The Making of a Six-inch Reflecting Telescope—II.

Instructions for the Amateur Instrument Builder

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VII. SILVERING

We shall describe the silvering at this point, though in the actual work it is of course best to have the flat ready to silver at the same time.

The silvering method that is undoubtedly best for beginners is the one known as the Martin process. Its simplicity is one of its greatest advantages, and it does give good films. The solutions will be designated A, B, C, and D.

Solution A.—Silver Nitrate, 175 grains, distilled water 10 ounces.

Solution B.—Ammonium Nitrate, 262 grains, distilled water 10 ounces.

Solution C.—Loaf Sugar, $\frac{1}{2}$ ounce. Place this in a flask with five ounces distilled water, dissolve by heating, add 50 grains tartaric acid, boil for 10 minutes in same flask, then allow it to cool; add 1 ounce alcohol. Add water to total 10 ounces.

Solution D.—Caustic Potash, in sticks (of the grade known as purified by alcohol) one ounce; distilled water 10 ounces. Bottle for this solution must have a glass or rubber stopper).

So here are the four solutions. In the actual silvering, equal parts of A and B are mixed, in another graduate equal parts of C and D are mixed; then equal parts of these two mixtures are taken, mixed, and poured over the surface to be silvered. The solution darkens, and after a few minutes a coating of silver forms on the glass as well as on the sides of the vessel or dish used.

Clean the speculum by washing in warm soap water; wash off soap; then wash in solution made of 10 drops nitric acid in two or three ounces distilled water; wash

flexures due to temperature changes. If the upper surface only is exposed to the silver, it is evident that only one-third as much silver is used as if upper and lower surface of disc as well as the bottom of the dish are covered with the deposit.

The various washings, with soap, plain water, nitric acid solution, and the potash solution, and final washings with plain water and final rinsings with warm distilled water, renders the glass chemically clean. Do not let your fingers come in contact with the surface after it has been cleaned. Prepare several swabs as follows, and as shown in Fig. 16 (b) cut some rubber tubing into pieces about two inches long, slip one end over the tip of a clean stick, and into other end place a swab of absorbent cotton. Cotton twisted around the end of a stick alone is all right too, but a better swab is made with the rubber

water from the plate until you are ready to pour on the silver solution, because the plate must not be allowed to get dry even in a little spot, nor should it be allowed to get cold. The mixture made by combining solutions A and B, (call it mixture No. 1), and that made by mixing C and D (mixture No. 2), may stand a while, but of course Nos. 1 and 2 are to be mixed only when ready to silver. The glass with the water in which it is immersed cools rapidly, and it is advisable to have mixtures No. 1 and No. 2 ready, then test the temperature of the glass and water, and unless the water feels quite warm to the back of the hand, add carefully and gradually enough hot distilled water to bring up glass and water to the proper temperature. Then pour off water, mix 1 and 2, and as the solution darkens, pour it over disc, rock continuously, and soon the solution turns black, and a silver film forms over the mirror. Watch for the change where the liquid seems to begin to curdle; little specks of precipitate the size of pin points appear, the liquid part resembling to some extent "whey." At this point pour off the solution, wash with several changes of distilled water (of room temperature). After a couple washings with the distilled water, one must look after the specks of precipitate that may be left from the solution. Cover the mirror with water, and then go over the surface very carefully with a lightly held cotton swab. Have the cotton loose and hold it so the cotton trails over the surface, but be careful the stick or rubber tube used for holding does not touch the film. Then run on cold distilled water, as cold as you can get it, and leave it in the cold water several minutes; then after leaving in cold water as above directed, pour off water, and wash over with several small changes of pure alcohol, which rid it of all water, then place it so it can drain and dry. As stated at the beginning of the paragraph, if the one side only of disc is exposed, the quantities of solution indicated are sufficient, but if bottom of dish as well as bottom of dish are exposed to the solution, there is ap-

