Sources of Illumination for the Microscope 1650-1950

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Introduction

DURING THE last three centuries, the evolution and development of the light microscope, both mechanically and optically, has been extensively recorded. Not so the sources of illumination used with the instrument.

As the resolution of the microscope improved during the first half of the 19th century, led by such brilliant innovators as J. J. Lister, the requirement for illumination of complementary quality became pressing.

The great socio-scientific advances of the Victorian age influenced all disciplines, and the increasing trade with the rest of the world gave the opportunity to experiment with a greater range of natural products.

Industrial processes using natural raw materials such as coal and oil, resulted in paraffin wax, paraffin and gas, all of which were to prove effective as illuminants for the microscope.

By the mid-19th century, the new power of electricity was a reality. Pioneered by Volta in Italy, Ampere in France, and Faraday in England, it began to transform many aspects of life, both practical and scientific.

As the Victorian age came to a close, microscopists could choose natural light, candle, oil, gas or electricity to illuminate their subjects. It was electricity however, which was to prove the light source of the twentieth century.

Daylight

Although few of today's microscopists will ever have seen their preparations illuminated by candle, oil or gas light, all at some time will have used natural light.

Henry Baker in his well known book of 1742 said:

> 'That for many objects dull light is the best. I mean the light of a bright cloud. As for sunshine, it is reflected from objects with too much glare, and exhibits such gaudy colours that nothing can be determined by it with certainty, and therefore it is to be accounted the worst light that can be had.'[1]

Towards the end of the seventeenth century Antony van Leeuwenhoek (1632-1723) was examining protozoa in pond water, (Fig. 1), and Robert Hooke (1635-1703) the structure of fish scales, seeds *etc.*, with the basic instruments at their disposal. It was all the more important to utilise the available illumination to best advantage for such pioneering work.

It is clear that both Hooke and Leeuwenhoek used a form of dark ground or oblique illumination to visualise the minute structures which they described. For this purpose daylight is more than adequate. By turning towards a bright cloud, blue sky or in the general direction of the sun, it is possible to vary the intensity of light.

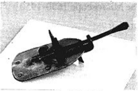

FIG. 1. A Leeuvenhoek Simple Microscope.

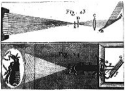

FIG. 2. A Solar Microscope.

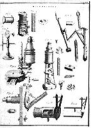

FIG. 3. Microscopes, 1700-1770.

FIG. 4. An Heliostat, 1930.

FIG. 5. The use of candlelight, c.1750.

FIG. 6. A 'candle-cracker'.

The direct light of the sun was employed with the solar microscope, (Fig. 2) an instrument thought to have been invented by Lieberkuhn in 1738. The image of the object was projected across a darkened room (camera obscura). The instrument was secured into a shutter in a window, which excluded the light except for that directed from the external mirror of the microscope, through the body and onto the subject.

The compound microscopes of the turn of the seventeenth century (Fig. 3) would have used direct sunlight to illuminate the subject by lighting from above.

As interest in the natural world grew during the eighteenth century, pocket microscopes became both cheap and popular. Makers such as Cuff, Withering, Ellis, Bate, Jones, Cary, *etc.* all produced both simple and compound pocket microscopes, for use in the field. Perhaps it is not too extreme a flight of fancy, to follow the line from the eighteenth century naturalist in the field, to a contemporary one, with the MacArthur microscope held to his eye.

The variability of natural light, due to changes such as those caused by cloud movement, would not have caused too great a problem during this early period, because observations were limited by the relatively poor optics, and very basic techniques of preparation of the specimen.

All this began to change with the work of J. J. Lister (1786-1869). His innovative genius pioneered the development of the achromatic lens in this country. His theory of spherical aberration (1830), was the foundation for the development of the microscope over the next fifty years. It was the basis for the work of Ernst Abbe, who greatly increased understanding and the potential of resolution, leading to practical immersion and apochromatic lenses.

One of the foremost microscopists of the second half of the nineteenth century, was Colonel J. J. Woodward of the US Army. He took up the challenge of resolving the diamond ruled test plates being made by Norbert. His choice of illuminant was monochromatic natural light.

