Instruments and Imaging Section
Technical Tips No. 7
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So... has it dried out yet?

In the previous *Technical Tips* the mystery object is the 'Ann' plate produced by the computerised drive of the Anglo-Australian Telescope in 1975. The instrument was enabled to carry out raster scans of any pattern in any orientation. Stars in the field mark out the patterns made by the moving telescope, and the lines in the scans are separated by 10 arcsec. The commissioning of the autoguider enabled the pointing calibration program to be made completely automatic. 'Ann' was Ann Savage, a member of staff of the UK Schmidt Telescope. Again a lone correct identification – this time by Denis Buczynski.

And for your next challenge: what is unusual about the instrument illustrated above?

Thanks are due to all those who responded to the plea concerning the perennial problem of condensation, resulting in this issue of almost 9,000 words of advice sent to around 2,000 Members.

The website of Rochester Institute of Technology (New York) includes an online calculator by which temperature, relative humidity, and dew point can be specified to define an environment and determine risk factors. Results can be saved and exported. http://www.dpcalc.org/
For humidity indicators and dessicants, see: http://www.brownell.co.uk/

Dewing in an SCT

Enquiry

Shaun Albrighton

Having recently obtained an 8-inch Meade SCT I have been having serious problems with condensation, which persistently accumulates on the inside of the corrector plate. I have fitted a dew shield and tried a heater, but these have been only partially successful in limiting or delaying the inevitable.

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Responses

Ray Taylor

I suffer similar issues with astrophotography, when at times the camera lens mists over. I would welcome advice.

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Michael Covington

I wonder if the air inside the tube is excessively humid and is rarely exchanged. I leave it to others to suggest solutions to this problem.

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Jeff Young

I find dewing a fascinating topic, largely because it is often misunderstood. Dew forms when a surface drops in temperature below the dew point. That part is easy. What is often misunderstood, however, is that under normal circumstances the surface in question is below ambient temperature. (If the ambient temperature itself were below the dew point, you would be fogged out or it would be raining.) So how did the surface get below dew point? All bodies radiate heat, but by and large they gain the same amount back from the radiation of their surroundings. The exception to the rule is the open sky, which radiates very little back. Therefore, anything pointed upward – such as a corrector plate – will gradually lose heat to the open sky, drop below the ambient temperature, and become susceptible to dew. This is also why frost does not often form under trees. It is not that the 'falling' dew is collected by the leaves before hitting the grass, but rather that the leaves are radiating heat back to the grass, thereby preventing it from falling in temperature. In contrast, grass in the open receives only a tiny fraction back from the open sky, and so the temperature drops below ambient. (The dew that forms on it condenses out of the directly adjacent air; it does not 'fall' onto it.) But how does this theory apply to an 8-inch SCT? My first guess would be that the tube itself is losing too much heat and cooling the back of the corrector plate, and a full-wrap dew shield (such as the Just-Cheney) would probably prevent this. Another possibility is that the tube is being moved from a much more humid location to the observing location so that the dew point inside the tube (where the air is more humid) could actually be above ambient. In this case, no amount of shielding will help, and the moist air needs to be evacuated from the tube.

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Richard Miles

The issue with SCTs is that they are usually isolated from the atmosphere, and ingress of moist air tends to be a one-way process through gaps associated with a loose-fitting corrector plate, or elsewhere. This leads to a build-up of humidity within the instrument, which then tends to remain high unless steps are taken to reduce it. In other words, the enclosure acts as a 'one-way valve', allowing water vapour to enter but then preventing its escape. High humidity is problematic, because as the telescope cools at the start of a night's observing, water can begin to condense on the coolest surface inside the telescope, which invariably is the inside of the corrector plate roughly midway between the central obstruction and the outer edge. If the relative humidity within the tube assembly is close to 100%, then condensation will occur every time the telescope cools down when pointing at the night sky. If excess water accumulates to such an extent that the liquid water remains adsorbed on

the internal surfaces of the tube even during the day, then even a dew heater may not eventually clear the condensation on the inside of the corrector plate at night. The solution to this dewing problem is therefore to reduce the relative humidity within the tube assembly. If this can be kept low – say around 20% relative humidity at room temperature – then dewing of this kind can be avoided. Beware, however, that on those nights when the ambient air is also very humid (>95% relative humidity, say), then dewing of the external surface of the corrector plate will also ensue, in which case a dew shield *and* a dew heater will be needed. Over the years I have tried various means of avoiding condensation within C11 and C14 telescopes. The most effective, I have found, is to use silica gel in a relatively thick-gauge plastic bag, placed over the end of the eyepiece tube (with the eyepiece removed) and held in place by a strong elastic band or bands when the telescope is not in use. Self-indicating silica gel is best, since it is necessary, say once per month, to regenerate it by leaving it in a hot oven for a few hours to drive off moisture, after which the light pink colour of the gel turns to dark blue. Silica gel, however, is not a practical solution if, for example, a CCD camera is to be mounted permanently (though an off-axis guider with the eyepiece removed could conceivably be used as a suitable entry port into which the bag of silica gel could be fitted). Another simple approach is to leave the telescope exposed to the air with the eyepiece tube open to the elements and the front cap removed. This can be done from time to time (say every few months) on days when the weather is such that the ambient humidity is low – especially on dry winter days. It allows excess water vapour to diffuse out of the tube assembly over a period of several hours, and is especially effective if, in the process, sunlight illuminates and warms the external surface of the tube. I have to avoid condensation on the inside of my CCD cameras operating at chip temperatures of –20° C, but I do not use silica gel. I start out with low humidity in the telescopes, and have low-voltage (12V) heater bands around the objective end of the telescopes and around the camera adapter tubes (using eyepiece heater tapes). I leave these heaters switched on permanently, operating at about a 20% duty cycle and providing permanent warmth. This approach has the effect of reversing the tendency for the tube to act as a one-way valve, thereby preventing the build-up of humidity and avoiding condensation problems entirely.