t. telescope tube; r. rod; w. wires; as. adjusting screws.
Fig. 15—Arrangement for suspending and adjusting flat mounting

in water; then in solution made by dropping 10 or 20 drops of the potash solution D into a couple ounces of water, wash in plain warm water, then rinse in two or three changes of warm distilled water, and finally leave it in distilled water of a temperature that feels quite warm when dropped onto the back of the hand, and thus when ready to pour on the silver solution, the disc is both clean and warm. These washing and rinsing operations should be carried out in the utensil in which the silvering is to be done, which dish must be glass, or porcelain, or granite ware. Ordinary water may be used for the washings, but distilled water must be used for making the nitric acid solution, as well as for the potash cleaning solution, and in the final rinsings, and for leaving the cleaned disc in when getting ready to do the silvering.

For a six-inch mirror it is best to use a dish, saucer, or similar utensil; the more nearly the size of the disc the better. You can experiment silvering face down, but I have had better satisfaction face up. If face down, place three bits of sealing wax in bottom of dish and so that these bits support the glass near the edge. With mirrors a foot or more in size it is difficult to get suitable dishes, and for these large glasses a rim of paraffined paper is placed so as to project above the rim of the dish, and thus the surface to be silvered constitutes the bottom of this dish-like affair, and the paraffined paper the sides. But for a six-inch mirror it is better to use a dish. If a utensil of a suitable size is used, one may do as indicated in Fig. 16 (a). Sealing wax in a melted state is run in all around the edge of the disk, preventing the silvering solution from reaching the bottom of the plate as well the bottom of the dish. Some prefer to silver both sides of the mirror, but it is in larger work only that such is needed, if needed at all, because it makes the physical makeup of both sides the same and thus helps to prevent

Fig. 14—Mounting of flat

tubing. Have several ready and lying on a clean paper. Also have a good sized pitcher of warm water ready, and a smaller one with slightly warm distilled water. When trying the temperature of the water, do not put your fingers into it; pour a few drops onto the back of your hand. If the cleaned disk is left in the warm water it is ready for the silver; just to pour off this water just before pouring on the solution. The solutions may be room temperature, and the room should be about 72 degrees.

If disc is arranged so upper surface only is exposed to solution, take $\frac{1}{2}$ ounce of A, $\frac{1}{2}$ ounce of B, mix them. Take $\frac{1}{2}$ ounce of C, and $\frac{1}{2}$ ounce of D, mix them. This latter will turn slightly straw colored, especially if standing a few minutes. Mix the two mixtures, and in a few seconds this last formed mixture will begin to turn brown, then darken, and as it begins to darken pour it over the plate. Do not pour off the warm distilled

Fig. 16—a. speculum in dish for silvering.

Fig. 16—b. cotton swab in holder.

proximately three times as much surface and a corresponding amount of solution must be used— $1\frac{1}{2}$ ounces of each instead of $\frac{1}{2}$ ounce. In the first instance the final mixture totals 2 ounces ($\frac{1}{2}$ ounce of each of the four solutions); while in the latter case the total mixture will be six ounces ($1\frac{1}{2}$ ounce of each of the four solutions). If any water gets spattered on the film after the alcohol washings, the washing with alcohol must be repeated. The alcohol is to get rid of the water, and the alcohol drains off and evaporates leaving a dry film. Water drops will leave spots after drying off.

After the film is dry, place it in a warm place, preferably where the sunlight strikes it; and leave it there for 24 hours or so. It may have a peculiarly foggy appearance, but this all comes off in burnishing. Take a soft chamois skin, roll up a wad of absorbent cotton about the size of a small walnut, and makes a pad for burnishing. The pad should also be warm, same as the mirror. Dip the tip of the pad into the rouge (to be described later) and start to gently polish the film in small circles, about an inch or so. Notice carefully if there seems to be any scratches from the pad, and if so rub off the rouge with a bunch of cotton, dip into some more rouge, and try again. Take small areas at a time thus, and it won't take long to get over the whole surface, and if all is right, a beautiful reflecting surface results. Do not touch any part of the film with the fingers, nor any part of the glass surface before silvering. And when you are exhibiting your telescope to your friends, particularly the mirror and flat, ask them at the outset not to touch the silvered surfaces. Finger marks are very hard to remove, often impossible. Some people simply cannot refrain from rubbing their fingers or hands over any and all bright polished surfaces.