Articles by him in 1869, described the use of a heliostat (Fig. 4) for photomicrography. Sunlight was sufficiently brilliant, that when passed through prisms, troughs and filters, designed to utilise the shorter wavelengths of light, towards the violet, it allowed him to produce photomicrographs, clearly showing the nineteen-band test plate of 1861, completely resolved. This feat was accomplished with Powell & Lealand's new Immersion 1/16 inch achromatic objective.

Candlelight

A candle is a cylinder of fat or wax enclosing a fibrous core or wick.[2] Naturally this construction was dependent on the solidifying of the melt as it cooled in a shape around the wick, which allowed the 'fuel' to be consumed steadily and slowly by volatalisation and combustion at the wick.

The date and invention of the candle is unknown. The Etruscans are thought to have used them, and there are records of candles made from threads of flax coated with pitch and wax in the first century A.D. Also recorded were rush lights, made from rush peeled on one side and dipped in melted wax or fat. This type of candle was used in England into the 19th Century.

Beeswax candles would have been used by the early microscopists, (Fig. 5) and even today some tall altar candles are made by ladling hot beeswax onto a hanging wick, building up a thin layer each time as the wax solidified. Beeswax gives a steady yellowish light, but most importantly burns well without guttering, when protected from draughts.

In order to increase the brightness of the illumination, an old device used for centuries by lace makers, was employed. This consisted of putting a spherical glass vessel full of water between the flame and the object being studied (Fig. 6). It was called a 'candle-cracker' and acted as a condenser for the light.

Edmund Culpeper was the first microscope maker in this country, to introduce a mirror below the stage of the microscope, *c.* 1730. This concave mirror made it possible to view objects vertically, by transmitted light, using candle light as well as day light. The picture of Marshall's microscope in use with a candle below, owes more to artistic licence than reality. If the candle had been close enough to the object to provide sufficient illumination, either the heat would have destroyed it or the smoke would have obsured it.

It was not until the last quarter of the 18th century that a new material which was a distinct improvement, became available. This was spermaceti. The growth of whaling provided certain specialised by-products. In the head of the Cachalot or Sperm whale is a cavity containing oil. When this oil was cooled, white crystals were deposited, which were separated from the oil by filtering or pressing. This product, spermaceti, could be used as candle material, burning well with a white translucency especially suitable for use in microscopy.

By 1800 a method of making the harder spermaceti into candles by moulding had been invented. Research was also progressing into the constituents of fats. Chevreuil in France showed in 1823, that fat was a compound of glycerine and fatty acids, principally oleine and stearine. It was possible to press out the oleine leaving the solid stearine. This led to an advance in candle making, because stearine burned more steadily and brightly, with less smoke, smell or guttering.

The portability of candles made them practical for microscopy.[3] To minimise the need to adjust the position of the candle flame in relation to the microscope, it was possible in the 19th century to purchase portable candlesticks (Fig. 7), in which the candle was fed upwards by a spring acting against an inturned ring, thus keeping the flame at a constant level.

As the optics and construction of the microscope evolved after 1830, candles were neither sufficiently bright nor constant as a light source, to enable effective observation with the increased magnification becoming available. The candle flame had the characteristics of uniformity and transparency, but the lack of brilliance made the need for other illuminants a necessity.

Advances did however continue, with various new oils such as coconut and palm, being tried in candles. In 1840 a snuffless candle with plaited cotton wick, made from stearine and the fat from coconut oil, had a short lived success.

The final innovation as far as candles for the microscopist was concerned, came in the 1860's. James Young, was working as an assistant to Faraday, and experimenting with coal oil. This he obtained from a mine in Derbyshire, which produced three hundred gallons per day. By a method of dry distillation and refining of this oil, he obtained a number of products, one of which was a form of paraffin wax.

This not only proved cheap to produce, but when used with the plaited cotton wick gave 25% more light than the expensive and dwindling supply of spermaceti candles. Paraffin wax candles are still available today.

Oil

Oil is a liquid, viscid substance from animal, vegetable or mineral sources. It has been utilised for thousands of years.

The well known illustration of Buonnani's microscope,[4] 1691, (Fig. 8), with 'built-in' illumination, and Hooke's 1665 illustration from *Micrographia*, clearly show how olive oil lamps were used as sources for transmitted and reflected light. It is unlikely however, that this form of illuminant was in common use during the first half of the 18th century. Henry Baker in his classic work *The Microscope Made Easy*, (1743) does not even mention it, only describing natural and candle light.

