dusted with fine bronze powder, and become absolutely opaque. Well-drawn process blocks thus reproduced make excellent lantern slides. If the lines of the cut are bold and severely simple, you can print at once on to an ordinary coated film and then dip at once into the fixing bath; then wash, dry, and mount between two cover-glasses.

Slide Painting.

No matter what enthusiastic amateurs may say to the contrary, the fact remains that plain monochrome slides, no matter how good, are apt to weary an average audience. Not very long ago a refined and artistic lady of my acquaintance said to me, "After I have been looking at a series of judiciously tinted lantern slides, the advent of an uncoloured picture is quite a disappointment." I give the following hints to those who wish to add the advantages of colour to their lantern slides. The best results with UNVARNISHED gelatine slides and VARNISHED COLLODION TRANSPARENCIES are got by a combination of transparent oil and water coloration. Varnished gelatine slides must be coloured entirely in oil, as water colours "strike through" the varnish and swell the subjacent gelatine.

The following articles and colours are requisite:

LIST I. WATER COLOURS.

Bottle (1d.) red ink.

Strong alcoholic solution of eosin (can be subsequently diluted to any extent).
Strong solution of saffron (as used by chemists for colouring medicines).
Whittaker's photo yellow.
Whittaker's photo grass green.
Saturated solution of phosphene (a foxy-orange colour used by saddlers).
Eight ounces enamel collodion.
A piece of sponge.
A few good quality brushes of various sizes.

List II.—Oil Colours.

One tube BEST Prussian blue.
One tube Chinese orange.
One tube crimson lake.
One tube Italian pink (yellow).
One tube burnt sienna.
One tube verdigris.
One bottle Rowney's oleo-Excelsior medium.
One small bottle Canada balsam.
Turps (twopennyworth).

The colouring of a GELATINE slide can be commenced from the moment that the washing is thoroughly completed. With a gritless sponge mop off all superfluous water, and on the clear, tacky surface boldly paint in WEAK tints (all the colours can be thinned by water) the fundamental colour basis of your picture. Roads, sandstone rocks, etc., can be indicated by phosphene in greater or less stages of dilution; hedges, trees, lawns, and fields can be filled in with a half dry brush charged with the photo green, whose crudeness when dry can be partly removed by a diluted wash of the reds mentioned in the first list. The yellow of golden twilight and evening sunset is best rendered by a weak solution of saffron or picric acid, which, if necessary, can be

warmed and mellowed by a subsequent wash of reddish hue. The groundwork having been satisfactorily completed, the plate is allowed to dry, and then touches of more concentrated red, orange, yellow, or green are put on—this constitutes the second painting. When thoroughly dry (and it is well to ensure this by holding for a few moments before a clear fire) the cooled plate is coated negative fashion with enamel collodion, which not only renders the previous work more transparent, but affords a magnificent surface for the reception of the final oil colours. Whilst the collodion is drying, squeeze out on to a china plate a small dab of Prussian blue, and pour out into an eggcup a little of the medium; take a moderate-sized brush, dip in the medium, and with its point pick up the tiniest portion of the blue, mix to a suitable tint, and, with longitudinal strokes, proceed to paint in the sky, blowing on the plate gently the while in order to spread the colour; when the paint seems slightly sticky, and the brush works a little stiffly, gently dab the blue tint with the pad of the ring finger (all cutaneous ridges having been previously removed by an application of soap, water, and pumicestone). Never mind the colour spreading on to other parts, keep on dabbing. After a little practice you will be able to produce a beautiful blue textureless film of colour. With a scrap of linen just damped with turps wipe away any superfluous colour, softening down any harsh edges with the finger tip. The blue, of course, can be combined with lake in order to secure purple tints, but the colour will not work nearly so well, and the amateur at first will probably find finger marking very apparent in the finished picture. The best results are secured by care in the first stage of painting. Now take a piece of soft wash-leather, twist it into a point, moisten with the merest suspicion of turpentine, and at the point

where the evening hues melt into the bluer portion of the sky faintly wipe out clouds, softening their edges with a dry brush or, better still, the far more sensitive finger tip. The most exquisite effects can be produced in this simple manner by an artistic and dainty touch. Treat any water reflections in a similar fashion, and then place the partly-finished slide in an empty grooved plate box, and put into a warm, but not hot, oven for about half an hour. This produces a curious kind of japanning effect on the colours. When cool, paint in the other colours, sometimes dabbing, sometimes brushing them on; on trees and large masses of foliage a bolder touch can be used, and colours can be combined and contrasted more freely; a little Canada balsam added to the medium will hasten the drying of the colours. Place in the oven once more, and, except for the mounting, your slide is complete, and if care has been taken to avoid dust, you will have a most beautiful miniature on glass, very different indeed to the ordinary commercial slide, whose gaudy primary colours seem to "shout" at you.

Ordinary slides, made by means of wet or dry collodion, are usually coloured with oil throughout. I adopt rather a different plan, which, although it gives more trouble in the first instance, leads to incomparably better results—a delightful softness and transparency resulting. I have before me on the table a positive by Valentine, representing the beautiful Town Hall of Leyden. In order to produce the ruddy tint of the old brick and stonework, mix on a white plate a tint composed of suitable proportions of the very best TRANSPARENT water colours (moist), the principal components being crimson lake, Italian pink, and burnt sienna. To ensure coherency, add a drop of gum water and a trace of oxgall paste; charge the brush with the colour, and make a trial test on a blank part of your palette or

a piece of chemically-clean glass. When it works pretty smoothly, sweep a tint across the required portions of your slide, distributing the colour by blowing. Put on one side, on a level place, free from dust. When dry, all streaks will have disappeared. By breathing on the slide and dabbing, portions of the tint can be lightened, superfluous colour and such items as the white window sashes and the high lights on the stonework being picked out with a damped rag twisted round a pointed stick. The tiled roof and neutral-tinted road can be coloured in the same manner, and, when dry, should be painted over very sparingly with the oil medium, which acts as a varnish, and at the same time imparts a high degree of transparency to the delicate water colour tint underneath. The sky and clouds are now painted in oil colours, and the slide completed as in the previous case.

CHAPTER VI.

HOW TO LECTURE.