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Brian Beesley

I do not pretend to have a complete solution, but the following hints may be helpful. 1. Dew shield. In my experience the commercial ones are far too short. The Astrozap model (with a flocked interior) is better than the others, but I find a camping mat, rolled into a tight-fitting cylinder and kept that way with duck tape, works much better, as well as being a great deal cheaper. This can be used full length on still nights and shorter on nights when there is a breeze (and condensation is less of an issue). 2. Heater strap. This should be positioned just behind the corrector cell, not directly over it. Heat conducted through the tube wall and radiated to the corrector plate is much more effective than heat conducted into the corrector plate through its edge. For this reason, commercial dew shields with inbuilt heaters are unsatisfactory. In addition, some models of heater strap are far more effective than others: the 'Dew Not' brand with low current draw is simply insufficient, and a current draw of 3–4 amps (at 12 volts) is necessary to keep the corrector plate of an 8-inch SCT clear in severe dewing conditions. The controller electronics should, of course, allow for adjustment, as excess heating will cause tube currents, ruining high-power views, and the power supply requirements in terms of battery should not be underestimated. My 70AH deep cycle battery is insufficient for all-night sessions in midwinter. 3. Insulation. Part of the problem is that the thin metal tube wall, usually painted a dark colour, can allow the air trapped in the tube to dew to below ambient temperature, which will result in condensation if the air is nearly saturated with water vapour. The conductive tube wall is helpful in allowing the tube to cool to ambient temperature, but when it drops below ambient it can cause tube currents as well as condensation. Insulating the tube may help, or at least reduce the power required to be supplied by the heater strap.I have found that throwing a towel over the exposed metal tube is helpful, as it helps keep moisture from minor showers out of the electronics too. With the above, you should no longer have internal condensation issues. You will, however, still get condensation on the outside of the corrector plate in severe conditions – for example, at my own site, when the breeze shifts from blowing cooled air from inland to warmer moist air from the nearby ocean. A 12V hot-air blower is the best way of dealing with this. Condensation issues affecting eyepieces and diagonals are common to all types of telescope, and no special measures are needed for SCTs. Finally, always cap the tube before moving it inside, and store it pointed downwards at 45° so that any condensation which forms in the tube drips down the inside of the tube rather than falling onto the primary mirror or corrector plate, where it may leave visible marks.

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John Hendry

I do a lot of astrophotography and had a Meade 8-inch SCT, and very good it was. I made a heater from 24SWG double silk Eureka wire round the location of the plate, and ran it at about 23W. However, I also placed two bags of silica gel inside the drawtube when the telescope was not in use – which is most of the time here in the north-east of England. I do the same with its replacement – a 190 Maksutov–Newtonian. This has proved effective for about six years now.

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John Davies

I have had the same problem with two of my SCTs. It is easily resolved by inserting a suitable container full of silica gel into the drawtube instead of an eyepiece. If this is done as soon as observing is finished, the moisture should have disappeared by the next morning. Plastic film containers are ideal, with small holes punched in the closed end and then filled from the capped end. To ensure that the container does not fall into the tube, suitable padding around the container might be necessary; masking tape is a favourite. When the silica gel needs regenerating it can be removed from the plastic container, and then a few minutes in the microwave will usually suffice to dry it.

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Gary Poyner

During my years as an SCT owner and user I came across this problem several times. I too used heaters and a dew shield, but on the dampest of nights I experienced condensation on the inside of the corrector plate. To eliminate the condensation I used a warm airflow from a hair dryer, held just inside the dew shield. It did not take long to cure the problem, but star images were pretty poor for a time afterwards. I always ran the heater band at full power during the course of the night, but on the worst of nights the hair dryer was my only saviour. It is important to ensure that the corrector plate is dry before the cap is replaced at the end of the night, and to ensure that the focuser either has an eye-

piece inserted or the cap in place. An SCT is obviously only a sealed unit if a CCD camera is left in place all of the time. It is easy for moisture to get inside an SCT tube; but if the problem is very serious and remains even on nights which are not excessively damp, perhaps the seal on the corrector plate is faulty.

