The Microscope in Science Fiction Films

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Submitted for your approval.

Introduction

A cowboy has his horse, the cop has his gun, and our inveterate scientist has his trusty microscope. No matter what is going on, real or otherwise, somewhere on the lab benches of some of our favorite SF films are microscopes. They are one of the most dramatic set pieces in SF films and when we the audience see a cinemascientist gazing into a microscope we get an immediate sense that something interesting was observed and key for plot development. In most of these cases we just see the cinemascientist looking in a microscope and his reaction right afterwards. On a few occasions we actually get a glimpse of what was seen under those optics, what the scientist was really gazing at. What is shown in these scenes has varied from drawings, to real images of cells and tissues, and to some completely different life forms from what was described. All of it passed onto a seemingly unsuspecting audience. As long as it looked cool and seemed reasonable it was OK.

Many of us were first exposed to both telescopes and microscopes while watching SF cinema in our youths. Most probably way before such instruments were first seen in a formal setting such as a school classroom. The ideas of these instruments are easy to grasp. The telescope for seeing distant objects, invisible to the naked eye, and the microscope for seeing tiny objects, also invisible to the naked eye.

The sophistication of the microscope in SF films varies dramatically from embarrassingly simple devices (a kiddie scope) to some astonishingly expensive items seen only in the most sophisticated research labs. In some instances the value of these high end microscopes is probably more than the entire budget of many B films. For example, a large speciality microscope called a fluorescence microscope was seen in the film, FROZEN ALIVE (1964) that by itself easily surpassed many a film budget. And in the film, WAR OF THE GARGANTUAS, we see scientists working with an even more expensive electron microscope. Due to its expense such a microscope would not be a part of a film set but, rather, the film crew visited a research lab containing such an instrument. The presence of such an impressive microscope is effective and an eye-catcher.

A light history of microscopes

Long ago in ancient times someone picked up a piece of glass (molten sand) that was thicker in the middle than the edges and when looking through it noticed that objects appear larger. The lens was invented. They were named lenses

because they were shaped like the seeds of a lentil. In Roman times such lenses were used to focus the rays of the sun causing fabrics and other materials to burst into flames.

A microscope (from the Greek: μικρός, *mikrós*, "small" and σκοπεῖν, *skopeîn*, "to look" or "see") is an instrument used to see objects that are too small for the naked eye and provides a window into the cellular and molecular world. Microscopes allow us to see what the unaided eye cannot see through the use of a lens or combination of lenses. It made visible the fascinating worlds within worlds and opened up the imagination to contemplate the wonders such small worlds can provide. There are many types of microscopes, the most common, and the first invented, is the optical microscope which uses light to see the sample. Other types of microscopes are the above-mentioned electron microscope (two versions, transmission electron microscope and scanning electron microscope) and various types of scanning probe microscopes. Confocal microscopes are a type of fluorescence microscope and are related to optical microscopes. In essence, no matter the microscope type, the three basic pillars of microscopy are speed, sensitivity and resolution: speed by rapidly analyzing different samples; sensitivity by detecting and analyzing minute samples; and resolution by analyzing the difference between sample areas.

The most common type of microscope is the optical or light microscope. This is an instrument that contains one or more lenses that create an enlarged image of a sample. These optical microscopes use refractive glass to focus the incoming illuminating light into the eye. There are two major types of light microscopes and they are distinguished by the eye pieces. A monocular microscope has a single eyepiece to look through and a binocular microscope has two, one for each eye. Binocular microscopes became more prominent during the early 20th Century. Typical magnifications of light microscopes are up to 1500x with a theoretical limit of 200 nanometers due to the limited resolution of diffracted light. These light microscopes, even one with perfect lenses and illumination, can not distinguish objects that are smaller than half the wavelength of light. (White light has an average wavelength of 0.55 micrometers so half of that is 0.275 micrometers. Any two objects that are closer together than 0.275 micrometers will not be distinguished and blur.) To see objects smaller than 0.275 micrometers a different source of “illumination”, one with a shorter wavelength than light, is necessary. For cellular imaging the maximal resolution for light microscopes is about 10 nanometers. Shorter wavelengths of light, such as the ultraviolet, is one way to improve resolution. Current instruments allow the resolution of tens of nanometers. As we move into the 21st Century there are continuing improvements in light sources, cameras, detectors, labeling technology, computers, and image analysis software. Signal-to-noise ratios have been improved and now 3-D imaging of intact cells is possible. Microscopy has come a long way.

Once the basic principles of microscopy were worked out, including the magnification limitations, the advancements made in the field involved the

mechanics of the microscope itself. Whether monocular, a single tube, or binocular, two eye tubes that merge near the optics, are all minor variations on the basic theme. Light sent through a series of lenses could significantly magnify an image and make visible the invislble.

Microscopic explorers

As mentioned, the first microscope to be invented was the optical light microscope. Though an early version was made in 1590 in the Netherlands, two eyeglass makers, Hans Lippershey and Zacharias Janssen (and his son, Hans) are credited as being the first inventors. They experimented with several lenses in a tube and discovered that objects were greatly enlarged when two convex lenses were combined. Since then, microscopy has enabled highly efficient and accurate molecular, genetic, and cellular imaging for countless research and clinical applications.