I NOW come to the most difficult part of my task. I have shown you how to use your apparatus to the best possible advantage, but I cannot render your lectures successful or yet make good platform hands of you. A good lecturer, like the poet, is born, and not made. That peculiar power of grasp over an audience that some men possess is inborn, and cannot be acquired by any amount of elocutionary drilling, although good manners, good matter, and good pictures will go a long way towards making a lantern lecture entertaining. I say, unhesitatingly, that the bulk of amateur lectures are dreary affairs, consisting of unrehearsed and twaddlesome talkee-talkee. Take a leaf out of the pressman's book, and ruthlessly cut down all superfluous verbiage. Avoid long perorations, don't give your audience too much introduction, or it will introduce itself into the nearest refreshment room. Mere gossip is detestable. In speaking of personal adventures, don't allow that seductive little pronoun I to creep in too often. Replace it as far as possible by the newspaper "we." Audiences dislike a "cheeky" and egotistical speaker. Avoid that foolish habit, which has been the ruin of many good voices, of addressing your remarks to the sunlight or chandelier on the ceiling. Keep your larynx in the position in which God placed it, and not a strained or unnatural one. Don't babble, and don't bawl. Speak slowly, and

you will be heard distinctly. Don't keep maps, diagrams, and mere illustrations on the screen a moment longer than necessary. Your more "fetching" slides may, however, be allowed to linger a little longer. The operator and the lecturer should be in such close touch (thanks to previous rehearsals) that signalling is unnecessary. Should it be advisable, however, to give the operator a hint, a single stroke electric bell (minus the gong), or a hand push, is the best contrivance, as the click of the armature is heard by the man it is intended for, and not by the audience generally. In default of a better appliance, I sometimes use one of the spring castanets so popular amongst schoolboys a few years ago. Thumping with the pointer, and the employment of such catch phrases and cues as "we see before us," "we pass on," "we are now gazing at," are exceedingly annoying, and should, by all means, be avoided. Rehearse every word you are going to utter, both mentally and orally. If possible, write out your lecture and commit it to memory—no difficult task when you consider that your pictures serve you as notes and headlines. One hint more, and my sermon is finished. Do, for goodness sake, put a little life into your efforts. Remember that genuine humour is the salt of existence. Put your audience in a good temper, and they will forgive a great deal.

I have endeavoured so far to give my readers a plain, matter-of-fact account of the manipulation of the optical lantern. In subsequent chapters, the management of biunials, triples, and the refinements of "dissolving views" will be dealt with.

CHAPTER VII.

THE PROJECTION OF ANIMATED PHOTOGRAPHS.

ANIMATED photography is a wondrous development of the "wheel of life" toy thing that used to amuse us in the sixties. The long paper slips of jumping clowns, dancing harlequins, and extraordinary hair-cutting proceedings are replaced by long ribbon-like slips of transparent celluloid ranging from twenty to seventy, eighty, and, in exceptional cases, many more feet in length, on which are photographically printed hundreds upon hundreds of tiny little positive photographs somewhere about the size of a postage stamp; along the edges of this much bepictured ribbon are a series of perforations which fit on to the projections of a sprocket wheel driven by clockwork. We can now understand that if this apparatus and long series of midget transparencies be placed in the position usually occupied by the lantern slide in a projective apparatus, and put in motion, we shall—thanks to "persistence of vision"—have something akin to our old zoetrope illusion. Unfortunately, the matter is not so simply disposed of, for, in addition to being propelled forward by the sprockets, the film has to be tautened and to stand stationary for some infinitesimal proportion of a second, a shutter has to fall, and during an almost imperceptible eclipse another little picture has to replace its predecessor, and so on for from fifteen to twenty times a second.

To achieve this result a multitude of cinematographs, animatographs, and "graphs" and "scopes" by the score have been invented. A few of the appliances sold simply project on the screen an image of the film supplied by somebody else, *i.e.*, the machine simply manipulates, so to speak, a ribbon of film bought in exactly the same way as a Kodak cartridge. In a large proportion of cases identically the same mechanism is used for taking the photographs, and for subsequently projecting the finished pictures. In special cases the little cinematographic photo-lens of short focus (two or three inches) is replaced by a projection one suitable for the requirements of a large lecture hall or theatre. The films sold by dealers are of two varieties. Those of the Edison gauge are about one and a half inches wide, the picture occupying one inch. Along the sides of the strip are cushion-shaped holes one-sixteenth of an inch across. Four of them go to a picture about threequarters of an inch high. The Edison gauge is based on the measurements of the films supplied to the Edison kinetoscope. In the Lumière films the perforations are quite different, and cannot be employed on an Edison machine, for although the pictures are somewhere about the same size, there is only one round hole two millimetres in diameter on each side of a picture. A few machines now on the market can be adapted for either gauge. In one ingenious contrivance the sprocket wheel is replaced by a spring finger, which tightens the slip by gripping it in the neighbourhood of the perforations, a little blunt projection actually dipping into the depression caused by each little punched-out hole in the celluloid.

Cinematographic Optics.

Gelatine and celluloid are capable of blocking out

a surprising amount of light. Sometimes more than half the time that any series of pictures takes in its exhibition is spent by shutter action, added to this the tiny picture is proportionately magnified nine or ten times as much as the average lantern slide; from this it follows that the illumination must be exceedingly good. A blow-through, except for very miniature pictures, is useless; the ordinary mixed jet suffices only for very ordinary pictures. For a large hall or theatre a powerful Gwyer's jet or hand-feed arc lamp is a necessity. On account of the minute size of the picture, the film must not be placed close to the condenser, but at a point much nearer the objective, where it will intercept the cone of rays passing through the condenser almost at its apex—just sufficiently far off to avoid chromatic fringing and uneven lighting. Supposing we had a two-inch objective, a one-inch film picture, and a four-inch condenser, the condenser would have to be placed six inches from the film and eight inches from the front lens of the objective. The heat concentrated by the coned rays would fire a celluloid slip in a very short time, and to avoid such an unpleasant experience it is necessary to have a glass cell of water, or, better still, alum and water, between the condenser and the film. Never allow the light to shine through a resting film unless so protected. The condenser may be bodily replaced by a perfectly spherical vessel of water with a pipe at the top for the escape of steam. The boiling point of glycerine being very high it may be used to replace the alum solution in the heat-absorbing tanks. Anhydrous glycerine may be used in a cell between the condenser and the electric light.

I almost fancy I hear the perplexed reader exclaim, "Well, Mr. Jack-of-all-trades, what is your advice about cinematographs, their purchase, and use?" In reply I would say that, as far as the question of

purchase is concerned, you ask me a question that I have great difficulty in answering. There is much of a muchness about cinematographic apparatus. Many of the so-called improvements are mere fads, and I warrant that if the patent specifications were thoroughly overhauled, comparatively few of them would "hold water." In view of the recent stringent regulations of the London County Council, it is advisable to have a fireproof apparatus, or one where the spool of film is automatically reeled up within a metal case immediately it has passed the condenser beam. Ether should not be used. An asbestos shutter is suggested as a means of preventing access of light and heat to the celluloid during the time that a film is stationary.