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Brian Mitchell

Sometimes when buying a camera or optical device, there may be included a small bag containing blue crystals which absorb moisture out of the air. They are crystals of silica gel, which absorb until saturated and then need to be dried by heat, but can be used many times. It may be possible to insert such a bag (usually only a few centimetres square) into the telescope, but ensuring that it can be removed for drying. Camera shops will probably have lots to spare.

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Richard McKim

I once had this problem with a Schmidt–Cassegrain that was left permanently outside, and the solution was to leave inside the drawtube after use (with an eyepiece or cap in place) a small glass tube with a plastic cap – the cap being pierced with a few holes and the inside filled with the self-indicating form of silica gel. This form of the gel contains a few crystals of cobalt chloride, and when it is exhausted (that is, has absorbed as much moisture as it can) the colour is a very faint pink. Placing the glass tube in a hot oven for half an hour dries the gel, and its colour is then that of the anhydrous cobalt salt – a deep blue. The procedure can be repeated as necessary.

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Brian Silcocks

Would it be possible to keep the whole telescope at, say, 15–20° C to keep it above the dew point during observing?

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Martin Male

I have had a 14-inch mounted SCT in a roll-off roof observatory since 2004, and have experienced this issue. The observatory is well ventilated, and is usually at equilibrium with the temperature outside, though I do sometimes get dew on the outside of corrector plate, particularly when the humidity is high. (It is not clear whether the correspondent is bringing his instrument from indoors, where the temperature change will, of course, exacerbate the problem.) I use a home-made foam dew shield which is about as long as the SCT tube. This can cause problems with 'wind shake', but, in my experience, if it is windy there is usually not too much condensation. I make a point of examining the corrector plate a few times during observing sessions, as it is easier to deal with a small amount of condensation before it becomes too troublesome (causing degradation of the image). I also have a Kendrick dew heater and controller; but I do not use this every night, as I have a hair dryer in the observatory to clear any condensation when it occurs on the outer surface of the corrector plate. I have found that running the dew heater at too high a temperature will heat the air in the tube, causing condensation on the inside of the corrector plate. I cannot be very scientific about when I might turn on the dew heater, as it is just a matter of experience. If it feels damp I will turn it on to about 25% initially, and turn it up in about 25% increments if the problem persists. I think the watchword here is small amounts of heat applied sparingly, as all at once will make things worse! To summarise: with a combination of regular inspection of the plate, and use of the hair dryer, dew shield, and dew heater, I seldom have condensation problems now.

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Nick Hudd

I am very much a novice in terms of telescope usage, and am the world's worst DIY man, but it sounds as if there may be a source of moisture inside the OTA. I suggest investigation of the interior, and checking of the reassembly carefully for airtightness.

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Jonathan Maxwell

I think I would go back to Meade about this.

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Geof Downton

I use a desiccant cap, available from:

http://www.harrisontelescopes.co.uk/acatalog/Revelation_2__Desiccant_Cap.html

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Alan Buckman

Once moisture gets inside a reasonably enclosed space it will stay there. The only solution is to change the air, and a fan and exhaust hole are required. We have this problem in electronics instruments, and major companies have moved away from hermetic sealing because it cannot be made to work. Inevitably, moisture will invade, perhaps wicking up a lead, and then there is nowhere for it to go.

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John Moore

I encountered the same problem with my Celestron C11. The outside of the corrector plate, and sometimes the inside too, would dew up readily. I solved it by fitting a ring of heater resistors inside the corrector and a second ring of lower-value resistors outside, the two rings being connected in parallel with each other. I drilled a small hole in the retaining plate for the corrector before replacing it, and bonded a temperature sensor directly onto the glass. With a humidity sensor I was able to build a closed loop control system that maintained the corrector at about 2 degrees above the dew point.

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Roy Hughes

I have had an 8-inch Celestron since 1974, but have never had this problem. When the telescope is not in use I always keep the eyepiece end capped, using a standard plastic 35-mm film can as a dummy eyepiece. If such a can were to have some small holes drilled in the end and a small bag of silica gel desiccant inserted, it would keep the inside of the tube bone dry and probably prevent internal dewing.

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Tim Haymes

I do not have an SCT, but I do have a Schmidt–Newtonian. I would suggest that at some point the instrument has been badly contaminated with moist air. This needs to be replaced with dry air by allowing forced (dust-free) air to circulate in a dry environment; or better still, to send it to an engineer or

optician to fill the instrument with dry nitrogen. Silica gel can also be placed inside the instrument by some means, as this would dry it out. A small bag of it can be placed in the central tube and left there for some days, and the procedure can be repeated. The drawtube should be plugged and the silica gel kept in place when the instrument is not in use. Self-indicating gel can be redried or replaced. Test strips for measuring water content, sometimes used in art galleries and National Trust buildings, can be obtained from PnJ Resources:

http://www.pnjresources.com/Humidity%20Test.html

If, however, the SCT was obtained new, it might be considered a manufacturing fault.