The rouge used for burnishing should be the very finest jeweler's rouge, and should be water separated,

same as that used for the last polishing of the speculum before silvering. Rouge is red oxide of iron, and will not cut glass, any cuts or scratch marks that may occur being due to grit particles of some sort getting into the rouge. Rouge is not expensive, the finest quality even being quite cheap. Place some of it in a "conical" sedimentation glass if such is available, if not a test tube or any tall, narrow container, add water and shake around or stir with a clean stick or glass rod, and then set aside for an hour or so; carefully siphon or pour off the clear water, and if the rouge is to be used for the polishing of the speculum before silvering, it may be taken in the pasty form directly with a clean spoon and smeared over tool or disk, but if for the burnishing of the silver film, it must of course be dried. The grit particles settle to the bottom of the jar or tube, and care must be used in removing the upper layers so as not to get any of the grit that may be in the bottom layer. The dry rouge desired for the burnishing is best obtained by removing a few teaspoonfuls of the upper layers of paste and placing in clean dish or saucer, and a few hours drying in an oven or on a radiator or stove will produce the desired result. It must be kept carefully covered so no dust or anything else that may contain grit can get into it.

Some authorities state that after this or that method of silvering has been carried out, the film need not be burnished, being ready to use as it is. I have not seen a film that was not improved by burnishing, and sometimes an extremely foggy film, one that appears to be a failure, will turn out excellently after the treatment with the rouged pad. Exposing the film to sunlight and keeping warm for a day or so seems to make the silver ever so much more adherent, and often so hard you simply cannot rub it off. Cuts from grit in the rouge are a different proposition however. If badly cut up from such a cause, it is better to resilver. Films are easily removed with nitric acid, which may be poured in small quantity over the glass and by carefully using a swab of cotton all trace of the old film is easily and quickly removed. Care should be used in handling nitric acid as it makes bad burns of skin and clothing, and every trace of it should be removed from all parts of the dish and utensil before silvering. Keep some ammonia on hand, and apply it immediately to any burn or any spot on clothing. Better use old clothes in this work, or else a good big apron, or a suit of "overalls."

In silvering formulae one often reads of the two solutions, one of which is referred to as the *silver solution*, or sometimes as the *nitrate solution*, and the other the *reducing solution*. This is because in practically all methods of silvering, regardless of how many solutions are originally made up, there are finally two mixtures that are to be united in the final step, and one of these contains the silver, while the other contains the sugar that with the aid of other elements acts as a *reducing agent*. The silver is in solution in the form of a salt, usually the nitrate. In the reduction, changes occur of a nature to take away the elements with which the silver is combined, and free, or metallic, silver results, and this deposits on the glass surface.

In the formulae described four solutions are made up, these being designated A, B, C and D, but for the final step there are but two solutions or mixtures to be combined before pouring onto the plate. A and B are mixed and that mixture we styled mixture 1, and is the "silver," or as some call it, the "nitrate" solution. C and D when mixed constitute the "reducing" solution. C contains the sugar and D is the caustic potash. These turn straw color when mixed and if allowed to stand some time will turn yellowish brown. But these solutions should not be mixed until one is ready to use them.