A long list of apparatus and makers' names is given in the appendix.

Projection of "Natural Colour" Lantern Slides.

Ives's krömsköp or photochromoscope resembles an ordinary stereoscope in appearance. On looking through its lenses, however, you see a little picture standing out in bold relief, and glowing with all the hues of nature. There are three sets of stereoscopic pictures whose original negatives were made through screens of red, green, and a blue tending to purple or violet. When positives are produced from negatives so prepared, we have, so to speak, three stencils, and when they are backed, or are looked at through screens identical with those through which the original negatives are taken, the colour effects present at the time will be reproduced with a marvellously close approximation to the truth. Optical, spectroscopical, and chemical difficulties have very, very nearly been overcome, but not quite. Photographic plates are still too sensitive to blue and the invisible actinic rays; they

are practically insensitive to deep red, and a lot of chemical coaxing is necessary to make them render green properly. Infinite care, too, is required in order that the tinted screen shall let through or block out just the right proportions of red, green, or violet light.

The krömsköp has been modified for projection purposes. Very pretty it is to see three small monochrome pictures of a vase of flowers or still life on the screen. The three screens are then put *in situ*. Result—three separate coloured discs in which you can just discern the faint outlines of the three pictures. A touch is given to the apparatus, the three discs blend, and a miracle is worked under your very nose; all raw colours disappear, as if by magic, and are replaced by nature's own tender tints and colorations.

The apparatus is put on the market by the Krömsköp Syndicate.

Dr. Joly's "Natural" Lantern Slides.

Dr. Joly replaces the three screens of Ives's process by a glass plate in which are an infinity of very fine diamond-ruled grooves filled up with transparent red, green, and blue-violet varnishes. The negative is taken through this, a positive is produced from the negative, and when the resulting positive has an identical colour-lined screen exactly superposed upon it, a coloured replica of the landscape, picture, or model will be produced. If the positive and carefully-adjusted colour screen be placed in the optical lantern, a picture will be thrown upon the sheet. The best effect will be produced by the spectator standing at such a distance, and permitting only of such a magnification of the

pictures as shall prevent the separate red, green, and blue lines from showing too plainly as isolated colour elements.

"Biunials," "Triples," and "Dissolving" Views.

In "biunials" and "triples," two or three optical systems, with their attached illuminants, are perched one atop of another, the object of this vertical arrangement being to secure facility of management in the production of "dissolving views." Thanks to careless and incompetent operators, this charming illusion is now at a discount. As seen at their best—say in the old Polytechnic entertainments, or Mr. Malden's lectures—a picture would be thrown upon the screen, perhaps a grim, dreary winter's landscape; a sullen sun sets, and glow-lights twinkle in the cottage windows, soon the moon rises, and frozen rut and frost-rimed hedges are outlined in silver. These changes follow one another imperceptibly within the charmed circle of the optician's limelit disc. How's it done? Well, almost everybody knows nowadays, and perhaps that is the reason why it is done so badly. As practised by many professional entertainers, "dissolving" is a grotesque and unnatural performance. When properly done, and when some degree of taste is shown in the selection of suitable slides, the effect is supremely beautiful. In the days when slides used to cost from twenty-five to fifty shillings apiece, showmen were willing to take a little trouble to secure the best results. In their side-by-side lanterns they would have paintings identical to a hair's-breadth, exactly similar in their principal outlines, but varying in colour according as the surroundings of day or night or summer and winter were desired. First of all, the two discs of light from the two lanterns were carefully centred, so as to exactly superpose.

Then the pictures, in standard wooden frames, with a certain definite sized opening, were placed *in situ*. Both lanterns were lit, and then pictured images, painstakingly adjusted by marks, stops, filing a bit off here, gluing a bit on there, till the "effects" corresponded precisely. Such slides were then said to "register" correctly. The light was shut off from each lantern alternately by a fan-shaped piece of metal notched with prolonged serrations.

When one can purchase "Gabriel Grubb," coloured and complete with dioramic effects, for a few shillings, it is absurd to expect accurate registration. I maintain, and maintain most strongly, that for ordinary teaching purposes, and the delivery of semi-scientific lectures, or addresses illustrated with slides from the nearest optician, the single lantern, with its single light, is far and far away the most useful. The lantern with me has been a hobby for many years, and the hints given in the succeeding pages are only intended for those who are willing to take a little trouble. I perhaps have a little advantage over my fellows in being a bit of a draughtsman and a fairly expert photographer. I have to work very hard for my daily bread, and my annual camera-accompanied holiday is thoroughly enjoyed. The "snap-shots" taken during the summer are made into lantern slides, and exhibited during the winter. As you develop your pictures, and as you colour them, ideas grow, and pleasant recollections are conjured up; as you potter round your lantern, testing your registration, these ideas simmer and coalesce, and, almost before you are aware of it, a new, bright, crisp lecture has been evolved. Surely this is better than delivering someone else's lecture illustrated by someone else's slides. I have a little memorandum book, and when a nice, catchy, semi-alliterative title strikes me, down it goes. A good lecture can easily be

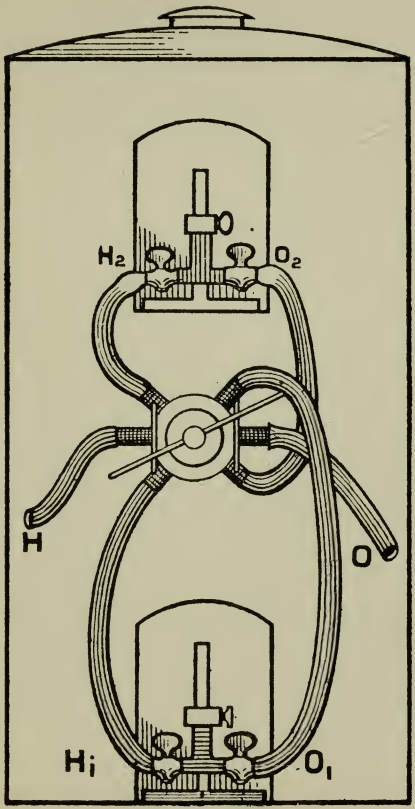
written round an attractive title. There is far more in a taking title than people imagine.

The Management of the Biunial.

To save space and to prevent myself going over the same ground unnecessarily, I shall presume that my reader has purchased a good class limelight biunial, complete with dissolver and "mixing" or "blow-through" jets. Thoroughly good regulators on the bottle or bottles are a *sine quâ non.*

You had better make your first trials in the same or a similar room to the one in which you intend to give your first exhibition, as adjustments vary according to distance from the screen.