Giovanni Faber coined the name “microscope” for Galileo Galilei’s compound microscope in 1625 (Galileo called it the “occhiolino” or “little eye”). The earliest tube microscope was merely a tube with a plate for the object at one end and at the other a lens which magnified objects about 10 times their actual size. Galileo worked out the principles of lenses and made a significant improvement with the ability to focus the lenses.

The father of microbiology, Anton van Leeuwenhoek (1632-1723), began as an apprentice in a dry goods store and used magnifying glasses to count the threads in cloth. He taught himself how to grind and polish new lenses that resulted in magnifications of up to 270x. With such lenses Leeuwenhoek was able to build microscopes that lead to the discoveries he is known for. He was the first to describe single celled organisms such as bacteria, yeast, the amazing amount of tiny life teeming in a single drop of water, and blood moving through capillaries. He called the small microorganism life forms he first observed under a microscope, “animalcules”. For the record, on October 9, 1676, Leeuwenhoek reported the discovery of his animalcules, the first window into the much larger microbial world, to the Royal Society of London.

The English father of microscopy is Robert Hooke who not only confirmed Leeuwenhoek’s discoveries but also significantly improved on the design of the light microscope by describing how to make single-lens versions. After Hooke few improvements were made in microscopes until the middle of the 19th Century when several companies began to manufacture fine optical instruments with magnifications up to 1250x. The success of this was all in how precisely the lenses were ground and made.

In 1644 the first detailed description appeared on living tissue, a fly’s eye, based on observations made with the use of a microscope. During the 1660s and 1670s the microscope was extensively used in research and the analysis of biological structures began. Those investigators who had impressive illustrators

to assist had huge impacts on how the world of the microscope was advanced. It was these illustrations that inspired subsequent generations of scientists to gaze into a microscope to further discover Nature's invisible wonders.

Since 1647 when Leeuwenhoek first observed cells in a microscope he built, imaging has been central to studies of the molecules and organisms that make up the microscopic world. During the past 366 years, we have definitely come a long way from those first observations with the introduction of new technologies including the electron microscope and super resolution microscopy in the early 1980s, both of which have vastly increased magnification and resolution and enabled imaging at single nanometer resolutions.

Types of microscopes

For every job there is the right tool. Not all microscopes are created equal and the main difference is in the optics. And the technology of microscopes is changing at a seemingly overwhelming pace similar to computers where it seems every 6 months or so new technology is introduced making the previous version obsolete. Light sources are no longer light bulbs with limited hours but consist of LEDs and lasers that can last significantly longer, that have higher intensities, different wavelengths, and a wider range of uses.

Not only are there many types of microscopes there are also many types of microscopy, each providing unique features with benefits. From simple observations of cells and tissues to observing the movements of specific molecule or protein complexes in real time to details of a cell's surface or cytoarchitecture are all possible. Though each of these types does provide different information, the combination of two or more microscopy systems provides even more. This is referred to as multimodal microscopy where different systems are coordinated and correlated to provide a superior resolution of the sample. Such multimodal combinations enable scientists to observe the real, three-dimensions of cells and their shapes. Some current microscopy systems offer fast 3D structured illumination microscopy, wide field microscopy, and localization microscopy techniques, all within the same system. All in all, quite a long way from observing those first animalcules through a simple convex lens.

Overall, microscopes can be separated into several different classes. One major class is based on what interacts with the sample to create an image, such as light (optical microscope), electrons (electron microscope) or a probe (scanning probe microscope). The other major class is whether the microscope analyzes the sample via a scanning point (scanning electron microscope and confocal optical microscope) or all at once (transmission electron microscope). Each class of microscope can give dramatically different versions of the same image.

As mentioned above, one limitation of light microscopes is their resolution. In addition to the light microscope there are several options available, the

distinguishing feature being said resolution. The higher the resolution the more sophisticated are the optics and, of course, the more expensive the instrument. A distinguishing feature in these microscopes is that they use lenses, both optical and electromagnetic, to magnify the image created when a wave of light passes through the sample or reflected by the sample. The resolution is limited by the wavelength used to image the sample, the shorter the wavelength the higher the resolution. For the scanning and electron microscopes the lenses focus a spot of light or electrons onto the sample and the reflected or transmitted waves are then analyzed at a much higher resolution than that of light microscopes.

For standard light microscopes to work properly an even light source must be shined through the sample, through the optics, and into the eye for observation. Thicker samples will block more light passing through to the eye thereby preventing any meaningful observation. Typically, samples are no more than 10 microns thick (one micron is a millionth of a meter) so enough light can effectively pass through to see. It wasn't until the late 19th Century that effective illumination sources were developed that has subsequently given rise to the modern era of microscopy. This extreme even lighting overcame many of the limitations of older techniques.