By 1780 sperm oil was available. It gave a steady, bright, white light suitable for microscopical investigation with the instruments of the period. In 1783 Argand's, new oil lamp (Fig. 9), came to England. This was a considerable improvement on earlier designs. It had a circular woven wick in the oil burner, which gave a good air supply, and thus a softer and more constant flame.[5] Other innovations on this lamp were a reservoir higher than the burner, which heated the oil and improved the flow. Difficulties had been experienced due to the heaviness of the oils. A blue glass chimney was added to counteract any tendency to yellow in the flame.

Towards the end of the 18th century the use of naphtha oil was introduced. It was obtained by distilling coal at low temperatures.

The new century brought many inventions to improve the efficiency of lamps, especially in France. The Carcel lamp[6] incorporated a device consisting of a double clockwork piston, which forced the oil through a tube to the burner, and was intended to overcome the problems of the heaviness of the oil, as was Franchot's Moderator lamp. The Cambridge Reading lamp (Fig. 10), based on Argand's design but with the addition of vertical movement, became the standard lamp in microscopy for the next fifty years.[7]

The scarcity of whale oil and density of available oils were sufficient incentives to seek lighter and more efficient oils. Many were tried. Coconut was very cheap but smelled disagreeable, and its acid nature affected the brass of the lamps, with verdigris. Solar oil from sunflower seeds was only efficient in the fountain type of lamp, where the oil is always presented to the burner at a constant level, otherwise it clogs. The same was true of Florence or Olive oil.

Colza oil made from Rape seed was a promising substitute, especially suited to the Moderator type of lamp.[8] Jatropha oil was a particular favourite in the city of Bristol, where it was landed from the Cape Verde islands. It was extracted from the berries of a shrub of the genus Jatropha, burned very brightly, was free from smell and clogging and could be purchased for five shillings a gallon. Also popular were lard oil and camphine, which was a purified distillate from oil of turpentine.

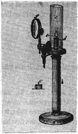

FIG. 7. Portable candlestick, 1875.

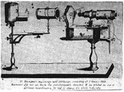

FIG. 8. Buonanni's microscope, 1691.

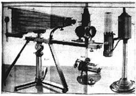

FIG. 9. Argand's lamp, 1780.

FIG. 10. Cambridge Reading lamp.

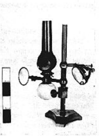

FIG. 11. Ross lamp, 1868.

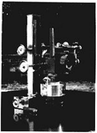

FIG. 12. Dallinger's lamp, 1876.

By the 1830's gas was an alternative means of illumination. Sir David Brewster in his *Treatise on the Microscope*, 1837, suggests that

'a stronger flame may be produced by using a gas lamp . . .'[9]

However it was the discovery of paraffin oil which revolutionised both lamp and candle illumination. The discovery was credited to Reichbach and Dr Christison in 1830.[10] In England it was James Young who was the innovator. By 1848 he had produced a number of refined chemicals from his dry distillation of crude mineral oil, obtained from the Derbyshire mine. Young produced lubricants, solvents, paraffin oil and wax from his process.

Surprisingly paraffin was not an instant success in England, but the Germans realised its potential. Young was perfecting his distillation method, and by 1856 he was selling commercially his paraffin illuminating oil. This was a considerable improvement on its predecessors, being lighter, cheaper to produce, relatively clean to use and with no shortage of raw material.

Oil was being discovered in many countries during this period, especially in America. In 1860 oil shales were found in Scotland.

New forms of lamp were tried (Fig. 11), utilising the new fuel, which led to the modern circular or flat wicks feeding the flame by capillary action alone. With a glass chimney, the lamp had become very usable for the microscopist.

By the 1880's all the leading manufacturers of microscopes were producing instruments with optics capable of high powers and excellent resolution.

Dr William Henry Dallinger (1840-1909), was studying the flagellate protozoan monads, in an effort to solve the contentious question of 'bio-genesis' or spontaneous generation, which was exercising scientific minds of the time.[11] Because of the minute size of these organisms, he used the highest powers, 1/35th, and 1/50th. This work required critical illumination, and Dallinger designed a lamp (Fig. 12) specifically for the task. In 1876 he read a paper to the Royal Microscopical Society, entitled 'On a new arrangement for illuminating and centering with high powers'.[12] This was subsequently published in the *Monthly Microscopical Journal* (Fig. 13).