Now let us have a look at the apparatus. The fronts, stages, and condenser are attached to the lantern body by thumbscrews, and a downward inclination can be given to the lenses of the upper lantern, and an upward one to the bottom. It is of extreme importance that the AXES OF BOTH CONDENSERS AND OBJECTIVES SHOULD BE IN THE SAME STRAIGHT LINE, otherwise endless hitches and bothers will occur. Between the slide-stage and the condenser is sometimes found a long strip of cut-out brass, so arranged that when one condenser is eclipsed the other is open. On raising this brass sheet the light is shut off one picture in exactly the same proportion that it is admitted to the other, and, as the movement takes place behind the slide in immediate proximity to the condenser, an effect exactly like the rolling up of a stage "drop" is produced; maps, etc., can thus be "rolled" up and down, and an agreeable means of changing the pictures is introduced. Dissolving is not produced by means of a double serrated fan; that would mean two lights constantly burning. Gas is economised, and the dissolving effect brought about by producing the light


H2
O2
H
O
H1
O1

at will in either lantern by means of a most ingenious "six-way" plug tap figured in the drawing on the preceding page. *Insist on the rubber tubes being properly adjusted before the apparatus is delivered.* As the matter is of great importance, I have thought it advisable to indicate the method of connecting up by means of diagram.

To Light Up a Biunial.

Turn on both H taps, turn on the H bottle, light the gas, and adjust its flame in both lanterns, turn the H bye-pass (the little tap on the left) till an inch high flame is left, just sufficient to warm the lime in the BOTTOM lantern; if it should turn down the light in the top lantern, just reverse the lever of the dissolver. Turn on O jet taps, open the oxygen bottle, and adjust and centre the resulting light in the usual manner. Now look at the bottom lantern. If the O bye-pass has been adjusted in similar proportion to correspond with the little neighbouring hydrogen tap, we shall probably see a little blue speck in the middle of the flame, or else a slight orange tint due to the tinge of the metal calcium (the basis of lime) being imparted to the jet flame. Reverse the dissolver handle, and again adjust light. Turn lights into BOTH lanterns and again adjust, otherwise one is apt to be more powerful than the other. Now take the carriers out of their stages and bring the two discs absolutely concentric by means of the thumbscrews and screw-washers placed at the top and bottom of the lantern. Next get your carriers as central as possible, insert two circularly-marked or two cushioned-shaped pictures into the carriers and adjust as well as possible. In spite of all your care in getting the first couple of views to coincide, the second couple, in all probability, will be a little bit out, and two circles, or two cushions, will be

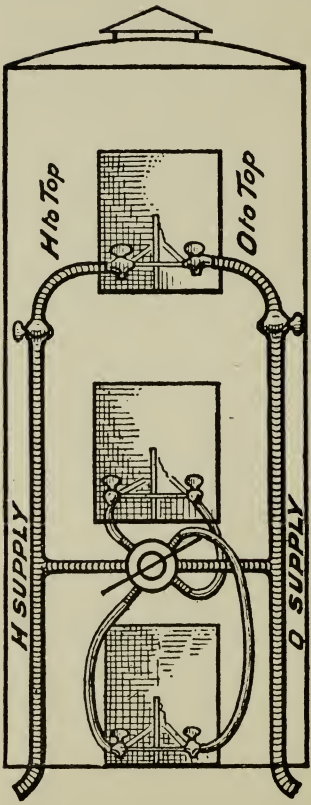
seen on the screen bisecting one another. This fault will be dealt with under the head of "Registration"; as it is you have learnt the ordinary "one-horse" method of producing an apology for dissolving views.

The Triple Lantern.

The management of the triple lantern is almost entirely identical with that of the biunial. As the arrangement of the dissolvers and somewhat complicated tubing is apt to worry a nervous operator, I append a rough drawing of the method I have hitherto adopted. It is simplicity itself, and is based on the fact that the third or top lantern is very seldom used* by the majority of operators, who have ample time to light up for special effects. To the right and left of the lower lantern the ordinary O and H supply pipes are replaced by brass tubing, the lower's ends being curved for the attachment of the necessary indiarubber tubing, their top ends being finished off with neatly-made gas cocks, and their middle being tapped for the supply of the dissolver between the two lower lanterns. Two or three inches of rubber piping makes the connection between the supply pipes and the top lantern complete. The top lantern is lit and the jet tap adjusted in the orthodox fashion, and when it works quietly the cocks on the supply pipe are almost turned off, leaving rather more H than O, however. The light can now be turned on to maximum intensity at a moment's notice. The bulk of the work is done by the lower lanterns, which are worked precisely as directed for the biunial.

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*In triples, the "rolling curtain" is generally placed between the middle and top lantern.


H to Top
O to Top
H SUPPLY
O SUPPLY

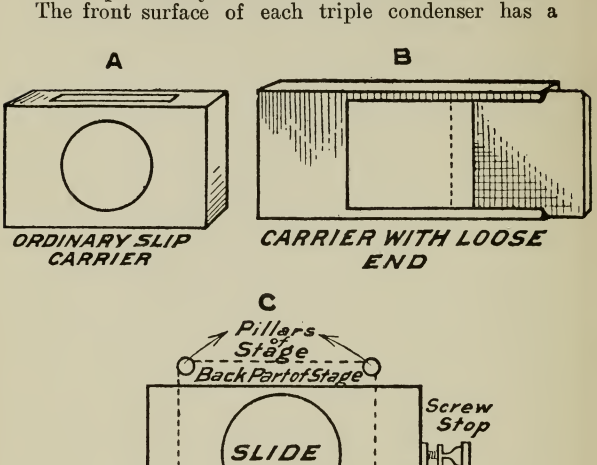
Registration.

The registration of two or three dozen slides fresh from the dealers is almost a matter of impossibility. They may be marked apparently carefully, but just take a pair of compasses and measure, and some of them will be found to be almost $\frac{1}{8}$in. out of centre. This slight untrueness magnified on the screen is most painfully noticeable. The best plan under such circumstances is when you get the signal to dissolve, dissolve as quickly as possible, and clap the flashing shutter or a lens cap over the temporarily disused objective to instantly stop any light from the still incandescent lime. If the slides are your own property, and you employ Beard's self-centring carriers, much may be done by readjusting the masks and gumming on bits of cardboard here and there. This form of carrier is supplied with removable metal masks, which, being placed in the lantern stages of a triple, and properly adjusted, would give perfect results were all slides printed to the edges, but as it is the masks are a little too large for the ordinary run of slides.