Potential light sources in addition to natural light are ultraviolet, near infrared, and fluorescence. Ultraviolet light is useful to image samples transparent to the eye, near infrared light can be used to see circuitry embedded in silicon boards (silicon is transparent to near infrared light), and fluorescent light can specifically illuminate samples to allow special viewing. For phase contrast microscopy there are small phase shifts in the light passing through the sample specimen that are converted into amplitude and contrast shifts to better see the samples. Now, in the early part of the 21st Century the traditional optical microscope has evolved into a digital microscope where the sample is no longer directly viewed through an eyepiece but through the sensors of a digital camera and displayed on a computer monitor.

The most recent developments in light microscopy involve not the microscope itself but rather in fluorescence microscopy, a technique where samples are labeled with fluorescent molecules, called fluorophores, so individual cellular structures can readily be visualized. For example, there are specific fluorescent labels for DNA, cellular proteins, and organelles such as the mitochondria that allow precise analysis of all cellular components in real time. These techniques allow for the analysis of cell structures both at the molecular level and whole cell level. The rise of fluorescence microscopy also drove the development of modern microscope design, such as with confocal laser scanning microscopes starting in the 1980s, that many fluorescent features are now incorporated into current microscopes that broaden their uses. And here in the 21st Century significant research is focused on developments of super resolution of fluorescently labeled samples and such structured illumination can improve resolution by two to four fold.

In the early 20th Century a significant alternative to traditional light microscopes was developed using electrons rather than light to generate an image. These electron microscopes work on the same principle as optical light microscopes but use electrons instead of light and electromagnetics in place of glass lenses. Since the wavelengths of electrons are much smaller than that of light the resolution of electron microscopes is much higher than traditional light microscopes and can easily reach magnifications of several hundred thousand fold. There are three main types of electron microscopes. For transmission electron microscopy electrons pass through the sample, analogous to basic optical microscopy, which are then detected whereas for scanning or scanning probe electron microscopy electrons are scattered over the surface of objects with a fine electron beam. Since electrons are strongly scattered by passing through samples careful preparation of these samples is necessary. The first transmission electron microscopes were introduced in 1931 and the first scanning electron microscopes were introduced in 1935. The first commercial transmission electron microscopes were marketed during the 1950s and the first commercial scanning electron microscope was available in 1965. In the 1980s the first scanning probe microscopes were developed and was closely followed in 1986 by the invention of the atomic force microscope.

The evolution of microscopes has co-evolved with advances in optics, light sources, and within the last generation, computers. However, in a basic analysis the glass lens of a microscope has not changed much in the last 100 years. What has dramatically changed has been major improvements in computers and sensor technology, to supplement what is visually seen.

These technological developments have moved hand-in-hand with the development of methods to embed and stain samples, the discovery of fluorescent proteins for intracellular labeling, and new techniques for monitoring molecular interactions within living cells, just to name a few. In fact, microscopy technologies change so rapidly nowadays that it is difficult to keep up. Different aspects of microscopy, each demonstrating how improving tools can enhance our understanding of what happens on a microscopic level, all contribute to a more complete picture of the invisible cellular and molecular worlds.

Co-developing along with microscopes is camera technology. Currently, digital cameras can be readily mounted on microscopes for more enhanced imaging capabilities. As biology became more sophisticated microscopes more or less kept pace by developing more sophisticated systems. The most important properties of any microscope will depend upon the intended application so features such as lens objectives, filters, imaging detectors, and illumination sources are important. Many modern microscopes are modular that can readily be upgraded, depending upon the application (for example, fluorescence that requires special filters), to maintain top performance.

If Leeuwenhoek or Hooke were alive today they would be able to watch physiological processes in real time, observe a virus infecting a lymphocyte, a bacterium replicating in a host organism, or a bacteriophage injecting its DNA into a host cell. They would also be able to detect and precisely locate single molecules and monitor their movement over hours or days, or study the embryological development of small animals. Microscopy has become poetical as we can now see a tapestry of cells and molecules woven together that provide the viewer an almost abstract beauty. Charles Darwin himself commented that the world seen through a microscope provides "endless forms most beautiful". We all marvel as we gaze at Nature's solutions to small-scale challenges readily viewed through a microscope. So, nearly 400 years later the lens of the microscope still remains the window into the cellular and molecular world.

The Films

It is always a thrill to see views down a microscope in our favorite SF films. In and of themselves these views are entertaining. The films discussed in this article focus on those that do indeed show point of view (POV) shots of what is seen when some of our favorite annoyed scientists are gazing down the eyepieces of a microscope. These are not all the films that show POV shots down microscopes but they are certainly representative of what has been seen in SF cinema.

It is interesting to note that the type of microscope can readily date the time of film setting. Microscopes made during the 1800s are quite different in look and design from those made during the early 1900s. And those microscopes manufacured after 1980 and into current times are also "of their times" and can be used to date film productions. And to keep you gentle readers up to date on the latest, the 21st Century version of the microscope is now all digital and images are viewed on a flat screen monitor and not directly through the eye optics. Images can easily be scanned and available software able to detect even the minutest of details. As such, what one thinks of as a microscope will become a museum piece or something relegated to "old time movies" as set dressing with the current digital machines infiltrating global biomedical laboratories and clinics.