Do not confuse this darkening of the mixture made by combining solutions C and D with the darkening of the final solution that is poured on the glass. When A and B are mixed there remains a colorless liquid. When C and D are combined a straw color develops in a few minutes or even a few seconds. That is all right. But if this solution of C and D stands for a half hour or more it may get very dark brown, and it should not be allowed to stand long enough for that. Now when you are ready to silver and you combine the mixtures (1 and 2), wait until you see that this final solution is beginning to turn dark brown (which it will usually do in a few seconds) then pour it on the glass. It will get darker and then silver will show up. Stop the chemical action when the little curds of precipitate appear and the rest of the solution assumes the appearance of "whey." Pour off the solution quickly and pour on distilled water, or the action may be stopped by pouring on a large amount of water, this having the effect of so diluting the solution that action stops, but this water with the remains of the solution must then in a few seconds be poured off and clean water run on.

When you have mastered the problem of silvering, you will enjoy it as much as the making of any other

part of your telescope. Should you never have occasion to do another job of silvering, you will never regret having learned this most fascinating experiment in chemistry.

VIII. THE DIAGONAL FLAT AND ITS MOUNTING

Let us discuss the diagonal flat. That shape of flat is best and that mounting is best, that least obstructs the light rays to the speculum below it, while permitting the greatest reflection of light rays from the mirror to the eyepiece. A right-angled, "internal reflecting" prism was once considered the best, but the amateur cannot make a prism and they are expensive to buy. Optical glass must be used in a prism, as in all cases where light has to pass through glass. The silvered plane is the most practical.

For the flat select the best piece of plate glass you can find. The thicker glass has as a rule a more nearly true plane surface, but otherwise there is no need of very thick glass for this part. This piece must be free of cuts

w, wooden socket; t, tube; ep, eyepiece.

Fig. 17—Mounting for eyepiece tube

Fig. 18—Mounting for speculum

a, speculum; b, wooden cell with cleats; c, bottom of telescope tube, with screws for adjusting speculum.

or scratch marks. If you have a glazier cut the discs for mirror and glass tool, it might be advisable to have him cut the flat also. Caution him to select a scratch free surface for the flat. It makes no difference if there are marks on the discs as they will be ground out. But remember that the flat is to be silvered with the surface plane, and it would be impractical for the amateur to try to grind or polish out the surface of the flat. If you get these parts of a glazier remember to get some small pieces of any shape for experimenting in silvering.

The flat should be elliptical in shape and bevelled at the ends so as to have no glass extending outside of the actual reflecting surface. If a rectangular flat is to be used it should be a little over one and one-half times as long as wide. By cutting off the corners as shown in Fig. 14 (f) an approximation to the ellipse is secured. Take a wood cylinder of about 1 1/4 inch diameter. Cut off one end at an angle of 45 degrees (best done in a miter-box). Cut the other end square, and have the part about three inches long on the longest side. A piece of curtain pole is very useful for this, such being about 1 1/4 inches in diameter as a rule. If a piece of brass or copper tubing of this size is obtainable, one end is cut off at an angle of 45 degrees, the same as the wood. This section of tubing should slip over the wood cylinder. If too large it may be made to fit by wrapping a layer or more of strong paper around the wood, or by splitting the brass tube and cutting out a section of such size that the tube fits when the edges of tubing are taken up. If tubing is not obtainable a piece of tin answers very well. First wrap a piece of writing paper around the cylinder and mark or draw a line on the inner side of the paper around the edge of the elliptical surface of the wood where it is cut at the 45 degree angle. This paper is removed and cut at the line marked. This is used as a pattern for

cutting the tin, except that four or five little projections are left, about 1/8 inch wide and about the same length. These are to be bent in over the edge of the glass flat to hold it in the mounting. The tin must extend down further than the edge of the wood, by an amount equal to the thickness of the glass flat. Fasten with small screws or tacks. The flat is put in place and the little projections are turned in over the edge of the flat, and thus hold it securely.