A thoroughly practical plan in dealing with the slides that illustrate fairly permanent lectures is shown at fig. A on page 82. The circular opening in the wooden frame is exactly the size of the ordinary circular mask. The unmasked slides, PRINTED TO THE EDGES (no difficult task to the amateur), are dropped in from above. Each of these standard frames is an exact facsimile of the other; any little lack of truth can easily be corrected with the aid of a glue-pot, a file, and a very small spokeshave or plane. Special frames can be reserved for special effects. The actual registration is brought about by the runners and stop figured at fig. C.

Making my own slides I am able to gratify my own particular whims and fancies without let or

hindrance. When I employ dissolving views, which is comparatively seldom, I use a somewhat unusual form of apparatus, and one having the merit of extreme portability. The slides are without masks. The front surface of each triple condenser has a



closely-fitting cap of brass, the centre being perforated with a circular opening the size of the average rounded mask. On each side of this aperture are grooves with a suitable lifting arrangement, and the slides, themselves maskless and frameless, are dropped into the rabbet. A unique form

of rolling curtain is provided, and the performance of the apparatus, which will be placed on the market shortly, leaves absolutely nothing to be desired.

My task is done, and one more book is added to the myriad of essays on this fascinating subject of the lantern. "I have said," and I hope my sayings will prove acceptable to the thousands of lanternists scattered about the kingdom.

A NOTE TO THE READER.

Don't sneer at the catalogue-like character of the appendix, as the labour involved in the compilation of its terse alphabetical paragraphs has been simply enormous. I think, rightly or wrongly, that the next best thing to having knowledge is to know where to find it. The ensuing pages are intended to be a labour-saving index of ready reference to all sorts of odds and ends of information. I find that the amateur lanternist, like the amateur photographer, is a distinctly progressive individual. The lamp is soon replaced by the "blow-through," and the "blow-through" by the saturator. Friend Jones is dissatisfied with the performance of his dissolver. He turns over the next leaf or two, and under the duly-indexed heading of "Dissolvers" he finds a list of these instruments, and a reference to certain pages of the "I.L.H."—"Indispensable Lantern Handbook"—and other periodicals where the desired information, together with illustrative woodcuts, can be found.

APPENDIX.

ACETYLENE APPARATUS.—

The "Abingdon" generator, R. T. Moss, 10, Conduit Street, Abingdon-on-Thames.
The "Aladdin" generator, Tylar, Birmingham.
The "Auto" generator, Dundras Street, City Glasgow.
The "Bonaccord" generator, Smith, 23, St. Nicholas Street, Aberdeen.
The "Fowler" generator, 298, Marsh Lane, Bootle, Liverpool.
The "Incanto" generator, Thorne and Hoddle, New Tothill Street, London.
Read, Holliday, and Co.'s generator, Huddersfield.
The "Simplex" generator, 3, Bath Buildings, Putney Bridge Road, London.

APHENGESCOPE.—An apparatus whereby *cartes-de-visite* taken from the family album can be exhibited life-size on the screen. An enlarged image of a watch constitutes a very striking subject. The objective having been removed, a rectangular box is fitted on to the lantern front in such a manner that the object on exhibition is brilliantly illuminated by the rays from the condenser, an image of the brightly-lit coin or whatnot being transmitted on to the screen. There is a good deal of light lost in these experiments, but with a small sheet, and a well-lit subject, the results are both remarkable and attractive. It should be noticed that the lantern body will have to be nearly reversed in order to place the image on the screen, when the latter is in its usual position with regard to the objective.

ATTACHMENT, VERTICAL.—A contrivance whereby, by means of the two halves of the condenser being separated, and the aid of a mirror, objects that could not be shown in the ordinary vertical fashion can be projected. Sometimes the condenser is not separated. In these cases, the result is brought about either by a second mirror or a prism *(vide* "I.L.H.," pages 213 and 214).

BOOKS ON THE LANTERN.—

"Art of Projection." (Hughes.)

"Book of the Lantern." Hepworth. (Hazell, Watson, and Viney.)

"Indispensable Lantern Handbook." (Iliffe, Sons and Sturmey Ltd.)

"Light." Lewis Wright. (Macmillan and Co.)

"Lantern Operator's Guide." (Riley Bros., Bradford.)

"Modern Magic Lanterns." (Upcott, Gill, and Co., Strand.)

"The Magic Lantern: Its Construction and Use." (Perken, Son, and Rayment.)

"The Magic Lantern." (Wood, Cheapside.)

"The Magic Lantern, and How to Raise a Ghost." By a Mere Phantom. (I believe this book was written by Mr. Chadwick, of Manchester.)

"Magic Lantern Journal." (Taylor Bros.) 1d. monthly.

"Photography." (Iliffe, Sons and Sturmey Ltd.) 1d. every Thursday.

"Amateur Photographer." 2d. every Thursday.

The two last-mentioned give special attention to lantern matters.

BRIN'S PROCESS.—A name applied to a method of extracting oxygen from the air by means of oxide of barium heated to low redness in a partial vacuum. The air employed in the process is first of all freed

from impurity, and whilst in a condensed state subjected to the action of the heated baryta. The remarkably pure gas resulting is stored in large holders, and compressed into bottles. Brin's Oxygen Co., Westminster, supply London and the South. The Manchester Oxygen Company, Limited, Great Marlborough Street, Manchester, supply Manchester and the North of England. For particulars, apply to Great Marlborough Street, Manchester, direct. Mr. Tyler, oxygen maker, 4, Sheffield Street, Lincoln's Inn Fields, also employs this process. Parkinson's Condensed Gas Co., Stretford, Manchester.

CUT-OFF.—A name applied to a special form of jet devised by Mr. Pringle. After the necessary adjustments have been completed, the light can be turned down to a glimmer, and instantly turned up to full intensity *(vide* "I.L.H.," page 144).

CYLINDERS, or gas bottles, are reservoirs for the reception of compressed gases. They are made of mild steel, and tested to withstand a pressure of 3,000 lbs. per square inch. Small sizes can easily be hired, and are not worth while investing in. Twenty feet and forty feet bottles, which are the sizes recommended for purchase as a general rule, have somewhere about the following dimensions: 20ft. 4in. diameter; length, 32½in.; weight, 18½ lbs.; cost about £2. 40ft. 5½in. diameter; length, 33½in.; weight, 31 lbs.; cost about £2 8s. The price of fittings is approximately as follows: Fittings, nipple and union, 2s.; key, 2s. 6d.; regulators (with differential screw), 33s.; gauges, 30s.; connectors for old and new style valve fittings, 3s.

CARRIERS, SPECIAL FORMS OF.—

Beard's self-centring ("I.L.H.," page 426).

Curtain carrier ("Photography Annual" 1895, page 585).