Please note that when analyzing the science in films it is important to keep in mind that, at the time of film production, what science is known to scientists and, of this, what science is known by the public. By and large the general public does not have first hand knowledge of cutting edge science but rather only that which has been filtered through various other sources. Eventhough the fundamentals of the light microscope have not significantly changed that much during the last 100 years it is the interprepation of the data that has changed dramatically. And this is of little concern to the movie going public. As long as that microscope looks interesting then all is good.

SON OF FRANKENSTEIN (1939). In a key scene in the refurbished laboratory of Dr. Wolf Frankenstein the good doctor and his assistant, Benson, along with

Igor and the monster are in the process of doing a seemingly thorough medical examination of the monster himself. Part of this medical examination is obtaining a sample of the monster's blood and examining it under a microscope. The microscope used in this scene is a top quality binocular instrument very popular at the time with three primary objective lenses. A special light source is positioned at the correct angle towards the microscope mirror adding a nice touch of realism.

The microscope POV images shown in this scene are indeed of a blood smear, though it is impossible to tell which species of blood. For the microscope scene Dr. Wolf first warms up the microscope slide over a Bunsen burner. Though this is an unnecessary step it was most likely included to evaporate off residual moisture from the bottom of the slide. The first POV microscope image seen is a relatively low power magnification, probably 40x, and later we see a higher power magnification, probably 100x. Though the large round cells seen floating about are red blood cells (RBCs), with an occasional white cell floating by too, that is not the most interesting aspect of this POV shot. Since the RBCs seen are 'floating by' suggests there is way too much fluid on the glass slide allowing fluid flows to occur; to properly observe cells under a microscope the cells should be stationary and not moving. What is interesting in this image are the small "specs" that appear to be rapidly and randomly moving about, some up and down and others sideways. These little specs seen moving about are in actuality several species of bacteria, some are small rods, some round balls, and others in between. What this means is the blood sample photographed for this POV shot was heavily contaminated since normal blood does not have ANY bacteria. It probably took a while for the cinematographer to set up the shot down a microscope and during that time the sample to be photographed became contaminated just by being exposed to the air. The high power POV shot is even more heavily contaminated than the low power POV shot suggesting the high power shot was done later allowing more bacteria to grow, divide, and overgrow the sample.

If such a sample was actually taken as is from a patient then that patient would be dead most likely from septic shock due to all the bacteria present. But since this sample came from the monster then there is room for interpretation. Then again, maybe the monster's physiology and immune system was such that it could tolerate, and may even require, such bacterial invaders to supplement the monster's metabolic and health needs. Since the monster's body was constantly in bacterial shock this would affect his behavior resulting in outbursts of mayhem.

While looking down the microscope in this scene Dr. Wolf says, "I've never seen blood like that before…polymorphocellular…extreme hemocrosis…the alpha leukocytes apparently do not dissolve. The entire structure of the blood is quite different from that of a normal human being." Then while looking at the higher power magnification Dr. Wolf says, "Cells seem to be battling one another as if they had a conscious life of their own." Polymorphocellular, though an interesting

sounding fifty cent word, is a made up one. A close word, polymorphonuclear refers to white cells with a multi-lobed nucleus (there is one seen in the POV shot from the film, HOD; see below). Hemocrosis is a term referred to an iron storage disorder characterized by excessive intestinal adsorption of dietary iron. How the good doctor came to this conclusion by looking at a sample of the monster's blood is a mystery. There is no such thing as "alpha leukocytes" so it is unclear what does not dissolve. (Leukocyte is another word for white blood cell.) Lastly, "cells battling one another" sounds like the monster has a healthy immune system where his cells are indeed battling invading germs and other microorganisms. Or perhaps he has some sort of autoimmune disorder where his own immune system battles his own cells and tissues.

HOUSE OF DRACULA (1945). Ever wonder what Dracula's blood looks like? We get a good image of that in this film when the good Dr. Edelman looks at a sample of Dracula's blood under his microscope. In this POV image we see long snake-like black "cells" that have three or four "fingered" projections on their whip-like ends that seem to encircle individual cells. The potential function of this is of interest since a possible mechanism of action is suggested consisting of capturing and engulfing cells. Also, these unique cells in Dracula's blood are also antigenic since an "antiserum" was developed by Dr. Edelman, to combat the vampire's blood disorder.

The microscope used is a small version of a v-shaped instrument. Since the objective lenses of this microscope are quite tiny the magnification power is limited with a 40x lens probably being the highest (for most light microscopes a 40x objective lens would be middle average and not the highest). Visible is a lamp shining directly onto the microscope mirror hinting at some realism though it should be pointed out that the lamp light is not on. However, even if the light were on it probably would not matter since the microscope mirror, which normally would be pointed directly at the light source allowing the reflected light, at the right angle, to go through the optics and into the eye, was almost pointed directly up thereby making it useless. As seen in the film SOF, the microscope slide used in this scene was also briefly waved over a Bunsen burner to help evaporate any residual moisture on the glass slide. The POV microscope image seen is of an actual blood smear, though a photograph of one and not a "live" shot actually through a microscope. The RBCs are plentiful with one white cell visible, just to the right of center, the one with the multi-lobed nucleus; these cells are called polymorphonuclear leukocytes. The RBCs with the long snake-like forms that end in finger-like projections are drawn over the blood smear image.

