

# Maintaining your microscope.

A short course  
for

Leeds Microscopical Society

by  
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# *Warning*

This course could make you paranoid!

You'll know when!

What's involved in maintaining microscopes?

Checking and testing

What's involved in maintaining microscopes?

Checking and testing

Cleaning

What's involved in maintaining microscopes?

Checking and testing

Cleaning

Adjusting and repairing

Question:

Why do we need to clean parts of a microscope?

Question:

Why do we need to clean parts of a microscope?

Answer:

Because they're dirty!

# Why?

You shouldn't clean a microscope that isn't dirty.

**“If it ain't broke, don't fix it!”**

Any interaction between two objects causes wear to result for both.

Therefore, checking your microscope is the first job.

Then, decide what to do next and how to do it.



## Adjusting and repairing

This will occupy the least of your time.

Every make and model of microscope is different, so it's difficult for me here to advise on particular aspects.

Most workings of microscopes don't need adjustment, nor, hopefully, repair.

# Checking and testing

## What you require

Space, clean surfaces (beware of stray small screws). Felt base can be useful.

A good lamp, maybe two: fluorescent strip light on moveable stand, and LED spotlight on bendy arm. Small LED torch.

Close-up spectacles or head loupes.

# Checking and testing

## What you require

Several magnifying glasses, dentist's mirror, focusing telescope



# Checking and testing

## What you require

Magnifying glasses and other aids:

Ideally a 6x with 3x magnifier. You can't focus into the bottom of a component with a high power lens. Low power lenses have greater working distance.

A lens such as an old projector or camera lens has reasonable magnification, highly corrected image and good field of view.

For immediate use, try inverting the eyepiece from the microscope. High-eyepoint types are good, so long as eyecup removed/folded down, but beware of scratching on the thing you want to view.

Focusing telescope (phase telescope/auxiliary microscope) – used in place of eyepiece to view the back focal plane of the objective lens. Highly recommended to check through the lens without having to remove it.

Dentist's mirror – useful for looking into tubes or up condenser from beneath.

# Checking and testing

What you require

Stereomicroscope(s)



# Checking and testing

## What you require

### Stereomicroscope(s)

Long arm stand. Good reach, focus by moving object by hand, no transmitted light, heavy.



Stereomicroscopes on stands with transmitted and incident illumination. RH student type, convenient but too small for comfort. LH more expensive, modular, comfortable and sturdy.

# Checking and testing

## What you require



# Checking and testing

## Test slides:

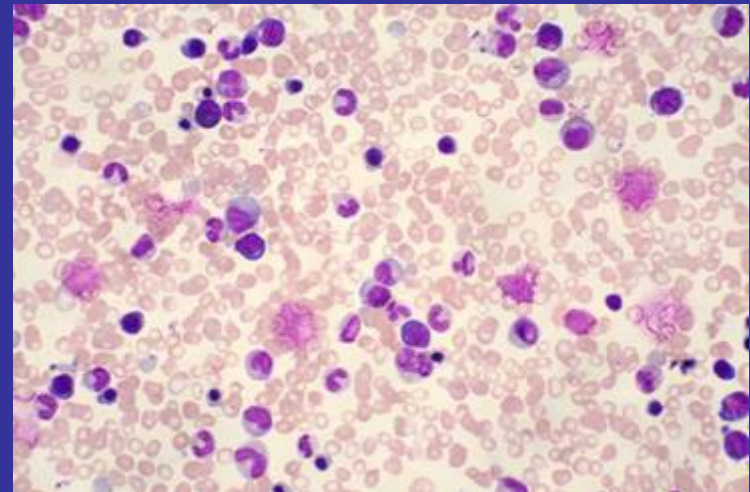
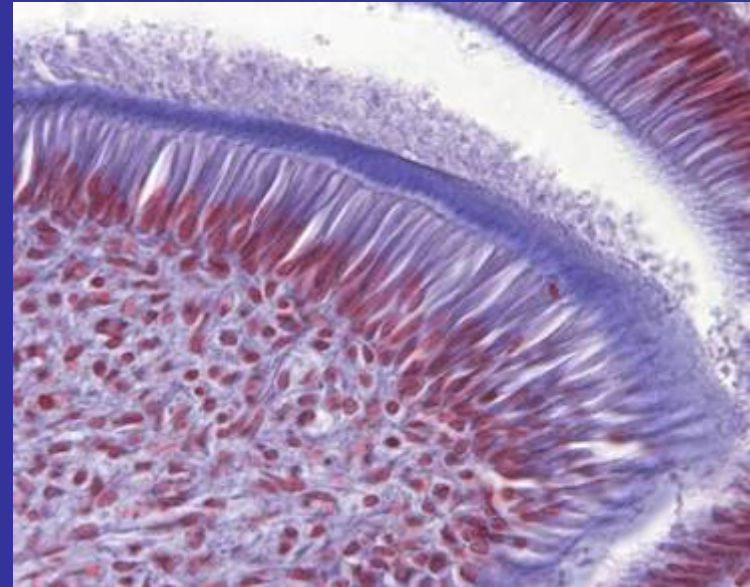
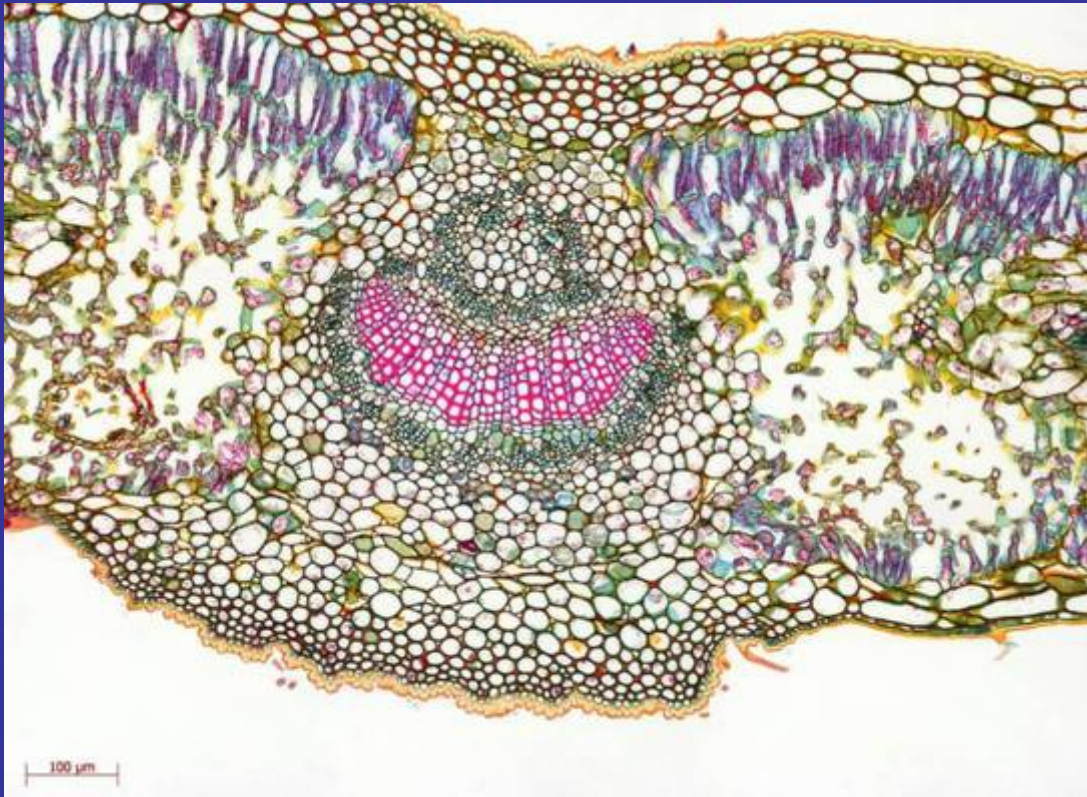
1. Well-stained section, plant or animal.
2. Low contrast specimen (unstained section, cheek cell scrape), also suitable for phase contrast.
3. Diatom test slide (Klaus Kemp).
4. Onion root section stained for chromosomes.

You can't know if the optical surfaces of the microscope require attention unless you're familiar with the image you should expect from the microscope. So get to know your test slides well.