Great care should be exercised at all times when handling the glass parts, whether unfinished discs or silvered speculum. Sometimes glass cracks very easily, while at other times it is surprisingly strong. Dropping the part or letting some object fall onto it should be guarded against. When wet the glass discs are very slippery, and aggravating accidents may occur. In working the edges of the disc or flat, whether with cutter, pliers or on the grindstone, a slip may cause serious injury. It may be advisable to provide some protection to the surface. Strong paper may be glued on or a piece of cloth material may be similarly used. It is easily removed by soaking in warm water. And even then one has to be careful to see that it does not come in contact with any hard or sharp object. Practise cutting elliptic or rectangular planes out of any rough scrap glass, and working and grinding the edges. Then when you feel you have learned to thus work reasonably well you may tackle the real work.

Get a bolt, 1/4 x 6 or 1/4 x 8, drill a 1/4 inch hole through the center of the wood, the lower end of this hole being bored out to permit counter-sinking the head of the bolt. Run in melted sealing wax or put in a wood plug to fill the space after the bolt head is in place. Cut six wires 10 inches long. Get six light bolts, and attach one end of each wire to the head of each bolt. Three of these wires are attached to the rod near its entrance into the wood, while the other set of three wires are attached to the upper end of the rod. A reinforcing band should be placed around the telescope tube where the lower set of bolts comes through, and another where the upper set emerges. The wires are adjusted at their attachments so that the rod is as nearly as possible in the center of the tube, and in line with it. Then by turning the nuts on these bolts the proper tension of the wires is obtained, and by lessening the tension on one while increasing that of the opposite ones the needed adjustments are very accurately obtained.

Of course the cylinder of wood and the piece of tubing are used only if the flat is elliptical. If the flat is made rectangular, a square piece of wood is required, and if the corners are cut from the flat, making it eight-sided, the wood should be eight-sided. If the beginner finds it very difficult to make an elliptical flat he may use the four-sided or the eight-sided and later as he finds time and is more experienced in working with glass he may make an elliptical flat and the corresponding mounting.

The optical parts may be mounted in a tube or in a skeleton framework. For a six-inch telescope a tube is better, and the average tinsmith can make a very suitable one of galvanized sheet metal, though two or three sections of seven-inch stove pipe will do in the absence of anything better. If not sufficiently rigid, reinforcing strips of strap iron or even strips of wood may be added, and also bands at the ends. Bands are usually needed too where the bolts that serve to secure and adjust the diagonal mounting come through the tube. Near the lower end of the tube there should be an opening or door to permit access to the speculum—placing it in or removing it, as well as placing and removing the cap that should be over it when the telescope is not in use.

For the eyepiece tube, the amateur if he wishes can make an arrangement like that shown in Fig. 17, which may be a little crude in appearance, but easily made and will be found to work quite well. A rack and pinion focusing adjustment is very convenient, but the material may be hard to get unless one has access to the stock of some big city hardware store. Most astronomical eyepieces are 1 1/4 inch outside measure, while the microscope eyepieces previously mentioned are 23 millimeters (23/25 inch) outside. So it is advisable to make the drawtube to take 1 1/4 inch eyepiece. An adapter that fits into the 1 1/4-inch drawtube and takes the 23/25-inch eyepiece, is made, and thus one can use the low-priced microscope eyepieces, or the regular 1 1/4 inch celestial eyepieces interchangeably in the same drawtube. This adapter may be nothing but paper wound evenly on the smaller diameter ocular until it fits snugly into the 1 1/4-inch drawtube. Focusing is accomplished by moving the drawtube in or out in its socket, which is attached to the side of the telescope tube on a level with the diagonal flat. This socket can be cloth lined and by having a proper fit, the tube can be moved in or out easily and still be a sufficiently snug fit to remain in focus.