The magnificent oil lamp which he designed, permitted the most critical centration of the light source by means of rackwork motion in both lateral and vertical directions. It was completely successful and the innovations were incorporated in lamps manufactured by such prominent firms as Watson, well into the 20th century. Although in its day this was a most expensive lamp, only two examples being made, it demonstrated this most effective and usable form of illumination (Fig. 14), allowing observation with high powers, over a considerable period, without undue strain.

Oil lamps were effective, cheap, as was their fuel, and more portable (Fig. 15), for field work than other lamps. There were few parts to go wrong and they were durable. On the debit side, they required coloured filters to counteract the yellow tinge in the flame, got moderately hot, and could smoke, smell and clog if not trimmed.

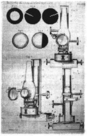

Fig. 13. Dallinger's lamp, M.M.J.

Fig. 14. Beck lamps, 1904.

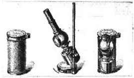

Fig. 15. Portable lamp, 1871.

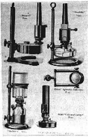

Fig. 16. Watson lamps, 1912.

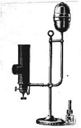

Fig. 17. Petrol vapour lamp.

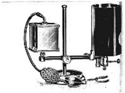

Fig. 18. Spirit lamp.

They were an important source of illumination for the microscopist during the second half of the 19th century, and the first half of the 20th (Fig. 16). Electricity was not available in every area of this country until the 1970's.

Watson made a petrol vapour lamp for photomicrography in 1912 (Fig. 17), and Beck produced an incandescent methylated spirit lamp in 1924, (Fig. 18), but it was paraffin which was the fuel of choice for the microscopist.

Gas

Gas was originally an inflammable product of the dry distillation of coal.

One of the earliest records of the use of gas was by a mine manager in Cornwall, William Murdock, who in 1792 successfully illuminated the interior of his house in Redruth.[13]

By the beginning of the 19th century the potential for the use of gas in the British Isles was realised. There was no shortage of raw material, and in 1812 the Gas, Light and Coke Company was founded. Progress was swift and the improvement in the manufacture of iron piping in 1825, encouraged the proliferation of gas for lighting and heating, both in streets and buildings. By the middle of the 19th century almost every town had its gas works.

For the microscopist gas had a number of advantages. There was a constant supply at the turn of a tap, it did not clog the lamp, there was little smoke, it was instantly ready and easy to adjust. The disadvantages were similar to those encountered with oil. The flame had a yellow tint, heat was generated in the lamp, the brightness was limited and the lamps were restricted to proximity to a gas point.

Perhaps the first lamps to be converted by having annular burners introduced at the centre, was Argand's. It was still the basic design of 1783, with a blue glass chimney.

J. T. Quekett, in his 1855 edition of *Treatise on the Microscope* illustrates a gas lamp with an argand burner (Fig. 19). He says,

> 'Those who may have their homes supplied with gas, will find that by means of a flexible tube connected with an argand or other burner, mounted on a movable stand, like those shown in Fig. 138. will get a convenient light for all purposes. If for instance in the centre of the room there be a chandelier, then a flexible tube may be screwed to one end of the pipes, being attached by its opposite end to a burner, the tube will allow of its being moved to all parts of the table where it may be required. If the table is a fixture, a large gas pipe, having a number of screws at the top to receive union joints, may be brought up through its centre, and as many burners as may be required attached to the central pipe by means of flexible tubes.'[14]

This gives a clear picture of the practical arrangement of gas lamps for the microscopist, and it did not change to any great extent for some seventy years.

Hogg in his standard work on the microscope praises Highley's lamp (Fig. 20), and also describes a monochromatic gas lamp with a blue glass chimney, blue/black neutral tint glass and metallic reflector.[15] This combination gave a bright cylindrical flame. A wire gauze covering the stage of the lamp further improved air flow and consequent steadiness of the flame.

The design of gas lamps paralleled those of the other lamps burning alternative fuels (Fig. 21), during the second half of the 19th century. It was Welsbach's invention of the incandescent mantle, patented in 1885, which was the next important advance in illumination.

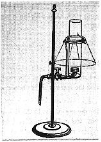

FIG. 19. Gas lamp, with argand burner.