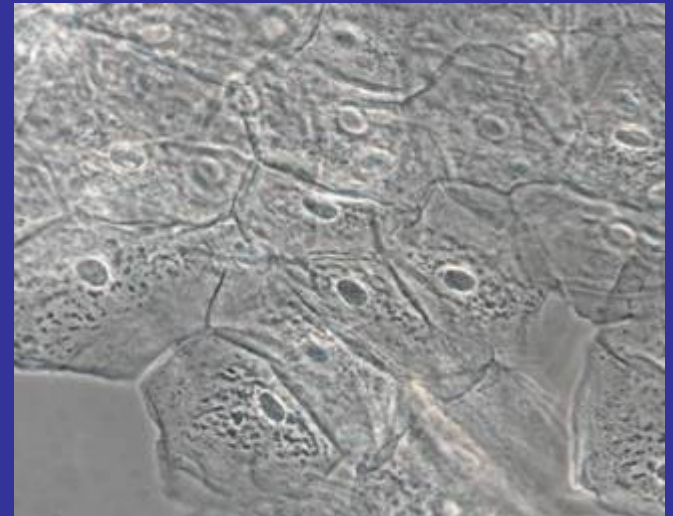
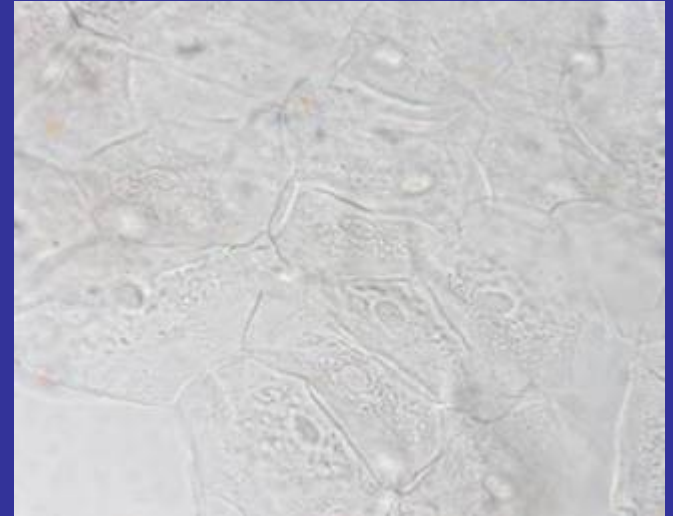
# Checking and testing

Well-stained sections etc



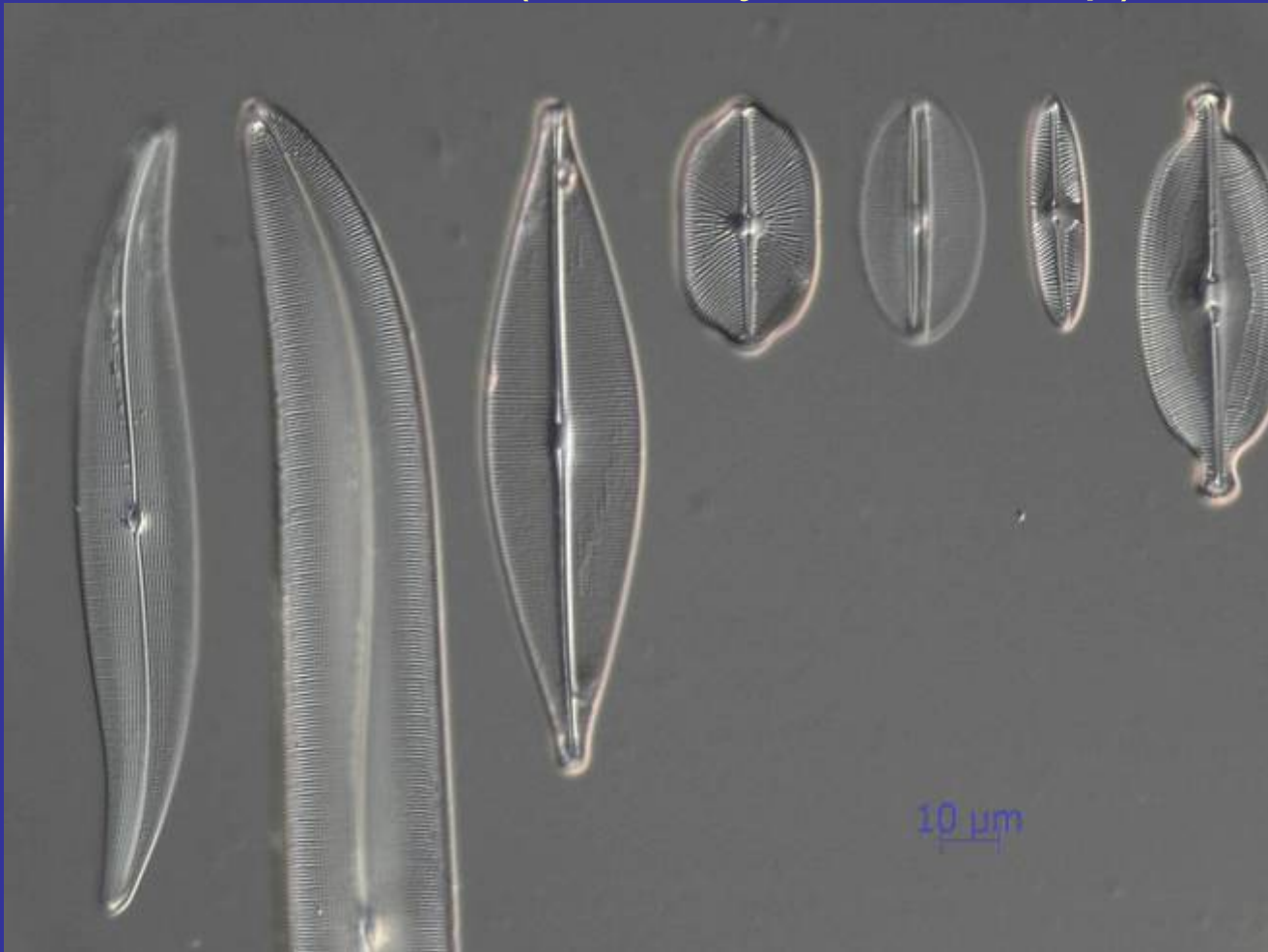
# Checking and testing

Low contrast specimen



# Checking and testing

Diatom test slide (made by Klaus Kemp)



# Checking and testing

## Methods

The illumination system must be set up according to Koehler.

Begin with the lowest power objective.

Observe the image with each objective in turn.

# Checking and testing

## Methods

Open the illuminating aperture diaphragm fully – the image will be slightly lower contrast, but if it is hazy the objective is dirty.

Use the focusing telescope to observe the lenses of the objective to verify what the nature of the problem is. It may be soiling or damage.

For phase contrast objectives, check also with the correct phase annulus in the condenser and check centration. Use a cheek scrape preparation or similar wet prep, or diatoms.

# Checking and testing

## Methods

If you can see dust specks, dark diffuse blotches, or blurred areas:

Identify the optical surface that needs attention.

Identify the nature of the problem, type of contamination etc.

# Checking and testing

## Methods

Which optical surfaces may be contaminated?

In order of likelihood:

Top of coverslip or underneath of slide.

Top of eyepiece.

The window covering the light opening in the microscope base.

Top lens of the condenser.

Lower lens of the objective lens.

Filters.

Lamp diffuser and collector lenses.

# Checking and testing

## Methods

Which optical surfaces may be contaminated?

In order of likelihood:

If using an attachment camera:

The sensor or the protective glass in front of it (great care required).

Optics within the camera adapter.

Prisms inside the photobinocular tube.



# Checking and testing

Dirt on the front lens of the objective cannot be seen when observing through the eyepieces. The image may be blurry; no image at all; have dark, diffuse blotches; even opaque (very dark image).

Dust near to the illuminated field diaphragm will be well-imaged (when the microscope is correctly set up).

Dust on eyepieces, top and bottom of slide, condenser top lens will be partially imaged.

# Checking and testing

## Order of investigation

If the contamination is well-defined, check the window where the light comes out of the base, or filters that may be on top of it.

If you see blurred contamination, move the slide around, then rotate the eyepieces. If the dust moves, it is on one of these.

If not, operate the focusing: if the objects change, or move if condenser centring or height adjusted, the contamination is at or below stage level, and most probably on the condenser, light window, filters, base mirror or lamp lenses.

If not to that, it is possibly inside the binocular/monocular tube.

# Checking and testing

If the image is poor, partly or totally blurred, partly dark or has dark fuzzy blotches, the contamination is probably on the front lens of the objective lens.

Remove the eyepiece and insert the focusing telescope to observe through the elements of the objective. You will not see an image of the specimen, and it may be easier without a specimen on the stage. Make sure you open the illuminating aperture diaphragm (in condenser) which you will also see clearly. If the image of the diaphragm appears lacking in black, or low contrast, there is probably grease on the front element of the objective. Rotating the objective will help to confirm.