There are many ways of mounting and adjusting the speculum, but I shall describe just one of many ways that requires nothing but the commonest materials and

but little labor. Cut a wooden disc—pine will do if free from warp or shake—about one inch thick and $\frac{1}{4}$ inch less in diameter than the inside of the telescope tube. Drill a hole in the center to take a $\frac{1}{4}$ inch or $\frac{5}{16}$ bolt, and countersink the head. Make three cleats as shown in Fig. 18, of some strong tough material as mahogany or oak, taking the precaution to drill the screw hole in the block of material before fashioning it into the cleat, thereby lessening the possibility of splitting it in drilling. A piece of felt should be placed under the glass and a little piece of the same material under the stop of each cleat, and the screws should be drawn down carefully so as not to endanger the glass. The construction that holds the speculum is usually referred to as its "cell." A cap that fits over the cell should be provided and the maker can exercise his own ingenuity in making it. This cap, or some other protection, should always be provided

and in place when working with the flat, or its mounting, or when doing any work where something may accidentally drop down the tube and injure the mirror.

Now you have the mirror mounted in its wooden cell, and have the telescope tube ready, but as yet no arrangement for holding the mirror cell; and it must be mounted with provision for adjusting and focusing it properly. This problem may be solved in a number of ways, but the method here described entails but little labor and calls for nothing more than a wood disc and few stove bolts. Cut a circle an inch thick and of a diameter equal to the inside of the telescope tube. Bore a hole in the center to take the end of the bolt projecting from the lower side of the mirror cell, and three other holes equidistant from each other and about $2\frac{1}{2}$ inches from the center. If of mahogany or oak or some other hard wood, $\frac{1}{4}$ inch holes may be bored and then $\frac{5}{16}$ inch

bolts may be threaded in and out, cutting a thread in the wood; and then run some melted paraffine through the holes and then thread the bolts in and out a few times again, and a very useful job results. String a few washers on the bolt projecting from the mirror cell, and push it through the central hole of the wooden disc, and draw up loosely with a nut. Insert the three adjusting bolts, and by screwing these in or out as needed the entire mirror mounting can be very nicely adjusted to focus the light on the diagonal flat. Little metal plates may be fastened to the bottom of the cell where the ends of the adjusting bolts turn against it, or a circle of thin sheet iron covering the entire lower surface may be attached. This wood disc of course is placed in the bottom of the tube and a few screws through the sheet metal and into the edge of the wood will hold it.

[TO BE CONTINUED]

The Parachute Up-to-Date

CHRONOLOGICALLY speaking the parachute is the pioneer type of aircraft, being generally acknowledged to have antedated the invention of the balloon. It is on record that several hundred years ago, Siamese royalty were entertained by an inventor who made leaps from great heights with parachutes attached to his body. That versatile Italian, Leonardo da Vinci, who appears to have anticipated a great many modern "inventions," described a parachute as long ago as 1514, but so far as can be ascertained, the first authentic practical demonstration of the utility of the parachute was made by a Frenchman, M. Lenormand, at Lyons, in 1783. This inventor suggested the parachute as a means of descending from the upper parts of a burning house, and actually succeeded in making a safe descent from the top of a building in Lyons. In 1783, the aeronaut Blanchard conceived the idea of using the parachute in ballooning and first tested one by attaching it to a basket in which was placed a dog. The descent was made safely, but when Blanchard tried the experiment himself, although the fall was certainly very much retarded, he sustained a broken leg. This happened in 1793. On October 22d, 1797, M. Garnerin made a very successful parachute jump from a balloon at an altitude of over a mile. With this famous descent it may be said that the parachute was fairly established as a means of checking the speed of a free fall from a height, and has been employed in this manner for a variety of purposes since that date.