WAR OF THE WORLDS (1953). In normal humans RBCs are the only cells that do not have a nucleus and, therefore, are unable to reproduce themselves like all the other body cells that do have a nucleus. Nucleated RBCs are those that have not yet matured and are usually seen in newborn infants and some anemia patients. Nucleated RBCs are rare in normal, healthy animals. When RBCs are first formed in our bodies they do indeed contain a nucleus. However, soon after

a stem cell changes into a RBC the nucleus is extruded resulting in a typical nucleus-free red blood cell. Without a nucleus RBCs are unable to divide and have a half-life of around 120 days. When RBCs are destroyed then new stem cells divide to create new RBCs. This normal process continues throughout the lives of mammals.

The POV microscope shot in this film is of “Martian blood”. A sample was obtained from a Martian blood-stained cloth and examined under a microscope. The nice binocular microscope used was contemporary for the early 1950s. Prominent is a light source pointed directly at the microscope mirror making this scene authentic; the mirror appears to be aimed at the correct angle to maximize the incident light through the optics. Of the three microscope objective lenses the lowest power is used in this scene which would be correct for examining a large view field of a blood sample. The view of the nucleated RBCs is interesting; it is a well done drawing and each cell has a nucleus. The nucleus areas of each cell are simply cross-hatch marks with no such examples in real life (or at least life on Earth). While examining the Martian blood sample the doctor says, “I don’t remember ever seeing blood traces as anemic as these. They may be mental giants but by our standards (i.e., the human immune system), physically, they must be very primitive.” The reason for saying this is the large number of nucleated RBCs, indicative of a primitive blood (and therefore, immune) system. This strongly suggests that there are very few germs on Mars so the native Martians had no need to develop an extensive immune or blood system. And, to take an educated guess, since there is very little oxygen on Mars the local natives needed to have their RBCs live as long as possible to get what little oxygen is there and to do so these cells would need a nucleus to control all the metabolic needs of long-lived cells. All this from a simple microscope POV shot.

SHE-DEVIL (1957). For the first scene in this film we see a drawing of what, as is mentioned later, a fruit fly (*Drosophila melanogaster*, to be specific). Though these fruit flies are small they are still too large for whole body views as shown in this scene with such a conventional light microscope. Such low-power, whole body images are easily seen in what is called a “stereo microscope” or compound microscope, typically used to view low magnification objects (around 10x-20x) such as insects, rock structures, leaves, etc. (one is used in the film, MIOS; see below). With the conventional light microscope used in this scene the actual magnification view of the fly would be quite high, so much so that one could readily see individual cells with such a high power magnifcation. So, the actual view of the insect head is way out of proportion with what a typical microscope view would be. In simple terms, the scale is wrong.

The microscope used in this film is contemporary with late 1950s instruments and is more of a teaching level microscope rather than a research microscope. Prominent is a nice light source in a contemporary housing unit specifically designed to illuminate microscope mirrors. Though the POV shot we see is of a

low power magnification, the microscope objective lens used in this scene is the medium power objective, much too powerful for the image shown. A medium power objective on this microscope, probably 40x, would be strong enough to see individual cells in one of the insects' antennae instead of the entire upper body portion.

It was great in '58
NIGHT OF THE BLOOD BEAST (1958). In this film we get two POV shots down a microscope. The microscope used is a somewhat below average monocular version with no visible light source for the microscope mirror. The middle objective lens is used and for that type of microscope is probably a 40x objective.

A spaceship crash lands back on earth and a sample of blood is taken from the seemingly dead pilot. As one of the scientists says, "(dead) seven hours and his blood is still alive." After looking at the pilot's blood sample under the microscope another scientist says, "I've never seen anything quite like it. Notice the way its fighting the others…I've seen amoebic dominance of a cell structure before but this is completely out of proportion..normal blood has two basic cells, the red carry oxygen and the white fight infection. But this blood has three. That third cell, the big one, that's completely foreign to any blood structure. If that bacteroid is contageous then we've all be exposed." For this POV microscope shot we see cartoon drawings of (alien) cells moving about, including some sort of fierce looking cells with tentacles (called pseudopods) that grab (and devour?) normal, "human" cells. Though "bacteroid" obviously sounds bacteria-like it is actually a made up word. The "red carry oxygen" cells are RBCs and the "white fight infection" cells are also called lymphocytes.

Later, after the pilot has been revived and appears normal, a second blood sample was obtained and again examined under the same microscope. After viewing the scientist says, "They're gone." As the scientist then explains to the pilot as he looks down the microscope, "That's what your blood looks like now. Normal in every respect (normal for a drawing!). Four hours ago it was populated with alien amorphic cell structures" (from the first POV shot). For this second POV microscope shot we see similarly drawn cells as in the first POV shot but instead, in this view, that third cell, "the big one", is missing ("They're gone"). The cells in this second POV shot also move about (via the same crude animation) and both red and white cells are visible. The red cells are the round cells and the white cells are oblong with a cell nucleus visible. Typically, in normal blood stains, red cells far out number white cells so the relatively excessive number of white cells seen in the POV view shown would suggest the pilot may have a blood cancer, like leukemia, that has abnormally large numbers of white cells. This could be a result of his "pregnant condition."