# Checking and testing

If blotches or dirt are seen only on the camera image.

These stay still on the monitor image when the specimen is moved.

First: rotate the camera only (not the adapters beneath it).

If the contamination stays still (specimen will rotate) the contamination may be on the camera sensor. It could also be an electronically imposed image as a result of background subtraction.

Second: if they rotate, when camera only rotated, the contamination is probably in the adapter optics or binocular prisms, so rotate these but not camera) in turn until found.

# Checking and testing

So, getting your eye in is as important as getting your hand in!

Next: what to do when you've found what needs attention.

# Cleaning

## Don't clean willy-nilly!

More harm than good can result.

It can be a waste of time. Normally 1-2 hours.

It can contaminate an otherwise clean surface.

All contact, even with the correct agents, carries some risk of scratching.

Cleaning is a bit like cooking – different people tell you that only this or that way should be used.

There are some rules, but a lot of educated common sense also good.

# Cleaning

Prevention is better than cure!



Manufacturer's dust cover

Eye-piece covers

Illumination window cover

Eye-piece covers

Eye-tube cover

Objective hole cover

# Cleaning

The eyepieces are the most prone to contamination – skin scales, greases and acid whilst in use, and dust whilst not. Cover when not in use.





# Cleaning

Once you have identified where the contamination is, and hopefully what it is, it will probably be easier to clean after removing the component.

Eyepieces (may have a grub screw to retain it) – replace with an eyetube dustplug or improvised cover (plastic cap, aluminium foil, cling film. Dust on the prisms can be difficult to remove.

Place components on clean surface (bench-cote, foil) and cover over with plastic sheet if being left there for a time.

# Cleaning

## Objective lenses.

If you have decided that the objective lens needs attention, remove with great care. Hold the lens with one hand as you unscrew with the other. Do not remove your hands until the lens has been safely disengaged from the thread.

More objectives are damaged by dropping onto the stage – and maybe then onto a hard floor – through careless removal.

Never attempt to disassemble and objective lens!

If stuck – see under repairs.

# Cleaning

## Objective lenses.

Examine the front lens of the objective lens to ascertain the type of contamination:

Look through from the threaded end – the optics will magnify any dust.

Use a 10x hand magnifier and observe the front element using a diffuse light source, as the lens is tilted back and forth. A long ceiling fluorescent tube will be reflected off the front element as a curved line. Should there be a droplet of oil or a smudge of grease, the line will be distorted.

Examination under a stereomicroscope in both transmitted and reflected light may also be worthwhile. This can provide higher magnification and longer working distance than a hand lens – useful if it is necessary to view inside the objective. N.B., do not dismantle objectives. If the rear element requires cleaning (rare), do this with the greatest of care (difficult). Do not use compressed air.

# Cleaning

## Condensers

Some condensers are designed to have certain parts disassembled, maybe the top lens, and sometimes a phase contrast slider or turret. If so, it will have knurled rings or hand-operated screws. You would undo any other screws at your peril. There may be a carrier for a filter attached to its lower part – be careful that the filter does not fall out.

Do not attempt to disassemble the iris diaphragm and do not get cleaning fluids, oil or grease on to it.

The background of the image is a dark, almost black space filled with a vast amount of interstellar dust and debris. The particles vary in size and shape, appearing as small white and grey specks, some with distinct colors like blue and green. There are also some larger, more complex structures that look like thin, fibrous strands or small clumps of material. The overall effect is a sense of a rich, textured environment of cosmic matter.

**DUST!**

**THE FINAL FRONTIER**





100 µm

A student microscope in geology lab in need of a clean

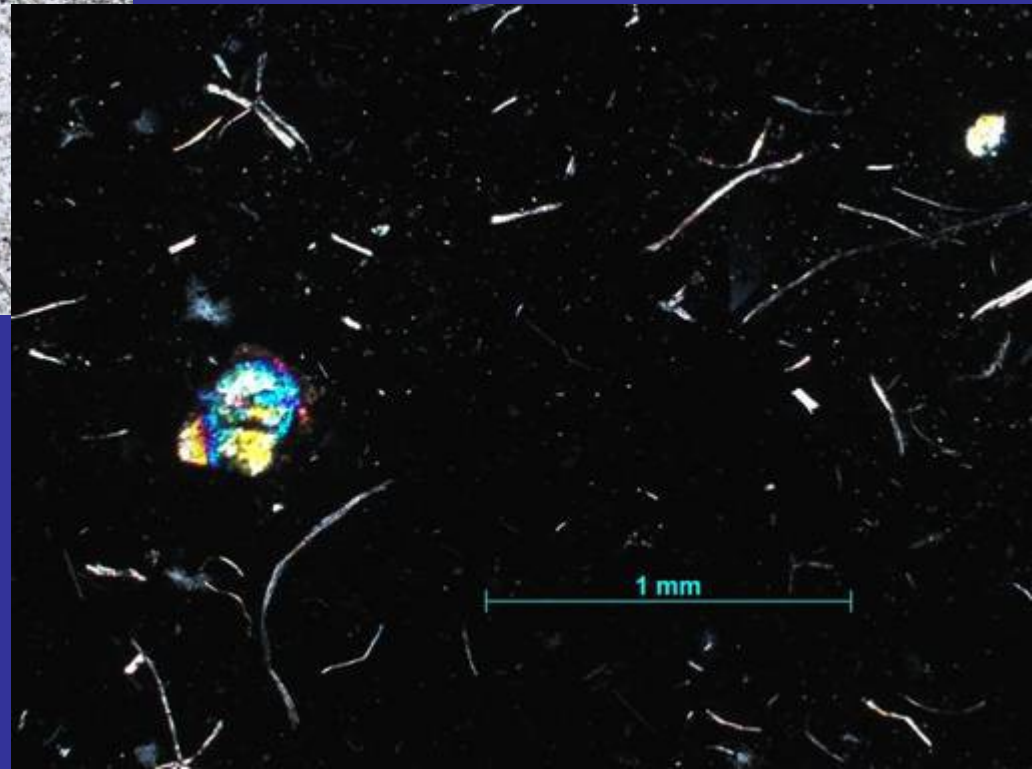
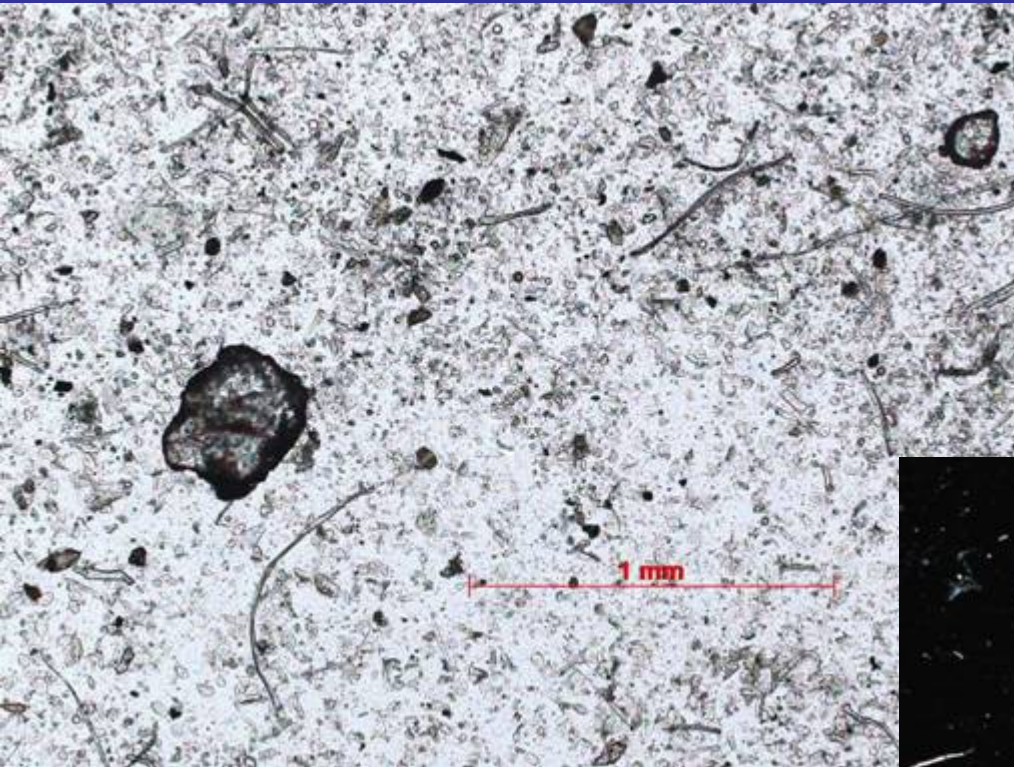




Simple – just dust, innitt! Yeah?