Fundamentally, there is no very great danger attending the descent in a parachute, provided the first essential condition is satisfied, *i. e.*, that the parachute opens. Unfortunately, there is, or rather, there was, always the possibility that the many cords which support the parachutist from the periphery of the parachute may become entangled and prevent it from opening. More than one life has been lost in this manner, and this uncertainty has, without doubt, been largely responsible for the suspicion with which many, one might perhaps be permitted to say, most modern aviators regard the parachute. In times of peace, when the possibility of breakage in the air is remote, it has been rightly argued that in most cases the aeroplane itself would form the best parachute the pilot could possibly have, as it is superior to the parachute in that it may be steered in any direction, thus enabling the pilot to choose a suitable landing ground, whereas in the parachute he must perforce go whither the wind chooses to send him. In times of war, however, it is unfortunately no infrequent occurrence that an aeroplane gets so badly damaged by gun fire that a portion of it, such as a wing or a tail boom, breaks away. Marvellous escapes in such cases are on record, but, generally speaking, it means certain death for the unfortunate pilot. It is quite obvious that if a parachute can be made which is absolutely certain to open when required to do so, and can be made to leave the aeroplane without catching anywhere, and tearing itself to pieces, an opportunity to save himself has been afforded to the pilot of a broken machine. Of what has been done in the way of parachute descents from aircraft during the war it is not, of course, possible to speak at present, but previous to the outbreak of war it may be remembered that Pegoud jumped out from an aeroplane with a parachute attached to his body and landed safely, the Blériot monoplane on which he made the experiment landing itself in a practically undamaged condition near by. In this country the parachute jump from an aeroplane was first made from a Grahame-White biplane by Mr. Newall, who was seated on one of the chassis skids. It may still be remembered how the parachutist continued to postpone the jump until the late Major Goodden, who was himself an experienced parachutist, became impatient, and, climbing out on one of the wings of the aeroplane, kicked his passenger into space. The landing was effected without a hitch, and thus ended the first parachute jump from an aeroplane in England.

With the extensive employment of airships, kite balloons, and spherical balloons, the parachute has become a necessary accessory, and its usefulness for these purposes is probably established beyond question. Slower, considerably slower, has been its adoption for use on aeroplanes. This is probably partly due to prejudice, created by the erratic and uncertain behavior of the old-fashioned parachute, and partly to the inherent difficulty of successfully launching it from such a fast moving vehicle as an aeroplane. In the first place, the parachute must be so placed in the aeroplane that if anything goes wrong with the machine, the pilot has but to release his safety belt and jump overboard, and the parachute will release itself from the machine and open in a minimum of time so as to reduce the length of "free fall" experienced by the pilot. Secondly, the possibility of the parachute opening before it is clear of the machine, and, therefore, likely to be blown back and catching in the tail planes or tail skid, must be absolutely eliminated. Finally, on reaching the ground the pilot must be able to detach himself instantly from the parachute, so as to avoid being dragged along the ground and through ditches, hedges, etc.

From a visit to the premises of Messrs. E. R. Calthrop's Aerial Patents, Ltd., at Eldon Street, in the City, we have received the impression that all these desiderata have been attained in the latest type parachute designed by this firm. It is now a good many years since Mr. Calthrop commenced his experiments on parachutes, and if he has at last succeeded in turning what was once a very erratic craft of the air into a machine designed to perform a given function with certainty, and no others, it is only after endless experimenting and improving upon improvements, that he has now succeeded, we firmly believe, and so far as we are able to judge, there is none of the old-time shut-your-eyes-hold-your-breath-jump-and-see-what-happens uncertainty about the Calthrop parachute.

Under present conditions, it would obviously be grossly indiscreet were we to give a detailed description of the Calthrop parachute, but a brief outline of what the parachute is claimed to do, and does, as evidenced by the series of moving pictures shown us, may be permissible. The chief advantage of the Calthrop parachute lies in the ingenious method by which it is released from the craft supporting it. This is at once simple and effective, with no possibility of getting out of order. A pull of given magnitude, furnished by the weight of the parachutist, releases it from its anchorage, and as soon as the supporting tapes are taut the parachute opens and sustains the pilot. The method of folding the rigging has been very carefully thought out, and the result is that, instead of tumbling out in a bunch with the attendant possibility of becoming entangled, the rigging is unfolded gradually, so that each of the strands is taut and straight for the portion of it that is at that moment outside the covering. The pleating and folding of the parachute body itself is carried out in a way that has been found by experience to give the least amount of friction between adjacent folds during the process of opening.