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Horst Meyerdierks

This occurred only once or twice early in the life of my C8, more than thirty years ago. Keep the tube in a hot boiler room for a few days to evaporate all water into the air in the tube. During that period also suspend a few sachets of silica gel on a string down the long baffle into the main volume of the tube. (Be extra sure you can get the sachets out again). After the silica has removed the water vapour from the air, retrieve the sachets and replace the cap. This process should extend over a few days to ensure thoroughness, but need not be repeated. Once you have very dry air in the tube, retain that air and keep all other air out. My tube is open for only a few seconds at a time when I remove the proper cap and insert an eyepiece, zenith prism, or camera. When not in use, the proper cap is possibly a better seal than a zenith prism. The thirty-year-old air in the tube is still dry, and the telescope has never again dewed up inside. The same procedure should be effective for a refractor tube, though a longer piece of string is required.

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John Mallett

The usual answer is to use is a dew heater, and for a 100% solution I would also advise a dew shield combine:

http://www.astronomics.com/dew-heaters_c399.aspx
http://www.astronomics.com/kendrick-digifire-10-4-channel-6-output-temperature-sensing-heater-controller_p9089.aspx

The dew shield is just a sheet of black mat plastic rolled into a tube to fit over the telescope corrector plate, to both shield from stray light and to assist in removing dew falling on the corrector plate.

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James Bryan

Depending on skill, resources, and willingness to access the inside of the optical tube assembly, it might be worth purging the interior of the tube with dry nitrogen, and the 'closed' tube assembly of an SCT may make this practical. The objective here is to modify and temporarily exchange the atmosphere in the tube assembly – *not* to produce a 'tight gas bottle'. To accomplish this, a port must be created on the tube wall – perhaps high on the tube, just below the corrector plate – to receive a hose connected to a regulator on a dry-nitrogen-filled pressure vessel. If the tailpiece behind the mirror is sufficiently open to the outside air it can be used as an exhaust port, but if the tailpiece is fairly tight a separate exhaust port can be installed low on the tube, near the mirror, and rotated 180° from the higher injection port, on the opposite side of the tube. Nitrogen that is *slowly* introduced into the upper end of the tube will modify the interior atmosphere by mixing and displacing it at the exhaust port. The problem with this method is that it requires knowledge and experience of the safe use of compressed gas – which is not trivial. Suppliers of compressed gases provide thick-walled steel cylinders that are delivered with an internal pressure of 2,200 lb/in^2. Empty or full, cylinders are dangerous objects when mishandled. Where I live (in Texas), gas suppliers' trucks make rounds to deliver large, tall, and heavy gas cylinders to their customers. No person could pick up such a cylinder under any circumstances, but there are small, short, and less heavy cylinders that are easy to handle and store. As for living with a cylinder, I do not store mine inside my dwelling, only in the garage. Also, for transportation I put it in the car's trunk, blocked and padded, and never near passengers. It is, however, advisable to let the gas supplier transport even a small cylinder. Once the cylinder is in the garage, it must be stored in such a way that it cannot be knocked over. If the valve and regulator are damaged, very bad things will happen when 2,200 psi pressure is suddenly released. Therefore, the correct pressure regulator must be used. This controls the flow of gas from the cylinder, and opening a cylinder without a regulator on its valve is always dangerous. An industrial-class regulator with strong flow rates – such as those used by welders – is of no use for astronomical purposes. I made a decision not to proceed with compressed gas for astronomical applications if the highest flow rate delivered by a regulator would create danger to myself or my equipment. My supplier identified a low-flow regulator with release rates that were far below those of industrial regulators; indeed, it delivered a gentle flow at its highest rate. With this special regulator and with careful handling of the cylinder, I used compressed nitrogen in safety for many years to purge continuously the interior of a 2¼ x 2¼-inch format roll-film camera while I observed with gas-hypersensitized photographic film. This application was successful in protecting the especially dry emulsion from atmospheric water. I also dealt with a Ritchey–Chrétien secondary mirror that was prone to condensation, though this was problematic. The situation was different from condensation on the inside of a corrector plate because the mirror was in the open air, surrounded by a mirror mount and a light baffle. Since the secondary mirror was at the top of a 'can' with its low end open to face the primary, I purged it with dry helium so that the gas would rise to surround the mirror and retain it in a drier environment for a while longer. Helium might therefore be used to combat internal condensation, and a single purge of the interior atmosphere of a closed tube assembly at the beginning of an observing run should prove effective. If not, a second purge later in the night might be needed. Nitrogen should not be flowed continuously during observations, as it will disturb optical performance with turbulence that will be accentuated by temperature differences between the nitrogen and the air in the tube. It is also worth determining, from the gas supplier, how much moisture dry nitrogen and helium contain. Overall this is an expensive solution, but it has good probability of success.

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Adrian Jones

Once moisture is trapped inside the closed tube it is difficult to remove simply with external warming such as with a dew heater, as the trapped moisture soon recondenses as the system cools. The dew heater really works only for dew forming on the external surface, where it is free to evaporate when heated. I have had this problem with a Meade SCT. On one occasion it was caused by ingress of a small amount of water around the corrector plate whilst I was cleaning it. The solution was to dry the air inside the tube using a desiccant plug in the focuser drawtube. I used bags of silica gel held in a netting bag placed inside a 2-inch adapter in the

focuser, being careful to attach the bag in such a way that it could not possibly fall into the telescope tube. The end of the focuser tube was then closed off and the desiccant left for 24 hours to do its work. I repeated the procedure with fresh desiccant for a further 24 hours, just to make sure. This solved the problem permanently.