No, it's full of quartz grains and grit!



So, just rub it with a rag, then, eh?

So, just rub it with a rag, then, eh?

**May as well use sandpaper!**



# Cleaning

Cleaning hardware and substances.

Do not use a **dry** cloth, paper or swab on an optical surface.

What do we use, then? What's in the case?



# Cleaning

## Tools



DO NOT USE pressurised air – it contains a propellant which forms a haze on optical surfaces which is almost impossible to remove.

DO USE rubber blower, such as this.

# Cleaning

## Tools



Variety of paint brushes, some with stiff bristles and others with very soft, fine hairs. Note the plastic bag, in which to store them.

# Cleaning

## Tools

Whatman 105  
lens cleaning  
tissue.



Selvyt  
cloth

Microfibre  
cloths



Cotton  
wool BP +  
bamboo  
skewers



# Cleaning

## Commercial lens cleaning kits



# Cleaning

## Commercial lens cleaning kits



# Cleaning

## Commercial lens cleaning kits



# Cleaning

Optical lens wipes are very effective but expensive if you need to do much cleaning. They are still worth keeping in your armoury, though.



# Cleaning

But do not use steri-pads. They contain surgical spirit as well as oils for moisturising.



# Cleaning

## Substances

In order of use

Distilled water – breathe a haze on to dry surfaces.

Aqueous detergents.

Aqueous detergents with a little alcohol.

Alcohol (IMS = Industrial Methylated Spirit).

Petroleum ether mixture.

# Cleaning

## Substances

### Distilled water from breath.

Concerns sometimes raised about danger to others through transmission of bacteria and viruses. But don't forget that your breath is being spread around the workplace anyway. Micro-organisms do not survive on clean surfaces. Just learn to do this without spitting! Don't worry about this, but do worry about dog mess!

# Cleaning

## Substances

### Aqueous detergents +/- alcohols

The Zeiss lens cleaning fluid contains an anionic detergent with a little isopropanol. It is ammonia-free. The foiled cloths contain the same.

The Bouchard lens wipes contain 5% anionic surfactants “amongst other ingredients”.

An effective lab-made fluid contains 95% pure water, 5% alcohol, 2-3 drops per 100ml Tween or Triton.





# Cleaning

## Substances

### Aqueous detergents +/- alcohols

These can be applied by moistening (not wetting) a lens-cleaning cloth (as supplied with spectacles), fine microfibre cloth, Selvyt cloth or Whatman 105 lens cleaning tissue. There are also some pads on sticks, such as Texwipes. Cotton wool is a little messy, but can be used effectively if only moist.

Particularly good for large surfaces and flat surfaces

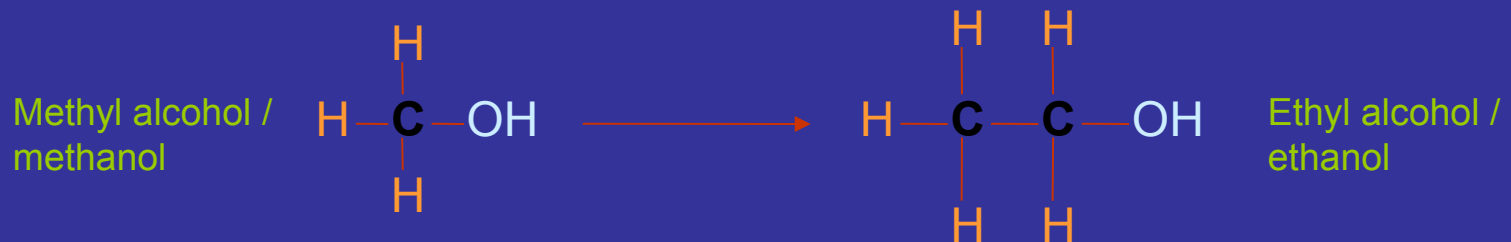


# Cleaning

## Substances

### Alcohols

The basic molecular unit of an alcohol is  $\text{CH}_3\text{OH}$ .



3C = isopropanol

4c = butanol

5c = pentanol

6c = hexanol

etc

# Cleaning

## Substances

### Alcohols

Methanol. Not heard of this being used.

Ethanol. To obtain IMS you will need to provide a justification, but to obtain pure ethanol you would need a customs and excise licence. Other than the latter, these alcohols leave a haze behind. Worth keeping for cleaning jobs other than lenses. Do not use on front lenses of old objectives – the cements were often alcohol soluble.

Isopropanol. Used to be highly recommended because it is very clean and could be obtained from chemists without restriction. However, it has been found to attack lens coatings. Very effective in aqueous dilution.

# Cleaning

## Substances

### Cyclics

These compounds are based on a hexagonal ring of carbon and hydrogen. The first, with one ring ( $C_6H_{12}$ ), is benzene. Toluene has two rings and xylene (xylol) has three rings.

All these are regarded as dangerous to health, though xylene used to be recommended for cleaning objectives, because the lens cement was (then) alcohol-soluble. However, a tiny quantity on cloth, tissue or swab may be the only remedy for xylene-based mountant dried on to front elements of objectives. Possibly better: leave the objective to stand in a little chloroform on a pad of gauze in a jar. Clean off bit by bit with lens tissue.

# Cleaning

## Substances

### Other substances

Acetone: effective but highly flammable and even its vapours will attack lens cements, rubber, neoprene, plastics and optical coatings. Excellent for cleaning slides.

Chloroform: similar but additionally dangerous to health.

Diethyl ether: very highly flammable and banned on most premises, though effective.

Carbon tetrachloride, trichloroethane etc: harmful and usually banned.

White spirit BS245: contains aliphatic hydrocarbons C9-C12 (>30%), aromatic hydrocarbons (15-30%), n-alkanes, iso-alkanes, cyclics and aromatics (2-25%). This is not suitable for lens cleaning, mostly because it dries very slowly and leaves a residue. However, it is useful for some stain removal from the microscope stand and stage. It dissolves grease and dried immersion oil very effectively.

# Cleaning

## Substances

### Hydrocarbons

These compounds are similar to alcohols except the hydroxyl groups are replaced by hydrogen atoms:

$\text{CH}_4$  = methane

$\text{C}_2\text{H}_6$  = ethane

$\text{C}_3\text{H}_8$  = propane

$\text{C}_4\text{H}_{10}$  = butane

$\text{C}_5\text{H}_{12}$  = pentane

$\text{C}_6\text{H}_{14}$  = hexane

septane, octane, nonane, decane etc.

# Cleaning

## Substances

### Hydrocarbons

Of these compounds, the only one recommended is n-hexane, which forms the basis of “petroleum ether”, together with higher compounds in the series. Petroleum ether is not a defined single chemical, more of a blend.

It is the main component in “Optical cleaning Solution L”: 85% petroleum ether and 15% isopropanol.

It evaporates and spreads quickly so is only suitable for use on swabs.

# Cleaning

## Substances

### Hydrocarbons





# Cleaning

## Substances

### Not to use

Supermarket-shelf / DIY store products, such as Mr. Muscle, Cillit Bang, Windowlene, Flash etc.

These often contain ammonia and acids, together with soaps and fragrances.

# Cleaning

## Methodology

How you clean depends on:

Size and type of optical component

Type of contamination.

# Cleaning

## Methodology

### Types of optical component:

Larger, flat glass surfaces, such as filters, the window where the light comes from, and eyepiece top lenses.

Curved surfaces, such as eyepiece lower lenses, condensers and objective lenses.

# Cleaning

## Methodology

### Types of contamination:

Dry dust, comprising mostly of fibres and skin scales.

Additionally with gritty dust, as produced during building work.

Grease from fingers, greased components or immersion oil.

# Cleaning

## Methodology

### Flat optical surfaces:

Usually relatively large, compared to objective lenses (though some objective lenses have flat front elements).

- a) Blow with rubber blower. Not always effective due to static attraction. May be possible to use brush at same time.
- b) Dry brush. Brush can be heated against a light bulb (trad.) and, when touched on surface should pick up much dust. Wipe on Selvyt cloth and repeat as necessary.
- c) Breathe on surface to create a film of distilled water and use soft brush. Smaller particles may remain, which can be removed with another breath and cloth.
- d) Or, use cloth or lens tissue moistened with aqueous lens cleaner (or lens wipes).

# Cleaning

## Methodology

### Flat optical surfaces:

Inspect the surface by eye and/or magnifier. It may be that you can see some blobs, which may be oil or mountant. These should be cleaned off with optical lens solution L, or maybe IMS followed by a clean cloth.