Are these "amorphic cell structures" alien stem cells with pluripotent capability? Or perhaps fertilized alien egg blastocyst cells and are nurishing themselves from

the pilot's body. Just a few interesting aspects to specuate about from this film, all from looking down a microscope.

MONSTER ON THE CAMPUS (1958). We are fortunate in this film in that we get to see two microscope images. The first one is of frozen bacteria and the second is of regular, room temperature bacteria moving about. The tiny little specs seen rapidly moving about (similar to that seen in SoF) are individual bacteria cells, some rod shaped and some ball shaped. Such a magnification would be several 100x magnification (400x?).

The microscope in this film is an older version with the two eye piece tubes forming a V-shape. For the first view of the microscope it is actually pointed backwards. The microscope mirror is typically opposite the person viewing allowing a light source to shine directly into the optics and in this first view the scientist is directly in front of the mirror effectively blocking any light from getting through. Also, the sides of the specimen stage of the microscope have odd flaps, the purpose of which is not entirely clear (block incident light?). A later viewing of the microscope has it pointed in the right direction with the mirror away from the person. At least with this orientation maybe some of the incident room light could have been focused on the mirror. Even so, there was no obvious light source for the microscope so the images seen would be dark.

It is unclear what the actual first POV shot is, though it is stated that the sample is "frozen bacteria". This first view down a microscope looks like simple dirt or debris often seen with dusty and unclean microscope slides. The second POV shot is much clearer in that it indeed is of normal bacteria all swimming about. (as mentioined, this shot is similar to that shown in the microscope scene from SOF, but without the red blood cells floating about.)

BLOOD OF THE VAMPIRE (1958). The Victorian age microscope seen in this film has both optic tubes merge, V-like, just above the observing stage of the microscope; an identical microscope is also seen in the film, TCF (see below). The optic tubes converge into a single objective lens and, as such, this does limit the instrument because only one magnification (probably 40x) is available. Though such v-shaped microscopes are quite useful the actual image seen in such instruments is actually one circle view and not the two fictitious somewhat overlapping "binoculars-like" images seen in the film. (The correct one-circle-view-down-a-V-shaped-microscope is seen in MOTC.) So you know, in the real world, ALL views down a microscope appear as a single circle and not the binocular-like overlapped views as seen in this film.

The reason for showing two independent fields in the same POV shot, as was explained by the scientist/vampire, Calistratus, is to show two different blood groupings, A and B, on two different glass slides. (Note: Calistratus correctly places a glass cover slip over the blood sample on the glass slide though almost forgets this step for the second slide.) Though the two slides were used in this

scene to simply advance the plot, in reality, it would have been physically impossible to view two separate slides as suggested by Calistratus with that microscope. Calistratus mentioned there are differences between blood group A and blood group B and had his assistant look at this with the microscope (the left image in the POV shot is A and the right image in the POV shot is B). The assistant comments saying, “I see the difference.” Quite frankly, both images seem identical to me. Lastly, such blood cells should not move around so on a glass slide indicating there is too much fluid in the slide preparation.

CALTIKI. THE IMMORTAL MONSTER (1960). This film is about a single-celled organism (Caltiki) originating from the Mayan civilization that grows when exposed to radiation. While trying to retrieve a bag of gold and jewels a man came in contact with the organism that infected his arm causing severe tissue degeneration. To examine a sample of the organism a scientist places a small amount onto a glass slide (note: without a coverslip over the sample) and proceeds to look at it under a microscope. The microscope shown is a monocular version, only one eyepiece, with only two small objective lenses (most standard microscopes have three objective lenses: low, middle, and high power magnification) of which it appears the higher power is being used (in this case, based on the size of the POV image, is probably somewhere in the 20x-40x range). The microscope appears to be a suboptimal choice for the work at hand. A dedicated small light source is seen correctly aimed at the microscope mirror and into the optics.

While looking at the sample under the microscope, Professor John Fielding comments, “It appears to be some sort of unknown organism, some fragment of an animal. A creature made up of one complete cell.” If Caltiki were indeed a single-celled organism then looking at a bit of tissue under a microscope would be like looking at a bit of jello, a lot of stuff but no visible structures. It would all be an amorphous mass with nothing to focus on. Since we do get to see a POV microscope shot then we can evaluate their premise of single-celled Caltiki. The actual POV shot through the microscope appears to be of fibroblasts, a type of connective tissue cell. [Note: fibroblasts is plural meaning there are *several* of these cell types seen in the POV shot so definitely NOT a single-celled organism.] The POV shot at first is out of focus but near the end of the brief scene the focus becomes clearer and these fibroblast cells can be seen.