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Simon Kidd

If the tube is sealed (as they virtually are with SCTs), then the air that is already inside the tube, along with the moisture it contains, remains there. If the telescope was assembled on a warm day when there was also very high humidity (or in a steamy bathroom!), then the large amounts of moisture in the air would have condensed out onto the corrector plate whenever the corrector cooled below the dew point of that air. The telescope needs to be filled with relatively dry air, otherwise condensation will reappear every time the telescope is cooled. I suggest that some small packets of silica gel be inserted carefully in the focusing tube, with a cap or cover sealing them in. If the tube is on a mount, orientating the tube upright will prevent them from falling into the telescope. The gel must be fresh, not already saturated with water, and moisture can be driven off by heating the packets in a microwave oven for a few seconds. This should be repeated until they feel dry, but they should not be overheated. They should then be left for a few days. On no account blow into the focuser, as moisture will be injected straight into the tube. Another method is to remove the corrector plate, ventilate the tube on a really dry, usually cool, day (but not in a centrally heated kitchen, where the humidity is high), replace the corrector plate in its *exact* position, taking care not to overtighten the clamp-ring screws, and recollimate the telescope. This procedure should not be attempted unless absolute accuracy can be assured. The telescope should be stored in a dry, cool area, but not in the high humidity of a centrally heated house, as the problem might return.

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Bob Winter

My tips are as follows. Work from an observatory. Dewing is a big problem in the open in Wales, where I sometimes image. Dispose of the reflector and use a good refractor. A heater on the dew shield will keep the lens clear. If you must use a reflector use a Celestron, not a Meade.

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Len Clucas

It seems that inside the tube there is moist air that will have to be dried out. A suitable cell containing well-dried silica gel could be plugged into the drawtube and left for 24 hours, the procedure being repeated at regular intervals. When not in use the telescope should be stored in a dry atmosphere.

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Andy Eskelson

This is a fairly common problem with STCs, especially when in a cold, damp environment. Perhaps the enquirer's telescope is in a cold, damp, unheated observatory. As with all such problems the cure is to increase the temperature of the telescope above the dew point before use. Larger STCs have fans fitted to the OTA which help stir up the air inside and speed up the warming process. I know of some people who have fitted a fan to an 8-inch, though this requires a complete dismantling of the telescope – which is not to be undertaken lightly. Another option is to make a small fan mount that fits on the back of the telescope in place of the eyepiece The hole is quite large, but if an additional focuser or camera is used it may not be desirable to repeatedly remove this every time to fit a fan. If a heater is inadequate for solving the problem, the implication is that it is not sufficiently hot. Perhaps some heater tape is required around the STC OTA body, but the telescope would have to become *very* cold to need that. More information concerning individual set-up and temperature is required in order to produce other than very general suggestions. A very simple solution is to cover the telescope in a thermal blanket made into a large bag – or even a large insulated box-type cover with a small light-bulb in the bottom of it to act as a heater. If a small low-power heater is available, 25–60W is normally enough, but this is dependent on conditions. A simple lamp-dimmer can also be wired into the system (assuming that the site has mains power), and this will enable easy adjustment of the temperature. If switched on some time before observing begins, the telescope would receive a temperature boost, and perhaps then the normal dew heater would be able to keep pace. It might be worth joining the LX200 classic Yahoo group, as this sort of problem is often mentioned.

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Paul T. Curtis

I have had this problem with my 10-inch Meade LX200. Firstly, a small hair dryer can be used to blow warm air into the cell end of the telescope, but I would not especially recommend this as it will also blow in dust. The best approach is to keep the air inside the telescope dry so that moisture does not condense. This can be achieved with a bag of desiccant (there are lots of sources on the Internet). I put mine in a sandwich bag, which I attach to the open end of the telescope with an elastic band, and always leave the telescope like this when not in use. The desiccant thus dries out the atmosphere inside the telescope, which should never be left open to the atmosphere. The desiccant will gradually become saturated, but can be dried out in a microwave oven. A couple of minutes usually suffices.

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Susan Henty

I have been thinking about this problem while walking around at night. I know this might seem daft, but has anyone thought of placing a knitted sleeve over and around the instrument when not in use? Then, when the cold air on the outside hits the wool sleeve first, it might prevent the warm air within the instrument from condensing. This is, of course, in addition to the normal covering.