Chadwick's "Eclipse."
Drawing-master slide ("Photography Annual" 1893, page 534).
"Presto" blind shutter ("I.L.H.," page 226).
"Pneumo" (Phœnix Works, Southport).
Tank slide for chemical experiments ("Photography Annual" 1893, page 534).

CINEMATOGRAPH MAKERS.—

Appleton, R. J., and Co., 58, Manningham Lane, Bradford.
Baxter and Wray, Borough Mills, Bradford.
Brown, F., 13, Gate Street, Queen Street, Holborn.
Bedts, George de, 368, Rue St. Honore, Paris.
Dallmeyer, J. H., Ltd., 25, Newman Street, London, W.
Dom-Martin, 51 bis, Boulevard St. Germain, Paris.
European Blair Camera Co., Ltd., 9, Southampton Street, High Holborn, London.
Fuerst Bros., 17, Philpot Lane, London, E.C.
Harvard, F., 28, Reedworth Street, Kennington Road, London, S.E.
Hepworth, Cecil M., 22, Cecil Court, Charing Cross Road, London, W.C.
Levi, Joseph, and Co., 97, Hatton Garden, London, E.C.
Maguire and Baucus, Ltd., 9, New Broad Street, London.
Noakes and Norman, 23, Nelson Street, Greenwich, S.E.
Otway, J., and Co., 178, St. John Street Road, London, E.C.
Paul, R. W., 44, Hatton Garden, London, E.C.
Riley Bros., 55 and 57, Godwin Street, Bradford.
Rider, Archibald, 83, Mortimer Street, Regent Street, London, W.
Underhill, Alfred, 32, Clarendon Road, West Croydon, Surrey.

Velograph Syndicate, Ltd., The, 242, London Road, Croydon.
Watson, W., and Sons, 313, High Holborn, London, W.C.
Wolff, Philip, 8, Southampton Street, Holborn, W.C.
Wrench, John, and Son, 50, Gray's Inn Road, London, W.C.

DISSOLVERS ("I.L.H.," pages 181 to 186).

EXPERIMENTS.—A large number of scientific phenomena, such as persistence of vision, retinal fatigue, complementary colour, double refraction, etc., can be demonstrated by the ordinary everyday lantern. If the lantern has in addition a vertical attachment, and the demonstrator possesses a little smattering of scientific knowledge, and just a little originality, an endless series of experiments, illustrative of nearly the whole range of physics, can be devised. As details of such experiments and demonstrations would spread out this book to the size of an encyclopædia, I shall content myself by telling the reader where he can obtain the fullest particulars of such experiments for himself, namely, in Mr. Lewis Wright's book, and also in Chapter XIII. of Mr. Hepworth's "Book of the Lantern," a volume which ought to be in the hands of everyone who realises the educational capabilities of the optical lantern.

The following simple experiments can be performed without any special apparatus:

Complementary Colour.—Punch holes in pieces of cardboard, and arrange pieces of tinted cracker gelatine over them, or devise something after the well-known "Pears' soap" advertisement.

Cohesion Figures.—Tint a little vaseline with any suitable colour, spread a thin film between two plain cover glasses, slip elastic bands over each

end, put in carrier, and separate plates slightly with point of penknife. Arborescent figures will then appear on screen.

Crystallisation.—Paint a clean cover glass with alcoholic solutions of urea and hippuric acid, or saturated solution of ammonium chloride.

Persistence of Vision.—Punch a needle hole in a card, and use as a lantern slide. Gaze fixedly at white spot on the sheet, then suddenly obscure objective. A faint image of spot will still remain.

Chemical Reactions can be shown with a few limitations. Precipitates chiefly by means of a tank slide.

Colour Forms of surpassing beauty may be produced by filling the hollow slide with alcohol, and allowing a single drop of any brightly-coloured aniline dye to just touch the surface of the liquid.

Vortex Rings or Wheels.—Fill tank with clean water, place in lantern stage. Dip a pencil-point into a little milk until a single small drop is formed on the end, just let this touch, or "graze," to use Mr. Hepworth's phrase, the surface of the liquid. For scientific slides and accessories *vide* "I.L.H.," pages 207 to 217.

Gas, Oxygen, Making.—Mix intimately four parts of chlorate of potash, free from sticks, chips, etc., with one part of black oxide of manganese, in powder; one pound of this mixture should yield four feet of oxygen. Make sure that the gasbag has not contained coal-gas. Then soften before a fire, and eject all air by rolling and squeezing. Fill retort about half full, connect up, and place retort on a moderate fire. The extra purifier is to catch water which otherwise would be forced into the

bag. Allow a little bubbling to take place before connecting with the gasbag, as a good deal of heated air has to be got rid of before oxygen pure and simple comes off. If gas comes off too quickly, lift retort off fire for a minute or two. When sufficient gas is made, remove retort from fire, and disconnect from purifiers at once. Turn off bag-tap.

GAS, OXYGEN, APPARATUS.—

Stedman's automatic generator (F. Brown, 13, Gate Street, Queen Street, Holborn, London, W.C.)
The "Rilford" generator (Riley Bros., Bradford).
Hydro-incandescent gaslight (The Welsbach Co.)
Oxy-incandescent gaslight (C. Sichel and Co., 52, Bunhill Row, London).

HYDROGEN GAS, MAKING.—Formerly made by acting on zinc with sulphuric acid, but ordinary coal-gas and compressed coal-gas are now used almost universally.

JETS, SPECIAL FORMS OF.—

"Cut-off" ("I.L.H.," page 144).
Bessus's jet clamp ("Photography Annual" 1895, page 581).
Injector jet (Manchester Hydrogen Co.)
Kershaw's ("Photography Annual" 1893, page 545).
"Newtonian" adjusting tray ("Photography Annual" 1895, page 589).
Place's ("I.L.H.," page 302).
Ross's "Radiant" (111, New Bond Street, London).
Staniforth's jet holder (Staniforth, FitzWilliam Street, Sheffield).
Simpson's "Non-whistling" jet (43, Sorby Street, Sheffield).
Steward's "Primus."
Willway 1,500 candle-power (Drawbridge, Bristol).
Woods's ("I.L.H.," page 402).

LAMPS, ELECTRIC, FOR LANTERN.—

Beaumont Queen's Staithe (York).

Borland's "Scissors" arc lamp (Leeds).

Hepworth-Ross arc lamp.

"Newtonian" arc lamp ("Photography Annual" 1895, page 588).

"Phœnix" (Reynolds and Branson, Leeds).

Ross's "New Model" projection arc-lamp (111, New Bond Street, London). (Vide *Photography*, October 6th, 1898.)