Incorporated in the rigging is a shock absorbing device which has been found to be so effective that the pilot did not experience any sudden jerk whatever when the full weight of his body was taken by the parachute. From a series of very interesting films it appeared that the longest time taken for the parachute to open after the pilot had jumped from the aeroplane was $2\frac{1}{2}$ seconds, the time taken depending, apparently, upon the speed of the aeroplane, the quickest opening occurring with the fast machine and the slowest with a slower machine. As regards the altitude from which it is safe to jump, Mr. Calthrop advocates 200 feet as the minimum, although we missed a film, showing a jump from only just over 100 feet, in which the pilot was being supported by the parachute while still a matter of some 20 or 30 feet from the ground. The quick release by means of

which the pilot detaches himself from the parachute on landing is of the very simplest type, and its effectiveness was clearly demonstrated in one of the films, which showed that the pilot got into an air current when only a few feet from the ground, the parachute trailing out at what appeared to be a very dangerous angle. However, by releasing himself just before striking, he landed safely, and the parachute came to rest as soon as released of the weight of the pilot. That this is a necessary precaution was illustrated in another film, in which the weight was in the form of a sand bag. A fresh breeze was blowing, and the bag trailed along a considerable distance before the attendants were able to capture the parachute.

Air and water-tight covers protect the parachute when not in use, and absolutely prevent it from getting damp. To ensure that nothing is tampered with in transit, the parachute is packed by the makers in a strong wooden box, which is then sealed, a card of instructions for use being tacked inside the lid of the box, to be carefully read before touching anything of the contents, which is all arranged according to the makers' system, even to the pilot's harness. Certainly, if careful design and painstaking workmanship count for anything, the Calthrop parachute is as near perfection as it is possible to get it, and the fact that a perusal of the, unfortunately, only too frequent accidents to aviators would indicate that a very great percentage of these pilots might have been saved had they been equipped with a reliable parachute, is a very strong point in favor of a more general adoption of this useful "accessory." We do not doubt that there are a good many people who shrug their shoulders at the idea of a parachute on board an aeroplane. We were inclined to do the same—until we saw Mr. Calthrop's "Guardian Angel."—*Flight*.

Factors Influencing the Condensation of Aqueous Vapor in the Atmosphere

EXPERIMENTS on the condensation of water-vapor in the air under different conditions give the following results: The formation of the nuclei which, besides dust, may provoke the condensation of atmospheric aqueous vapor is determined especially by the presence of ozone, nitrogen peroxide, and, indirectly, ammonia. Electrical discharges, flames (independently of their fumes), and glowing bodies favor condensation in so far as the above substances are formed in their neighborhood. The property exhibited by some substances of disturbing fumes in the air is identified with the phenomenon of deliquescence, the latter property being manifested without the surrounding medium being saturated with moisture. The conception of a medium saturated with vapor is, at any rate in practice, of relative and not absolute character. This relativity is implied by Kelvin's law, according to which the condensation or dew-point depends not only on the vapor pressure, but also on the radius of curvature of the surface of bodies in the immediate neighborhood of particles of vapor; it must now be extended to the consideration of the nature of these bodies and of their distance from molecules of the vapor.

Contrary to the conclusions of Lenard and Ramsauer [Abs. 441 (1912)], the action of the ultra-violet light is not necessary for the formation of the nuclei and functions only as a source of ozone. Further, gaseous ions exhibit no power to constitute condensation nuclei, so that ionization of the air by either radio-active substances or Röntgen rays has not been shown to be a necessary or sufficient cause for condensation of supersaturated aqueous vapor.

Trees, especially tall ones and those rich in resins, give rise to ozone, and should therefore favor production of rain. Opinions on the actual influence exerted by trees, are, however, very variable.—Note in *Science Abstracts* on an article by A. MASINI in *N. Cimento*.