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Nick Atkinson

I used to experience dewing problems with my refractor. A dew shield merely delays the inevitable, and using a hair dryer provides temporary relief. I found that the only solution is to use a heater cable fitted around the dew shield and another around the finder objective. Power is provided by a 12V accumulator, and current is controlled by a device. Of course, the solution for a refractor in an enclosed tube is relatively straightforward, whereas with a reflector or other instruments using a mirror, some form of heating must be delivered to the mirror. Kendrick Astro Instruments supply heaters for 8-inch to 18-inch mirrors that are very effective in preventing dewing in Newtonian optics – particularly Dob-

sonian telescopes with open truss tube designs. They are installed between the mirror and the cell by placing a thin skim of RTV silicone onto the heater and allowing the heater to dry to the back of the mirror. Kendrick recommends using heaters that will wrap around the outside of the optics, as the thickness of a Newtonian primary mirror renders them ineffective due to its mass. It is much better and much more effective to heat a primary mirror from behind. Kendrick also supplies heaters for secondary mirrors. I use a DigiFire 7 controller, which draws up to a maximum of 7 amps (or at least that is the value of the fuse). Another company that supplies controllers and heater cables (with less impact on the wallet) is AWR Technology.

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Glyn Marsh

I have encountered the same problem, and cured it by purchasing some silica gel desiccant and placing it in a porous container that will fit inside the eyepiece drawtube (1¼-inch in the case of an 8-inch SCT), ensuring that it stays there, sealed up, when the telescope is not in use (that is, for the vast majority of the time). Regular drying out of the desiccant will be required initially, but intervals will lengthen after a while. The larger the volume of desiccant used the better. In my case I constructed a tube about 3 inches long (but within a 2-inch drawtube). It would also be prudent to ensure that, although porous, the container will not allow particles of desiccant 'dust' to be released into the OTA. Needless to say, all openings on the OTA – bolt holes, especially the locking transporter bolt holes at the rear of the OTA, and other openings – should be sealed over with, for example, a couple of thicknesses of PVC tape.

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Tom Boles

At one time I regularly experienced dewing inside my three SCTs that I use for patrolling. Dew caps and heaters will do very little to solve this, as it is caused by saturated air inside the tube, and is particularly bad during August and September when the air is very damp and dew points can be low. The solution I have used is to remove the eyepiece (or in my case, the camera) and roll a bag of silica gel inside the eyepiece drawtube. The first time it is used it might take a few days to absorb all the excess moisture, but it will succeed. When the silica is loaded (or every two weeks or so without the indicator) I blast it for a couple of minutes in the microwave to drive off the moisture, and then reuse it. During other months this is rarely a problem, but I still use the silica gel so that I am never disappointed when I set up. In addition, a humidity indicator can be used internally, and can be viewed through a transparent polythene bag covering the eyepiece holder. The type that I have used is like a card with litmus spots or lines that change colour when the silica becomes fully loaded. This can prove useful, but is more a luxury than an essential.

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Peter Whalley

I too experience this problem on a 10-inch Meade SCT during winter viewing sessions. Heater tapes do not prevent misting on the inside of the corrector plate, as it accumulates from the secondary mirror housing outwards. (Possibly the metal mirror housing acts as a cold 'well'.) I have used a desiccator inside a polythene bag attached to the rear of the open tube in daytime, in case it is an accumulation of moisture within the tube, but on the next cold night when the dew point is reached it reoccurs. I use a small 'traveller's' hair dryer (which is useless for drying hair, apparently, but ideal for this task) in a circular motion around the secondary mirror housing to clear the moisture in a couple of minutes. Once cleared, the misting does not seem to reoccur for the rest of the night. Misting does not seem to occur on the primary or secondary mirror, as the imaging quality is restored once the moisture on the inside of the corrector plate is removed. For myself, misting on the inside of the corrector plate is a more frequent issue than dew on the outside when the dew point is reached. If it is a particularly damp night when the dew point is reached, then the outside of the corrector plate around the central housing will accumulate moisture (despite heater tape and shield). Any misting on the inside, if present, is obscured by the exterior dew. If it is there, it clears when the hair dryer is used on the exterior dew. When the nights are drier and dew point occurs, that is usually when mist on the inside of the corrector plate is apparent without any (or little) dew accumulating on the outside. I have considered using a reusable, chemical 'hand warmer pad' attached to the secondary mirror housing to counteract the possible cold 'well' effect, but I have not had the courage to risk the thermal hazard to the corrector plate and secondary mirror, as the pad cannot be regulated other than by adding or removing insulation layers between the pad and the metal housing. I wonder if anyone knows of a rechargeable, battery-powered heat pad small enough to do the job – or better yet, of a tried-and-tested reliable solution.

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Astrid O. Ohlmeier

There are various solutions to this problem. The air inside the OTA needs to be purged of damp air under the driest (lowest humidity) conditions possible. This can be achieved with a flow of nitrogen, which can be left to fill the interior. An alternative remedy is to use a Lymax SCT CatCooler, available from:

http://www.lymax.com/sct/

This can be run indoors, where it is dry and warm, to dry out the interior of the SCT. Dew shields and heaters are intended for the elimination of condensation on the outside of the corrector plate, which all SCT users encounter (unless living at very high altitude). There still remains, however, the question of how damp air entered the telescope in the first place. One possibility is that if the OTA is disassembled for cleaning, moisture can become trapped during reassembly.