Steward's semi-automatic arc lamp ("Photography Annual" 1895, page 588).

LAMPS, READING.—

Candle ("Photography Annual" 1895, page 540).
Lamps, desks, etc. ("I.L.H.," pages 194 to 197).

LANTERN MICROSCOPE.—The adjunct to the lantern known as the lantern microscope is simply a variation of the ordinary table instrument, the tube being removed, and the light from the condenser, reinforced perhaps by a substage condenser, replaces the light thrown by the mirror of the ordinary instrument. In all the better-class instruments, an alum trough for absorbing heat rays is provided, otherwise the balsam of slides would be melted, and delicate sections injured. By means of this instrument, a fly's proboscis becomes of mammoth dimensions, and a flea assumes Gargantuan proportions ("I.L.H.," pages 207 to 210).

LIMES.—

"Noyce" (85, Nunhead Road, Peckham Rye).

"Marriott" (Nottingham).

"Hardazion" (enquire of dealers).

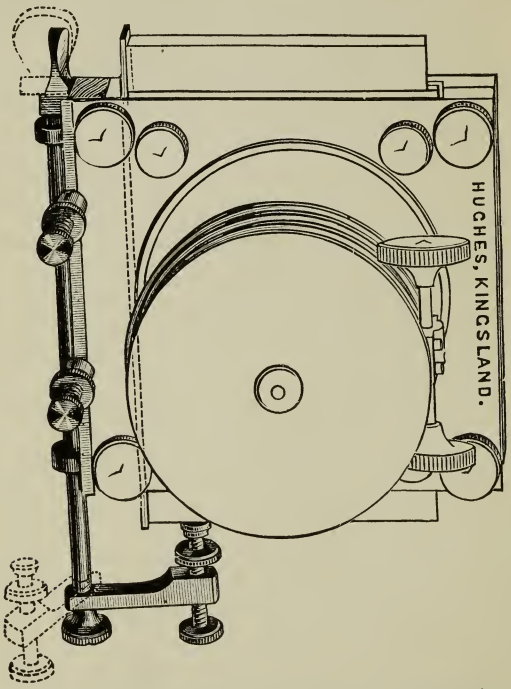
"Excelsior."

OXYGEN MAKERS.—*Vide* Brin's process.

REGISTRATION OF DISSOLVING AND "EFFECT" SLIDES.—If I were asked offhand, "What is the best system of registration?" I should say, "Take your choice of the methods of Messrs. Hughes, Noakes, and Steward." I and my acquaintances have had experience of all three systems. I strongly recommend a careful perusal of appended notes to all who are interested in securing PERFECT dissolving. Messrs. Noakes won't give away their system, so I am unable to do more than tell the reader that each lantern is corrected individually for optical and mechanical defects before the question of registration is dealt with.

Hughes's Registering Apparatus (W. C. Hughes, Kingsland).—This can be adapted to any upright or other lantern, and, worked in conjunction with the special register carriers, will bring every picture a dead centre on the screen, and once set will always remain so. This form of register is perfectly rigid and firm, and will, by an ingenious contrivance, fall over in order to allow of panoramic frame effects being centred without in any way interfering with the register of carriers, etc. Each carrier can be raised or depressed by means of the side screws and special platform arrangement which is attached to the registration apparatus. This produces true coincidence of discs, and compensates for the possible inequality of the stages of the lantern, and thus enables the operator in any emergency to register his slides and effects in any particular slide-holder of his biunial or triple. The carriers are most carefully centred in sets of twos or threes, as may be required, one set for square pictures and the other for circular—the point gained being this, that after the carriers are once

centred all other framed slides and effects can be registered likewise to them with absolute precision



and ease, without fear of failure or disappointment.

Steward's Centring Stages (J. H. Steward).—An arrangement of vertical and horizontal adjustments

and locking nuts, so that each lantern stage is set perfectly true at any angle or distance from the screen. The following description of the apparatus is from the "British Journal of Photography," and needs no fresh writing up on our part: "For existing lanterns, these registering adjustments are fitted to a metal-back plate that slides into the ordinary stage, and can be rigidly fixed in position by clamps. It also holds the metal masks for cutting down pictures to a definite size. So that without sending the apparatus to the optician, the owner can fit the patent improvements himself; and if he marks the sliding tubes so that they can always be placed back in the original position if moved, he can preserve the same relative optical angles. For it is found that a partial rotation of the draw tube disarranges the centring. In order to secure the preliminary adjustment of the lanterns prior to an exhibition, or before registering new lantern slides, special slides are employed. They can be of various designs, but for convenience those employed with the apparatus described are plane cross lines and letters in the open spaces. These are photographed by contact so as to be absolutely alike, and are then (by carefully calipering) fixed with putty into a frame very accurately made to a given size, say 7 x 4½ (or, if the smaller frames are preferred, 7 x 4). With these frames each absolutely alike in the lantern stages, the clamps (milled head) are released, and the adjusting screws raised or lowered, or moved backwards and forwards, until all the crosses and circles agree. The clamps are then screwed home, and the registration is perfectly fixed. For perfect dissolving of views and effects, it is a *sine quâ non* that all slides must be framed. A simple method of getting photographs and pictures central in their frames is to have the grooves made full large, so that if the

glass is not very exactly cut true, or the mat is not exactly central, the glass can be raised or lowered, or moved right and left, and the difference between it and the wood filled up with cardboard. If the view and the effect be held up to the light a very close approximation to superposition can be obtained, and then, when the slide is put in the lantern (previously adjusted, as explained), the frame can be planed off or added to, until the view and the effect, or the two similar views, exactly agree. For this purpose, a shooting board and plane are required, as well as narrow strips of mahogany and glue. From experience it has been found best, for new, unframed views and effects, to use mahogany frames having about one-sixteenth more wood on one edge than the other; this, then, in nearly every case, prevents any addition being necessary, and the process of planing off this superfluous wood is simple, until just the amount is left. Pieces can be added to the end of the slides that are short, and those that are long can have the part cut away just where the registering stop comes, or with photos down to a uniform size. There is a circular mask also included. The advantage of this carrier is that all slides are inserted and withdrawn from the same side, and each is automatically centred."

REGULATORS.—

Beard's ("I.L.H.," page 181).

Brier's metallic bellows ("Photography Annual" 1893, page 545).

Clarkson's bellows ("I.L.H.," page 180).

"Godwin" (Riley Bros., Bradford).

The "Duplex" (Clarkson, Bartlett's Buildings, Holborn).