REPTILICUS (1961). A lot of microscope action occurs in this film. The first microscope shot is a brief glimpse of one on a lab bench. This small monocular microscope has no visible light source for the mirror. The second view of a microscope is of one placed on a scientist’s desk. This also is a monocular microscope with the standard three objective lenses and a dedicated light source directly attached to the mirror; the light cord is visible. For the third view of a microscope it is back at the lab bench only this time it is on the opposite side from when first seen on the bench. The first POV shot seen is a high magnification of a tissue sample from Reptilicus and from the shown field there

are 11 white cells (the large ones) and at least 30 RBCs (the smaller cells). If such a field were from typical animal blood there would only be 2-4 white cells visible, not 11. With that many white cells visible suggests some sort of hyper metabolic and/or immune state. If such a blood sample was taken from a human then there is the distinct possibility the person either has leukemia or lymphoma, both cancers of the white blood cells, and not a good sign. Since this sample came from Reptilicus then the beast has some interesting blood indeed.

The second microscope scene takes place on a small desk of a recently hired helper. While eating his sandwich the helper is cleaning the microscope, a small monocular version with only a single objective lens, probably 10x or 20x magnification. The lab helper takes a bit of his sandwich (could be fish or chicken, not sure) and looks at it under the microscope. What are seen are small parasites that live in aqueous environments (water bound). If that is indeed what is crawling on his sandwich then he does have much to be concerned about. The real problem with this scene is the lack of an obvious light source to reflect off of the mirror below the viewing stage to send light up through the underside of the slide, through the optics, and into the eye of the viewer. With no visible light source it is difficult to understand how the images of the parasites were so easy to see.

MUTINY IN OUTER SPACE (1965). Compound microscopes are low power microscopes that are useful for observing large objects such as rocks, leaves, and insects. Some illumination is necessary though not as much as a light microscope. The standard compound microscope seen in this film, with V-shaped eye tubes and a single objective lens, is used several times. Each time it is used the microscope is pointed backwards, similar to that first seen in MOTC, in that the microscope mirror is aimed at the scientist instead of opposite to shine a light source through the optics. Though there is a lamp near the microscope mirror it is of a general overhead light type and not one designed specifically for a microscope so the actual illumination that gets into the optics would be minimal and not strong enough to see a clear image. The last time this microscope is used, also pointed backwards, no light source at all is visible.

An alien fungus from “ice caves” on the moon contaminates a space station. This fungus grows when exposed to heat (from a warm body) and is inhibited from growing by ultra cold temperatures (then how does some manage to grow around the outside of the space station, in the cold of space?). Three microscopes are seen in this film. The first is a small black light microscope on a back bench top and the second is the light gray compound microscope, described above, used to view the fungus. The third is what seems to be an electron microscope (an overkill on a space station). The small black microscope is briefly seen early on and never seen again. The images shown of the “alien fungal strands” appears to be synthetic fibers stretched out. The reason I say this is due to the reflective light given off the fiber strands. Such reflected light would not come off the surface of actual fungus (however, it is an alien fungus so

maybe their surface does indeed consist of reflective elements; maybe metal particles?) so this just adds to the alieness of the fungus. The electron microscope has no business being on a space station since all the necessary infrastructure to make sure such an instrument is functional would be extensive. For example, electron microscopes use liquid nitrogen to cool down the electron beams and this would be a very difficult, not to mention very expensive, item to keep stored on a space station and these supplies would have to constantly be replaced.

WAR OF THE GARGANTUAS (1968). In this film we get to see five microscopes, three standard light microscopes, an inverted light microscope, and an electron microscope. All at the seemingly fictitious, "Toto University Laboratory. Biological Atomic Chemistry", though based on the instruments seen must have been some actual biomedical lab where the scenes were filmed since producers would have no real need for a functional electron microscope so they just brought their cameras to a lab that has one. The first microscope seen is a low-end version that is also facing the wrong direction; the incident light would be coming in from the large window and the microscope mirror is inexplicably facing away from that light source. The second microscope seen is when Dr. Stewart (Russ Tamblyn) is on the phone and over his right shoulder, on the bench of an adjacent lab, is the microscope. This one is facing the correct direction with the mirror facing the window. Though the incident light from the window would be substantial it still would not be as strong as a dedicated light source for the microscope.

The next microscope we see, the third, is an actual electron microscope and photos taken from such instruments are called electron micrographs. A scientist is seen walking out of the room with electron micrograph photos taken from this microscope of Gargantuas' tissue sample. Though it is stated that both photos are of "hair cells" only the first photo is even close showing a cross section of cilia, considered micro hairs, usually too small to be visible to the naked eye (such high resolution as seen from these electron micrographs was too high to have any real meaning or interpretation). The second electron micrograph photo is of mitochondria, small organelles within each cell that serves as a metabolic powerhouse, so not a hair sample.