# Cleaning

## Methodology

### Flat optical surfaces:

#### Some exceptions

Eyepieces. You should not need to disassemble eyepieces. Focusing eyepieces, however (only), are intended to be dismantled in order to insert graticules (a necessarily clean operation).

Some very old eyepieces can be disassembled since the blackening often becomes deposited on the inner lens surfaces. Make sure that they are replaced the right way, as often the screw threads are the same on both ends.

# Cleaning

## Methodology

### Flat optical surfaces:

#### Some exceptions

Fluorescence filters. Usually, these are not exposed on more recent instruments, but can still attract microscopic dust. Coloured glass types can be cleaned as described but “interference” types (they are mirror-like and coloured) have extremely delicate surfaces. Clean very gently with paint brush, lens tissue or fine, clean cloth with aqueous lens cleaning fluid with alcohol or with lens wipes, not with cleaning fluid L.



# Cleaning

## Methodology

### Curved optical surfaces:

Initially, use blower and brush as described. Finish with aqueous cleaning fluid with alcohol on a clean, fine cloth or lens tissue.

Eyepiece lower lenses rarely get dirty, but condenser top lenses (often flat) often become contaminated with immersion oil and fragments of broken glass from slides. In this case, the oil and glass should be removed very gently using a cotton-wool swab loaded with optical lens solution L, changing often until surface is clean. Condenser lower lenses rarely get dirty.

# Cleaning

## Methodology

### Curved optical surfaces:

#### Objective lenses - 1

The lower lenses of objective lenses do not become as dirty as eyepieces, but their performance can be very easily compromised by a single fibre from clothing. Careful inspection is vital.

Dust and fibres only – brush with fine, soft brush and blower (possibly under a stereomicroscope). That may be all that is required.

# Cleaning

## Methodology

Curved optical surfaces:

### Objective lenses - 2

If not: a new or clean fine cloth can be used on the larger front lenses with a drop of aqueous fluid.

For smaller front lenses, either make a conical shape with lens tissue or make a cotton-wool swab, either just moistened with aqueous fluid.

# Cleaning

## Methodology

### Curved optical surfaces:

#### Objective lenses - 3

If you can see that the contamination is immersion oil, remove the major part with a lens tissue, just touching against the puddle.

If you can see dirt and grease together, make a cotton-wool swab and dip rapidly in optical cleaning solution L (solvent) and work quickly around lens in a spiral from centre to edge once only. Do the same for residual immersion oil. Repeat several times until clean.

# Cleaning

## Methodology

Curved optical surfaces:

### Objective lenses - 4

It is tempting to resort to the solvent cleaner for all cases. This should be avoided unless necessary, because regular use may quite possibly degrade the lens cements or varnishes around the front element.

# Cleaning

## Methodology

Curved optical surfaces:

### Objective lenses - 5

Other notes: objective lenses on inverted microscopes will become dirty very quickly. Take special care to protect and cover them when not in use. Inspect regularly with a magnifier and focusing telescope.

Objective lenses designed for oil immersion should have a black ring around them (if less than 50 yrs old). If not, don't oil immerse.

Cleaning beneath a stereomicroscope (6-8x mag) can be very beneficial. You need both hands, so you can't use a magnifier. Head loupes also good.

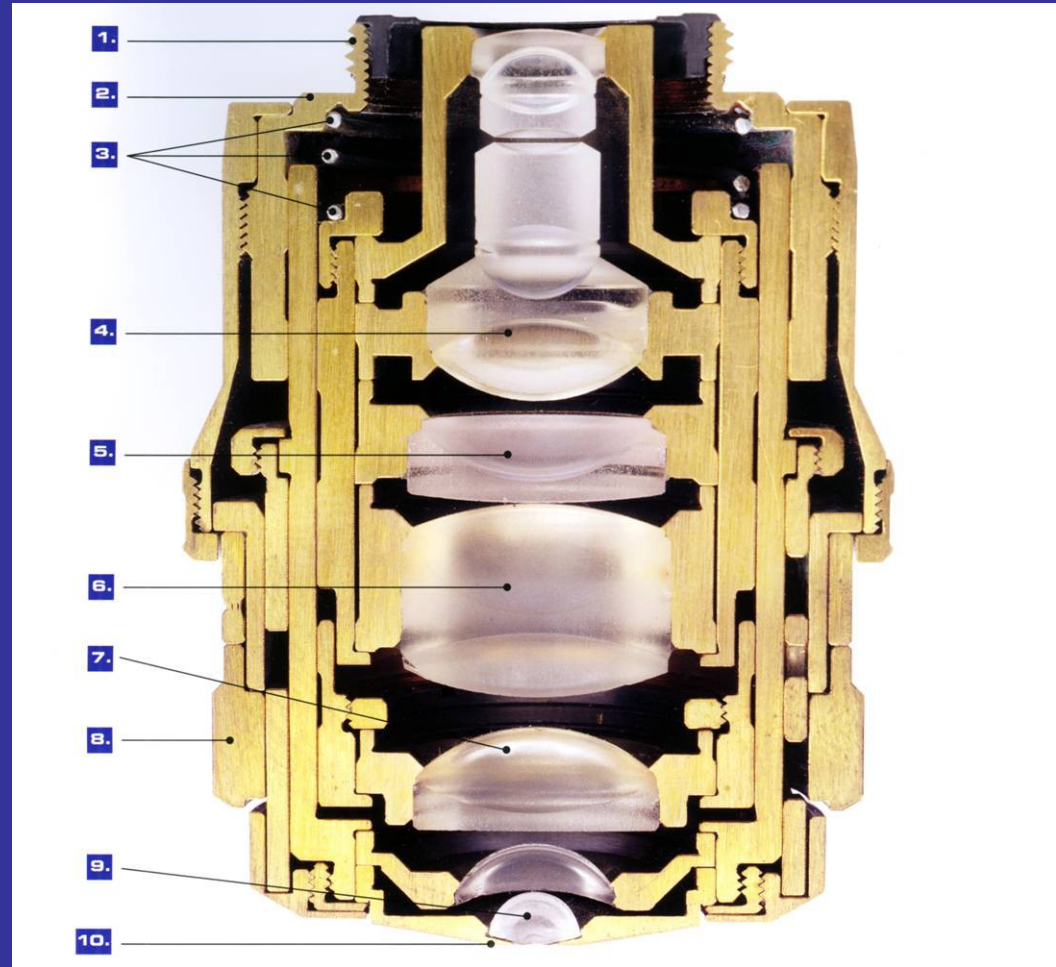
# Cleaning

## Methodology

Curved optical surfaces:

## Objective lenses – 6

Objective lenses are complex, precise and expensive.



# Cleaning

## Methodology

Curved optical surfaces:

## Objective lenses – 7

Objective lens front lenses can be very small and are still made and assembled by hand.





# Cleaning

## Methodology

### Making a cotton-wool swab - 1

Keep cotton wool (BP only / DIN61 640-A, Ph. Eur., DAB) in a new plastic bag, after first loosening it up with vinyl or cotton gloves or two pairs of thoroughly cleaned forceps.

Keep bamboo skewers also in a plastic bag and keep the one in use in its own bag. Use only for 20 times or so, though you can break 1" of end off using Spencer Wells forceps. If the two are leaving a residue, discard the stick. If new one still leaves deposit, the fluid may be contaminated. Test by pouring a few drops onto a clean slide and leave to evaporate. Examine for rings of deposit. Discard. Best keep working solution in a small bottle.

# Cleaning

## Methodology

### Making a cotton-wool swab – 2

Break end off stick with a pair of clean Spencer Wells forceps to leave a hackly end. Keeping the cotton wool in its bag, pull off a small quantity with the end of the stick. Use fingers outside bag to press onto the cotton-wool on the stick and twist the stick to form a bud-type swab.

If right handed, hold stick in right hand and bottle of solution in left. Undo lid using little finger of right hand and hold it there as swab is dipped rapidly into fluid. Replace lid and use swab immediately.

As mentioned, make a spiral motion from centre to edge once only. Pull off the cotton wool and repeat if necessary.

# Cleaning

## Methodology

### Making a cotton-wool swab – 3

And this is how you become paranoid:

The cotton-wool, stick, spare sticks, fluid in use and stock fluid must be kept cleaner than an operating theatre.

Fine grit in the cotton wool, grease from fingers on the sticks or contamination of the solvent make your job worthless and frustrating.

The solvent absorbs water from the atmosphere so don't breathe in it or leave the lid off for longer than necessary.