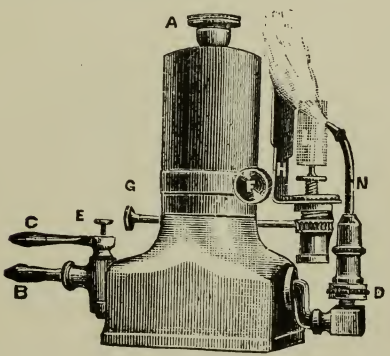
RETORTS FOR GAS MAKING.—

Saucepan form recommended ("I.L.H.," pages 167 to 170).

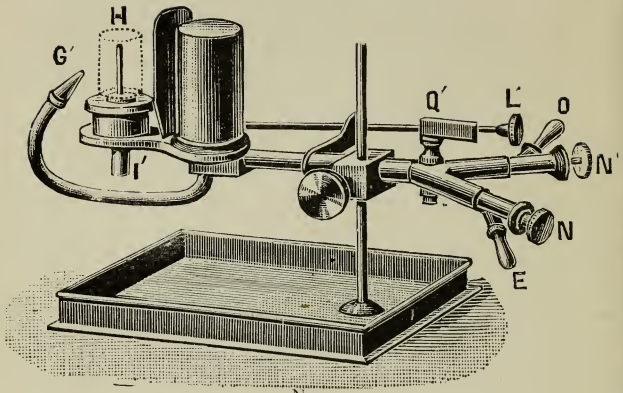
SATURATORS.—A well-informed dealer will give particulars of any of the following saturators:

Cutt's "Barrel" (Sheffield).
"Gridiron."
"Optimus."
"Pendent."
"Timberlake."

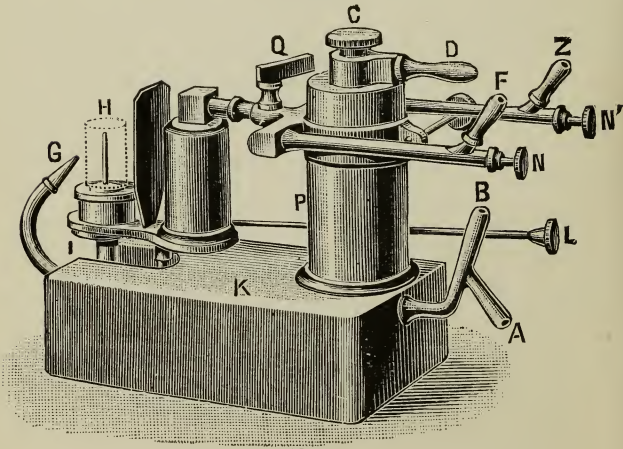
Sundry forms of saturators have been most carefully described in the pages of THE OPTICAL MAGIC LANTERN JOURNAL. The following working directions for Lawson's saturator are reprinted from the patentee's instructions:



The Lawson Patent Saturator obviates the use of coal-gas or hydrogen, and fits inside the lantern. With it the only tubing required is that which connects the saturator with the oxygen cylinder, hence



No. 1.



No. 2.

this apparatus enables the lecturer to take the lime-light into country districts which would never pay the expenses of two cylinders, and have no house-gas for use with safety jets. Giving a light far more powerful than the ordinary limelight, the apparatus is the most simple to work that could be devised. There is only one tap on the single saturator, so the operator cannot well get wrong, and, being quite independent of his surroundings, he is saved all anxiety and perturbation of mind. The expense, after the initial outlay, is no greater than with the safety jet, for the few coppers that it costs to charge the saturator are saved in the diminished consumption of oxygen. The saturator is absolutely safe, and can be knocked over with impunity. The saturator as employed for a single lantern is portability itself, and most easily manipulated. A somewhat different form of apparatus is employed for biunial purposes. The cut No. 1 represents the jet and tray attached to the upper lantern, whilst No. 2 represents the prime saturator and the attachments which are placed in the lower lantern. The two instruments are of course connected up by means of tubing, and the light burned from lantern to lantern by a simple form of dissolver. I should like to "spread" myself on the advantages of these dainty appliances, but as time, space, and printers' demands are inexorable, I must content myself by recommending those interested in the working of easily-managed ethoxo appliances to write for Messrs. Riley Bros.' lucid little explanatory pamphlet.

Slide Making.—"What plates do you use?" is a favourite question of amateur photographers. Good results, with the aid of patience and a little "brains," mixed with developers, can be secured on almost any of the numberless brands now on the market. Personally, according to the results

I wish to obtain, I employ (1) Ilford Special lantern plate; (2) Thomas's lantern plate; and (3) Thomas's print-out plate. (1) If I require cold blacks in reproducing dense snap-shot negatives, I employ "Ilford Specials," with minimum exposure and only faintly restrained ferrous oxalate or hydroquinone developer. (2) If I require warm, transparent blacks, with shadows that permit light to pass, I use Thomas's lantern plates developed with well-restrained hydroquinone. (3) If I want to suggest the russet autumn hues of a wood with its tawny tangled undergrowth I use "print out" plates, printing till the sky is quite dark, then I put into a combined fixing and toning bath. These beautiful slides are far too delicate to be painted on direct; they must be varnished or your paintbrush will abrade portions of the film. Full working directions are given with each box of plates, and details may be found amongst the various papers and formulæ in the year books of the photographic press.

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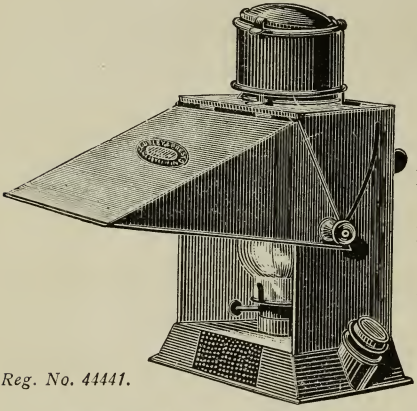
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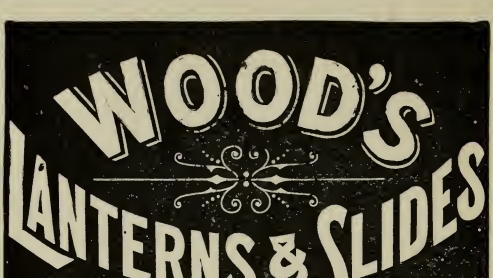
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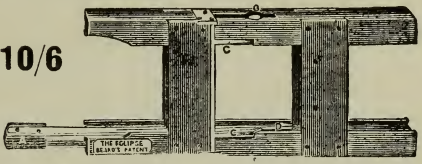
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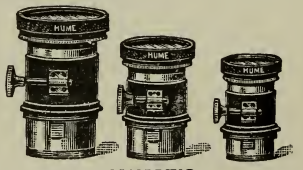
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