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Bob Butterworth

I had a similar problem with a Cape Newise 200, though it happened only occasionally. I eventually deduced that it resulted from allowing the telescope to become hot and to then cool down in very humid conditions. In cooling, humid air was drawn into the telescope body. To get rid of it I had to remove the mirror, ventilate the inside of the telescope, and close it up in dry air. Afterwards, I did not expose it to hot, humid conditions again.

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Dave Tyler

My remedies apply particularly to a C14. I have a 25 x 2-inch 16g alloy tube, the top end of which is drilled with numerous 8-mm holes, all carefully deburred. In the undrilled section of the tube, as a filler, is a length of tufnol rod – though a plug or a wooden or plastic rod would do equally as well. The top

ventilated section is filled with sachets of silica gel and is topped with a turned plug held in position with three c/sk M3 stainless screws. After using the telescope during the winter months I load the tube into the instrument, through the JMI focuser and baffle tube, so that the silica gel section is visible between the corrector plate and the baffle tube end. The lower end is a little larger than 2 inches in diameter to prevent its moving further into the telescope. The silica gel is changed every autumn. When not deployed I keep a plastic bag over the end to prevent the gel from becoming saturated with the evening dew. The photograph of this device [below] also shows the black plastic insulation tape fixed round the joins where the mirror cell and corrector plate holder meet the tube. There are two more solutions – one of them being a quick fix sufficient to be effective for a week or so, dependent on local environment. First remove the corrector plate. This is not as scary as it might seem, as it takes only a few minutes – but be sure to mark its orientation first. Blast the inner surface with a hair dryer from about a foot distant, continously moving it round and round the disc for about 10 seconds, and then blast round the inside of the tube for about a minute. Replace the corrector plate, and recollimate the telescope. The third solution can be described as 'desperate measures'. Play the hair dryer over the corrector in a constant circular motion from about a foot distant, whilst shining a torch on the glass (the procedure obviously being carried out at night). The dew will disappear firstly from the outer surface, and then slowly from the inner surface. If it was very bad it might recondense on the primary mirror, and if it does then the corrector plate needs to be removed and dried properly. Over the past seven years I have used all these methods on my C14, and it is still in perfect condition.

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Martin Mobberley

Over the years I have received many enquiries about this problem. Dave Tyler's solution is shown in the accompanying photograph – my composite of his C14 with a tube containing silica inserted. This works on older SCTs, but the newer ones – such as the Celestron EdgeHD series – have a lens in the drawtube and so cannot have a silica rod inerted, though being sealed they are less susceptible to condensation. There are few other solutions apart from using a hair dryer on the corrector plate, or as a last resort, removing the corrector, cleaning it, and reinstalling it with the orientation preserved. The older C14s seem to be better sealed and dew up inside very rarely, and the Meades seem to dew up far more easily than the Celestrons.

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Peter Anderson

I have had a C8 for 22 years now, and have had other Schmidt–Cassegrains and Matsutovs. A year ago I purchased a CPC11 as a second instrument to accompany my 16-inch Newtonian. My experience with the C8 has been that after some years the grease or lubrication sublimates and forms a coating on the inside of the corrector plate, which then needs to be cleaned. This is a nerve-wracking operation – making alignment marks, undoing the screws with Allen keys, gently removing and cleaning the plate, and being sure to position it with the alignment marks when reassembling. Thankfully, I have had to do this only twice in 22 years – and the first time was by far the worst for my nerves. When I acquired the CPC 11 I determined that I would not let any 'nasties' enter the sealed optical system, and I therefore screwed in a UV-filter fitting before attaching the diagonal prism and so on. The enquirer clearly (to me) has some residual moisture in the tube – in which case, when the temperature drops the coldest spot is the corrector plate, and the problem appears. The moisture is simply being recycled. I have known people to use the type of desiccant packets that come with various electronic goods, placed in a container or eyepiece shell exposed to the inside of the tube in order to reduce the humidity, though such desiccant may need to be treated to keep it active. However, I would try another simple method first. Point the tube down and remove the diagonal set-up so that the top of the tube is open to the air, and use a hair dryer on a low setting, or the heat from an old-fashioned tungsten lamp, to heat up the corrector plate, which is now pointing down. If a hair dryer is used, this procedure should preferably be carried out intermittently over a period of a few hours, so that the entire telescope is

slightly warm and the moist air has been expelled. The tube should become slightly warm, but not hot. After several hours the rear of the tube should be capped, and hopefully the moisture will have risen and been expelled. If it is still present, then all is not lost, because nothing dramatic has been done. If, however, the problem is solved, the eyepiece end of the tube should be sealed when not in use, and not be left open. It should also be considered whether the telescope can be stored in a drier or more protected location.

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Keith Morris

The moisture inside the tube needs to be eliminated. This can be achieved by placing in the telescope, when it is not in use, a desiccant blanking cap. This device is available from Billetparts:

http://www.billetparts.co.uk/catalog/alloy-desiccant-blanking-p-171.html

They are available in 2-inch and 1¼-inch sizes, but if the focuser is not of standard size or type, the makers should be able to advise.