The 4th microscope seen is when Dr. Stewart is examining a fresh tissue sample from the green Gargantua. This microscope is a contemporary top of the line research microscope. The light source, with a dimmer knob, is integrated into the housing of the microscope and is an expensive instrument indeed. The third tube coming out the top of the microscope is there as an option to attach a camera. With all these expensive microscopes one would think that they would get something right. Unfortunately, the photos shown are all misinterpreted and the POV shot we see on microscope #4 is amusing. We see, binoculars-like, two separate fields of view, no overlap at all with the left view in focus and the right view starts out of focus and then becomes in focus. Both of these fields are of

the same photo with the one on the right being slightly shifted. This image seen from the 4th microscope is a cross-section of cilia micro hairs, similar to the first electron micrograph shown earlier in the film. However, showing two separate images in the field of view is just wrong. Another problem with this photo image is this is one observed with the ultra-magnification of an electron microscope (the magnification of this image is probably around 40,000x, much larger than standard light microscopes that may have a maximum magnification of around 1,500x) and not the implied light microscope that Dr. Stewart is looking at. The scale is wrong.

The 5th microscope we see is an expensive and impressive inverted microscope that also is a first rate research instrument. The inverted microscope, with the lens objectives *underneath* the viewing stage, has the light source permanently fixed on top of the instrument so it can shine directly down the optics through the observed specimen and into the objective lens and viewed by the eye. These last two microscopes, not to mention the electron microscope, seen in this film are impressive and both would surpass the budget of most contemporary SF films of the day.

THE GREEN SLIME (1968). In this film we see two microscopes, a brief look at a compound version as well as what seems to be an “electron microscope”. The image shown on the flat screen is of an actual liver cell undergoing cellular division, meaning one cell is splitting into two daughter cells. The images shown of this happening in the film take up just a few seconds of screen time whereas in real life such a cell division may take up to an hour so what we saw in TGS is in actuality very much sped up fast motion. Also, the “electron microscope” being used deserves some comment. Though it is supposed to look like a fancy and expensive electron microscope it is in actuality a set of binoculars used as the eye pieces, positioned such to give it a look of an electron microscope, with a simple telescope tube used as the upper portion. Without knowing what it is it does look convincing and in reality is just a very cheap prop.

A scientist places some of the slime blood (a very tiny sample) on a glass plate for viewing under their “electron microscope” and the glass plate used is way too large for this purpose. Also, glass slides will not work for electron microscopes since the sample is prepared in an entirely different manner for viewing, either embedded in resin or placed on a metal plug. Furthermore, the cells appear to be living and cells observed under an electron microscope are in a vacuum and therefore not alive. Lastly, the small sample on the glass plate was placed such that is was directly between the two binocular lenses, that are about 5” apart, thereby making it physically impossible to view through the eyepieces. Needless to say, it all looked convincing and that is what matters. To maintain an electron microscope on this space station would present the same problems as seen in the film MIOS where an elecron microscope, also on a space station, is operational. In a prescient nod to current microscopy images from this film are seen, as mentioned, on a large flat screen monitor. Microscopes around the

world currently use such flat screens to view the images, all digital, seen under the lens of a microscope.

THE CREEPING FLESH (1973). Though two light microscopes are seen most of the action occurs with a nice antique (contemporary for Victorian England, the time of the film) brass microscope where both optic tubes merge, V-shaped, into a single objective lens on top of the central optic stage. This is the same microscope seen in BOTV. Each optic tube has its own focus knob. Since there is only a single objective lens then only a single magnification is available. The second microscope is seen briefly late in the film quietly resting on a shelf. This second microscope is actually a better instrument, though admittedly not as dramatic looking, than the one used throughout the film primarily because of the multiple objective lenses available and therefore not as limited as the V-shaped version. Lastly, no visible light source was seen for the main microscope used in the film.

All told, the final tally in this film is seven different slide preparations for viewing under a microscope. The first few preparations were done accurately with a drop of the blood specimen first placed on a glass slide followed by using another slide to smear the drop across the slide essentially creating a gradient from thick to thin. However, no coverslips were used in any of the preparations. The last few preparations were sloppy and the blood specimen just dropped onto a glass slide with minimal smearing. The end result would be a very thick and therefore difficult to properly see blood preparation. It is noted that for the first slide preparation made (by the Peter Cushing character, Prof. Hildern), the actual glass slide used has a white frosted end. This is so information, such as an identification number or other information, can be written to identify what is on the slide. Unfortunately, such frosted slides did not come into common use until well into the 20th Century and this film is supposed to take place in Victorian 19th Century!

The microscope POV shots seen are of three varieties. Two images seen are of individual red blood cells (with way too much red background color) followed by circular cells with long tentacle-like hairs, almost like a sea urchin, that help propel it and capture other cells. The third is of a mixture of the red blood cells and the tentacle-like cells. All of them are fake.

Summary

As seen in some of our favorite SF films the microscope comes in many shapes and sizes. Through the lens of a microscope we get to see a variety of images from the invisible world. The most interesting is when the audience gets to actually see point of view shots of what the scientist is looking at. In addition to various cell types we also get to see novel life forms. We get the chance to see what Frankenstein's and Dracula's blood looks like. We also get to see blood from Martians and other aliens. Frozen bacteria, normal bacteria, parasites,

fungus, and totally imagined cell types are all seen through the microscope in SF cinema. This more or less covers it all from this earth and not from this earth.

Thanks for reading. Its back to the lab for me. My microscope awaits. Stay healthy and eat right.