# Cleaning

## Methodology

### Making a cotton-wool swab – 3

And this is how you become paranoid:

Therefore, don't touch anything and don't breathe!

Don't use latex gloves as these usually have powder in/on them (hydrated maize grains).

Keep all brushes, cloths, cotton-wool and sticks in plastic bags – and don't put your greasy, salty mitts inside them!

# Cleaning

## Non-optical parts

Microscope stand – use a coarse type microfibre cloth moistened with tepid water with a few drops of washing-up liquid.

Avoid frank grease and, if cloth contaminated, wash.

Brush dust out of corners with a stiff-type paint brush.  
Clean extruded grease away with clinical wipes / cosmetic Kleenex etc.

Finish with Sheen or Pledge.

# Cleaning

## Non-optical parts

Microscope stage – remove slide clip and clean any immersion oil away from both with clinical wipes.

White spirit may be used on tissue to clean most off. IMS can be used to finally clean and dry, but test first beneath stage that the black is not alcohol soluble. Don't drop the slide clip in solvent or hot water and detergent because these will remove the grease from the spring arm.

Condenser – as above but also use brush to remove powdered glass and dust. A microfibre cloth moistened with detergent may be used after.

# Cleaning

## Non-optical parts

Eyepieces - remove the eyecups if possible. These can be washed with soapy water or dropped into warm water with detergent. They will be dirty with sebum, skin scales and makeup, as well as regular dust and dirt.

Clean the metalwork of the eyepiece itself with a microfibre cloth lightly moistened in tepid water with a little detergent.

Objective lenses – unless heavily soiled with immersion oil (use clinical wipes) use a microfibre cloth. Alcohol and other solvents may remove the paint from the engravings. Some old objectives have water soluble pigments inside engravings.

# Cleaning

And when you've cleaned the whole microscope to your total satisfaction, you won't want anyone else to use it!

Then you'll know you're truly paranoid!



# Maintaining microscopes

## Part 3

Adjusting and repairing

# Important!

- Unless there are microscope parts that are intended to be adjusted by the user on a regular basis, beware that making any adjustments or repairs whilst the microscope is covered by warranty could nullify the warranty.
- If the microscope is still under warranty and you think such adjustments may be needed, you should contact the supplier of the microscope.

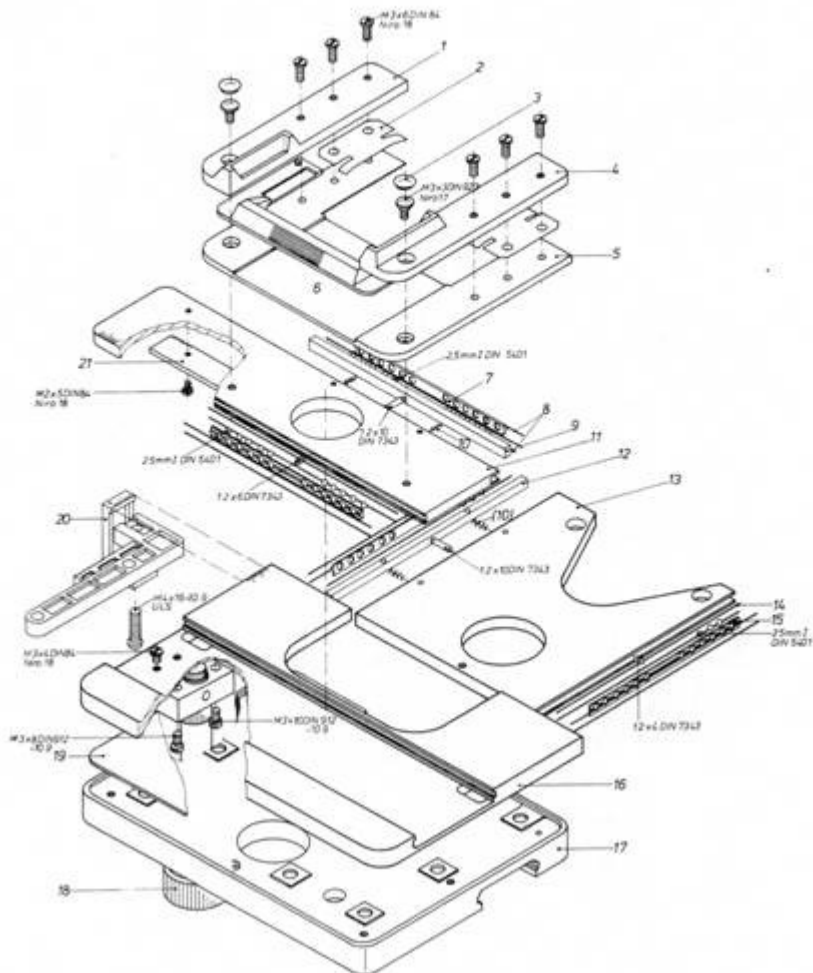
# What parts may be intended to be adjusted regularly?

- Adjustment for the tension of the focusing controls.
- Removal of the slide holder assembly of mechanical stages.
- Change of illumination light bulb.
- Centring of light bulb.
- Orientation of monocular or binocular head.
- Removal of objective lenses, eyepieces and condenser.
- Centring of condenser and phase contrast annuli.
- Occasionally, adjustment of tension of stage controls, and possibly also their height.

# Lubricating

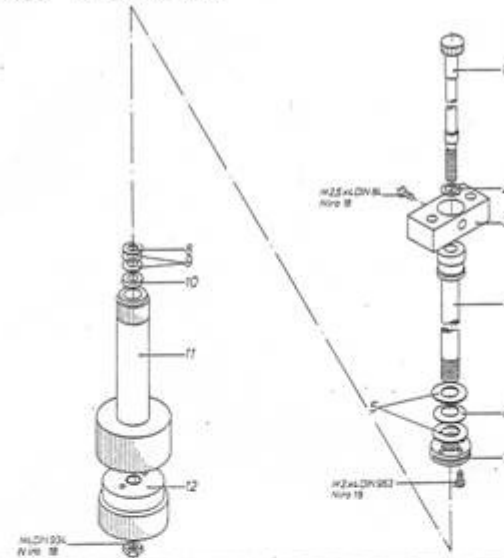
8.7 Kreuztisch links 47 06 30  
Kreuztisch rechts 47 06 31

38  
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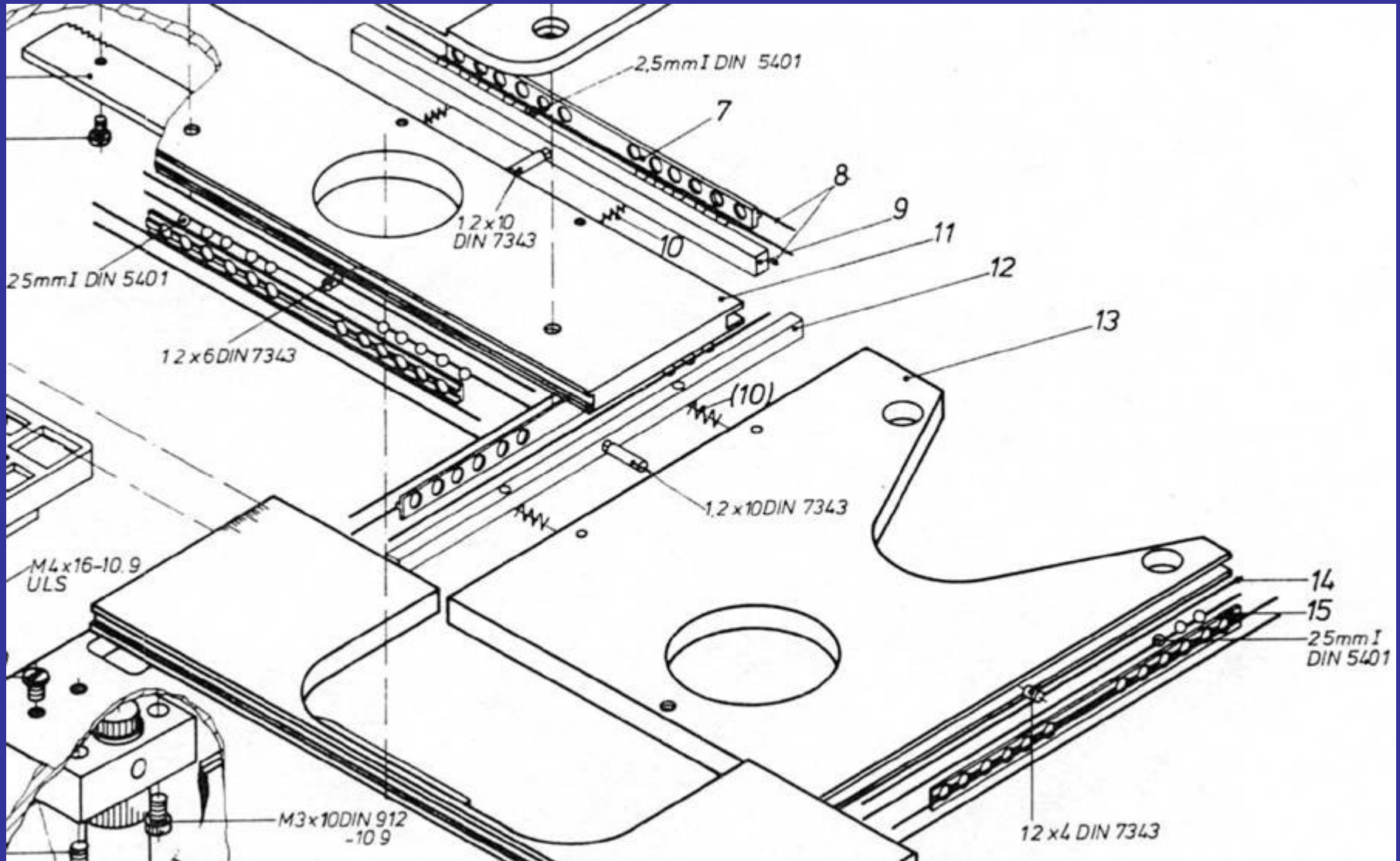
Trieb 47 06 30-9001