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Bill Ward

I was interested to read about the condensation problem, as I have had to deal with it frequently myself. I have carried out tests with a suitable meter, and it is frightening to see how quickly the relative humidity rises as the temperature falls on some nights! Herein lies the problem. Due to the closed design of SCTs, warming the outside has only limited success, as although the air is warming a little on the outside, clearing the external dew, the air inside the tube is not doing the same – both because of the glass element, and the fact that still air is a good insulator. What remains is a large pocket of still air inside the tube! The solution is difficult due to the usual SCT design with a baffle running up from the main mirror. What needs to be done is to desiccate the air inside the tube; but it is the responsibility of the owner to decide whether it is worth the trouble or risk of attempting it. I have done this, but accept no responsibilty whatsoever for the results of others! The heat source must be dry – either a normal wall radiator or electric heat source (but not a hair dryer or blower, as there is a significant risk of breaking glass with these) – and a few medium-size bags of desiccant must be available. These can be purchased online – and it is best to buy at least ten of them, as it is a small price to pay for telescope happiness. The procedure is to place the telescope vertically on the floor, corrector plate down and main cap on, and remove any elements attached to the back – coma corrector, star diagonal, and so on. There must be a free path into the tube. Carefully place a sufficiently large bag of desiccant over the hole to cover it, ensuring that the bag is big enough to not fall into the tube even if pushed a little. (It is not desirable to have to disassemble the telescope to remove it if it falls in!) Usually, bags of desiccant are a fibre material and should not shed any dust, but before it is put in place it must be checked by shaking it over black card. If it is a new, clean bag there should not be any dust. The bag does not need to be pushed into the tube at all – simply placed on it – and the telescope should be 12 inches or so from the heat source. When the heat is turned on, the tube should not be allowed to become warm, and if there is any indication of its doing so it should be moved away from the heat source. This is a gentle process. A touch of warmth on the back of the hand is sufficient to indicate that some radiation is falling onto the tube. Then wait. After around 30–60 minutes, rotate the tube 90°, and then repeat over a period of several hours. The intention is to heat the internal air and to get it moving slightly. But this alone does not solve the problem in the long term. Even if the corrector plate is successfully cleared, as soon as the telescope is used again the condensation will reappear. It is the desiccant that is doing the work by lowering the humidity of the air inside the telescope. After a sufficiently long period (dependent on personal patience), remove the desiccant from the tube and seal it quickly. Then store the telescope in a box, including a couple of bags of desiccant for good measure, and keep it closed until the next observing session. With patience and luck the process will have been successful, and hopefully the drier air (thus lower dew point) will tolerate a greater drop in temperature and keep the inside clear. The alternative strategy is to lay the telescope horizontally with the desiccant loosely taped in position. This might actually be a better way of persuading the air to mix and exit via the baffle, though with attached items such as a mounting rail and finder bracket it is a little more awkward to rotate the tube on this axis to produce uniform warming. Another useful measure is to make an insulating jacket for the whole tube. This can be produced with a cheap closed cell foam camping mat, wrapped around the telescope, and cut and trimmed to fit. By reducing the bulk radiation from the whole surface of the tube, the telescope will cool down much more slowly. This reduces the temperature gradient across the tube wall and (hopefully) keeps the internal air above its own dew point, minimising the risk of internal dewing. Although not allowing the telescope to cool down quickly or completely is counter to what is usually held to be correct for telescopes that are not kept at true ambient temerature, reality dictates that there needs to be a compromise. I believe that for occasional observers in the UK environment (I would be prepared to wager that that includes most of us), it is better to observe something than nothing with the telescope dripping with condensation. An additional important point to be considered is that taking a cold telescope indoors can be disastrous. Even if it did not have any condensation on it, it will have as soon as it hits the warm air inside the house. This is where slowing the whole temperature-change process is often a better idea. A very cold telescope taken indoors will develop condensation on both the outside and inside of the tube, causing the internal humidity to rise, and producing the very problem that we were trying to solve! There is also the issue of fungal growth. Various glass-eating horrors can grow on the (inside) optical surfaces of telescopes that are used only occasionally, brought into a warm house, and packed away damp. To help prevent this eventuality, a procedure must be developed for minimising the impact of temperature changes and dewing. When an observing session is ended, place the telescope in a good-quality box while it is still in a lower-temperature environment, include a couple of bags of dry desiccant, and close the box. Then carry it indoors, and leave it where it will not be exposed to the highest temperatures in the house. The following day (or for early-morning observers, a few hours later), open the box – which should have slowly warmed since it was closed – and there should be no dew anywhere. Replace the telescope, close the box, and store it safely until the next observing session. The bags of desiccant can be left in the box, and the better quality ones can be regenerated at intervals by baking them at very low heat in an electric oven. It must be electric, as gas ovens generate a huge amount of water vapour during combustion. I would also like to emphasise that it is good practise to place bags of desiccant with everything optical – telescopes, eyepieces, cameras, and so on – as it really helps in the long run. A telescope is a valuable asset, and it is worth the extra effort to keep it in good condition.

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