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Lfd. Nr	Benennung description	Bestell- Nr order no	Stück pcs
1	Ritzel pinion	470630 0201 000	1
2	Reibscheibe friction washer	470630 0202 000	1
3	Flansch flange	470630 0223 000	1
4	Lager sleeve	470630 0228 000	1
5	Pa. 3-4: Lager, vollständig pair 3-4: bearing, complete	470630 8102 000	1
6	Scheibe washer	470630 0203 000	2
7	Tellerfeder diahal washer 12,8 x 7,2 x 0,2	990905 5131 500 (22 Göttingen)	1
8	Mutter nut	473415 0111 000	1
9	Ring washer	470630 0204 000	1
10	Tellerfeder diahal washer	990905 5130 500 (22 Göttingen)	2
11	Ring ring	470630 0205 000	1
12	Triebkopf knob	470630 8103 000	1
13	Knopf knob	473415 8036 000	1

# Lubricating



# Lubricating

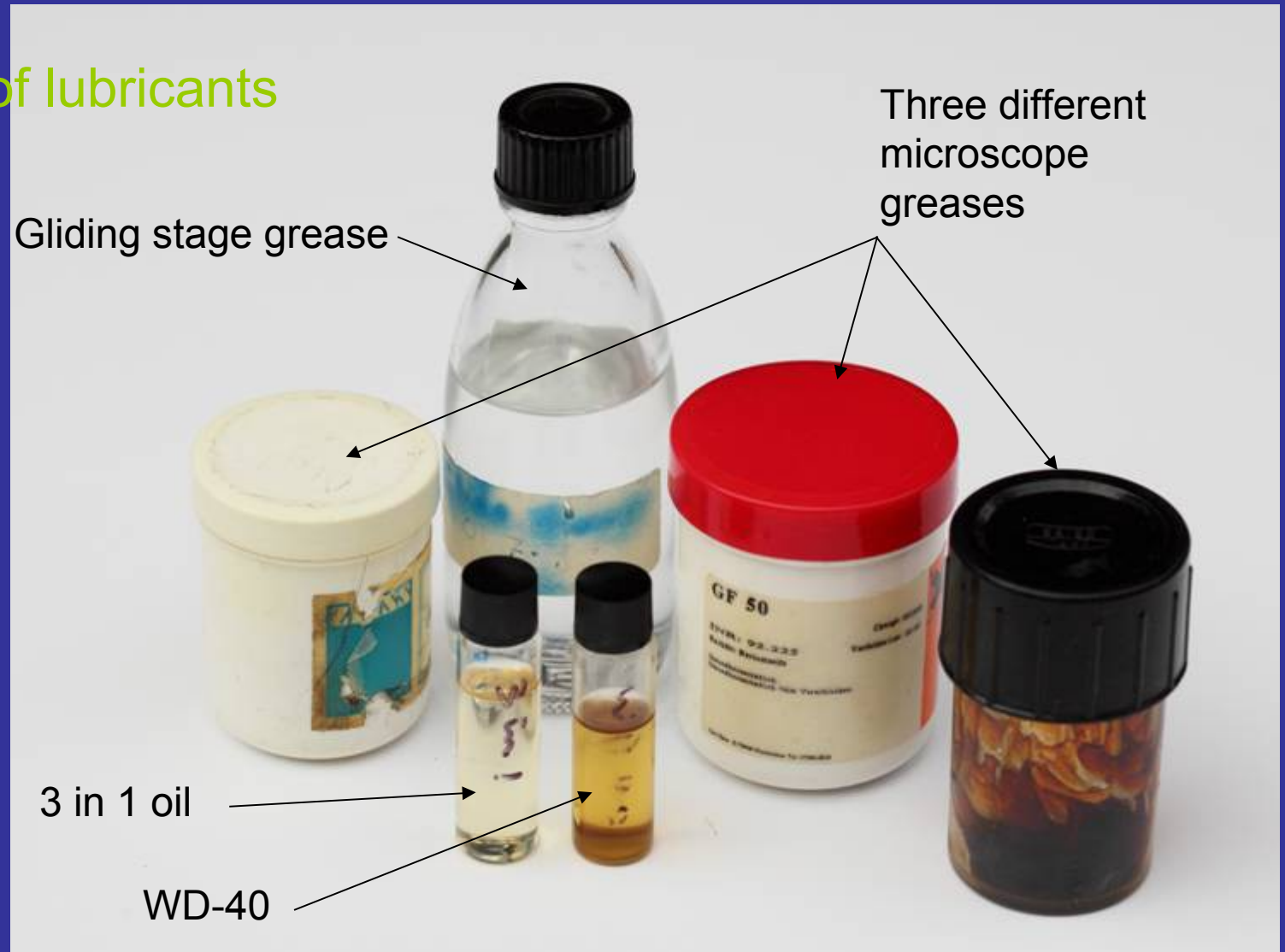
A microscope may have 6-12 different lubricating agents used for different parts, different performances and sometimes for different climates.

The type of lubricant for each component may only be known by the company that made it.

Therefore, it is highly likely that you cannot use precisely the correct lubricant.

# Lubricating

## Types of lubricants



# Lubricating

- Greases – these are non-stringy or gluey, but have thickness to restrain movement. It may be worth a try at obtaining some from your microscope supplier.
- Gliding stage grease is extremely sticky and not for lubricating otherwise.
- Do not use silicone grease because it creeps and has an affinity for glass!
- “Rocol” is a semi-fluid grease.
- A “thick oil” by Starrett is sold by R.S. shops.



# Lubricating

- Oils: general household lubricating, such as 3 in 1, clock oil is thinner and instrument oil a little thicker.
- WD-40 should not be considered as a lubricant. It should really only be used for freeing-off. Then it should be removed and replaced by proper lubricant. This is because it evaporates and, if used to thin a stiffened grease, the grease may subsequently solidify.

# Lubricating

- Grease removers. White spirit is quite effective. A couple of applications may be needed and then removed with meths or IMS.
- “Residual Oil Remover” is a cleaning fluid for removing greases and oils from optical and other surfaces.

# Lubricating

- What may need lubricating?
- Screws used to clamp binocular tubes, lamphouses and condensers in position.
- Dovetail slides on nosepieces, nosepiece rotation.
- Condenser centring screws.
- Slide clips.
- Mechanical stages.
- Focusing systems.
- Condenser mechanics.

# Lubricating

- How often should I grease parts?
- With only a very few exceptions, greases should remain in a usable condition for many years.
- (I have several Zeiss microscopes over 100 years old and the greases are still perfect).
- So, generally, the answer is: mostly only if necessary.

# Lubricating

- Some specific parts
  - Mechanical stages
- Heavily-used mechanical stages, such as in cytology labs, should have their stages checked annually. If the grease runs dry (because the constant movement has pushed it out) the guide rails that channel the ball-bearing races bend, will come out and allow the ball bearings to fall out. It would be folly in such a lab not to have these dealt with professionally by the manufacturer.

# Lubricating

- Some specific parts
  - Mechanical stages
- For less intense or important use, if it is found that a stage is becoming stiff, rather than re-greasing (which necessitates dismantling the stage), a tiny drop of 3-in-1 oil or instrument oil could be added at strategic points on the slideways and in the racks and pinions of the controls. It will take several days for this to be dispersed throughout the existing grease and effectively thin it.
- Do not use WD-40!

# Lubricating

- Some specific parts
  - Nosepieces
- Very few microscopes now have removable nosepieces via a dovetail slide but, if necessary, apply regular grease, spread lightly on the dovetails.
- If the rotation of the nosepiece becomes stiff, do not dismantle unless you want the fun of catching the ball-bearings. Ideally, return to the manufacturer for re-greasing. A partial measure may be to introduce a small drop of oil to the bearing surfaces and click-stop mechanism (all objectives removed).

# Lubricating

- Some specific parts
  - Screws
- A light application of regular grease as required to keep them easy to operate.
-



# Lubricating

- Some specific parts
  - Slide clip (spring-finger design)
- A very small drop of thick oil should suffice.
-

# Lubricating

- Some specific parts
  - Focusing systems
    - For stage or limb focusing and condenser focusing.
- On simple instruments, it may be possible to add small drops of oil or thick oil to strategic parts of dovetails, if visible. Often, however, it is the focusing mechanism inside the stand that requires re-greasing. I would not recommend tackling this, unless the microscope is otherwise useless, but return to manufacturer.

# Lubricating

- Some specific parts

- Condensers

- A condenser may simply have an aperture diaphragm. These can stiffen over many years and it may be due to oil or grease that has crept in from the sides. The diaphragm should have no oil or grease on it. If it can be detached from the optics, it may be possible to remove the grease but, if not, dismantling the diaphragm assembly will be required. This is a most difficult and frustrating job and should be avoided at all costs!

# Lubricating

- Some specific parts
  - Condensers

- Other condensers have a rotating turret which can become stiff, or the centrable phase annuli have stiffened. The only solution here is to dismantle the turret – if possible away from the optics – and remove much the old stiffened grease with tissue and swabs, before adding Rocol or a little thick oil. Avoid getting grease on the diaphragms at all costs!

-

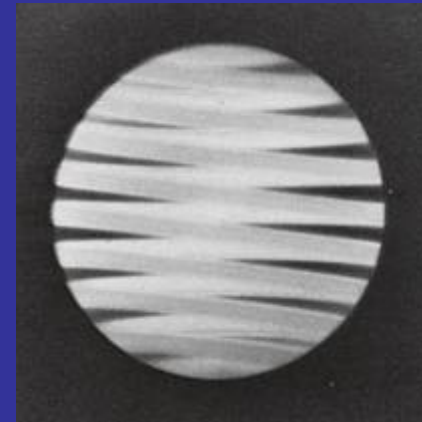
# Lubricating

How to apply: syringes and small paint brushes.



# Lamp replacement and centring

- All microscopes differ in the lamps they use, the method of attachment and the means of centring, even from a single manufacturer. You'll need to check the instruction manual for each microscope model.
- Not all illuminators permit centration. For those with centring facilities, it is almost essential to have a removable diffuser and to observe the back focal plane using a focusing telescope.



View of back focal plane showing lamp filament correctly centred.

# Blue and ND filters

- The light produced by filament bulbs is yellow. Our eyes work best in daylight and blue light carries the finer detail. A blue filter should be used to bring the microscope illumination at least to a similar colour as ambient.
- Neutral density filters can be used to change the intensity of the illumination without changing the colour.
- LED illumination may benefit from yellow filtration.

# Adjusting the height and centration of condensers.

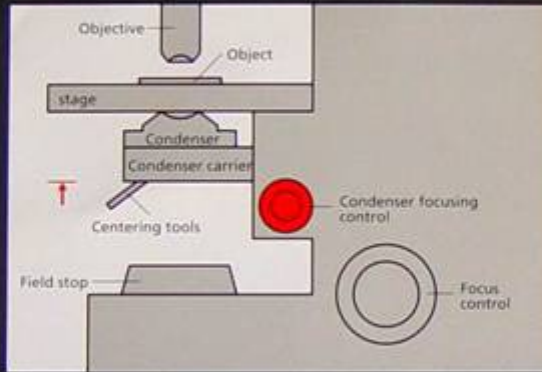
- The x-y-z adjustment of a condenser is otherwise known as “setting-up the illumination” or Koehler Illumination.
- It is essential that when a microscope is returned to use, the illumination is set up according to Koehler’s principles.



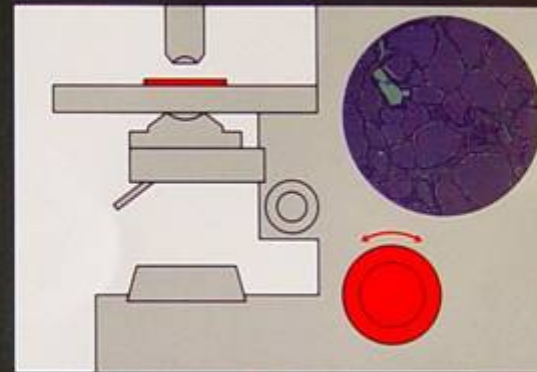
# Köhler illumination

## Brightfield

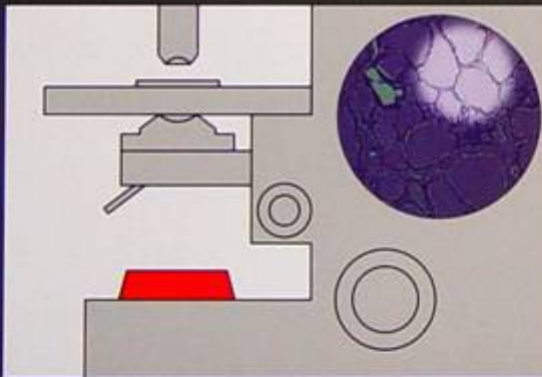
**1**  
Move the condenser in the upper position and position the condenser for brightfield.



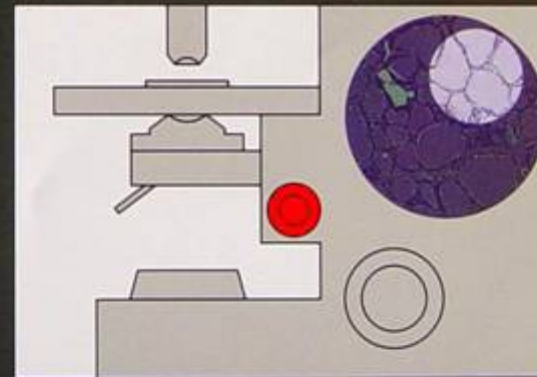
**2**  
Focus the object.



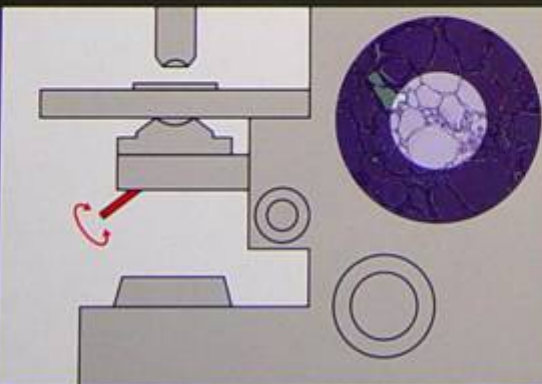
**3**  
Close the field stop to see image of the field diaphragm in the eyepiece.



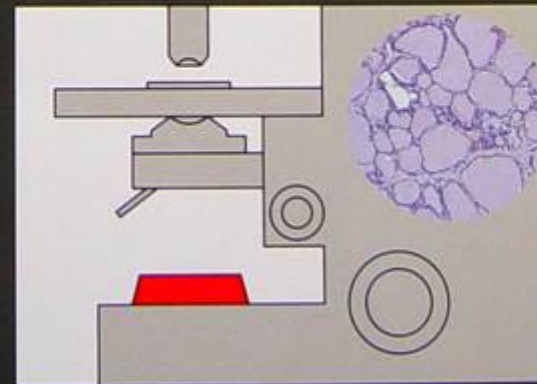
**4**  
For focusing the field diaphragm, move the condenser up or down.



**5**  
Centering the condenser centers the image of the field diaphragm.



**6**  
Open the field stop: image of the field diaphragm is at the edge of the field of view in the eyepiece.



# Other useful tools

Torches

Digital  
calipers

Toothbrush

Pin keys



# Other useful tools

Cap remover  
by Zyliss from  
Lakeland.  
For removing  
stubborn  
objectives  
from  
nosepiece.



# Immersion oils



Which one should I use?