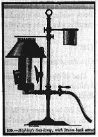

FIG. 20. Highley's gas lamp.

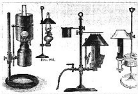

FIG. 21. Negretti lamps, 1880.

FIG. 22. Watson lamps, 1930.

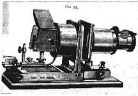

FIG. 23. Ross Oxyhydrogen Projector.

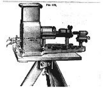

FIG. 24. Swift Oxyhydrogen Projector.

His method was more efficient and gave a much brighter light than its predecessors. The combination of gas and air heating the mantle to incandescence, gave a steady, bright light source, enhancing the image, especially when high powers were being employed.

Gas lamps of both types, incandescent and ordinary were sold by all the main manufacturers into the 1930's (Fig. 22).

An instrument requiring an intense light source was the projection microscope, which had evolved from the solar microscopes of the 18th century. It enabled an audience to observe microscopical images for education or entertainment. The bulk of the instrument was taken up by the illuminating source, the microscope being attached to the front in place of the usual projection lens.

In order to generate sufficient intensity of illumination, various methods were used. In the Drummond light a jet of oxygen was fed onto a flame in contact with a ball of lime. Ross's lantern of this type is illustrated (Fig. 23), was designed for use with objectives up to ¼ inch focal length. Swift's oxyhydrogen projector (Fig. 24) was available in 1884, and typical of the instruments using gases, in this branch of educational microscopy.

The Bude light was an Argand lamp in which oxygen was passed into the lamp. Like many others of the period, it was short lived, and later adapted for coal-gas.

Acetylene gas was mainly used for photomicrography. Its advantages were a pure white light, with a lower temperature of flame than that produced by coal gas. It required however a relatively complicated apparatus (Fig. 25). The outer vessel held water, and enclosed an inner one. The calcium carbide was contained in a wire basket, in the inner vessel, and when in contact with water gave off, acetylene. The flame was regulated by a tap.

Electricity

The nineteenth century saw the beginnings of the realisation of the possibilities of electricity. Much experimentation had been undertaken in England by Cavendish, Davy and later Faraday. In Italy Alessandro Volta's contribution to understanding electricity had been considerable, as had that of Ampere in France.

By 1834 it was possible to purchase a generator in England for commercial use. As the optics and construction of the microscope evolved it was the development of the battery which held most promise of usable electricity for the microscopist. In 1868 Warren De La Rue perfected his silver chloride cell, which gave constant potential Secondary batteries or Accumulators (Fig. 26/27), for storage. Swan improved this capacity still further.

One of the earliest uses of electricity in microscopy was that of Donne and Foucault in 1844, who succeeded in taking a photomicrograph using an electric arc made by Chevalier (Fig. 28).

Although the arc-lamps (Fig. 29/30/31/32) were not ideal for this purpose, because of a variation of intensity due to wear of the carbon rods, as well as considerable heat generated, they did produce a very bright light.

FIG. 25. Acetylene lamp.

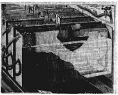

FIG. 26/27. Accumulators.

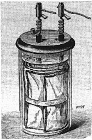

FIG. 26.

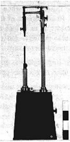

FIG. 28. Foucault's Arc, 1859.

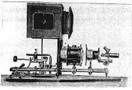

FIG. 29. Swift Electric Arc, 1890.

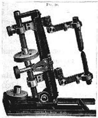

FIG. 30. Ross Arc, 1900.

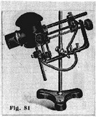

FIG. 31. Baker Arc, 1904.

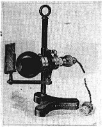

FIG. 32. Baker Arc, 1932.

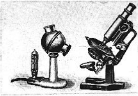

FIG. 33. Leitz Nernst lamp.

FIG. 34. Watson Nernst lamp, 1913.

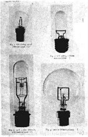

FIG. 35. Pointolite lamp.

FIG. 36. Mercury Vapour lamp.

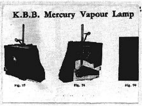

FIG. 37. Baker Mercury Vapour lamp, 1932.

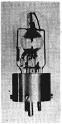

FIG. 38. Mercury Vapour lamp, 1945.

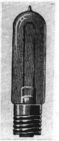

FIG. 39. Electric bulb for the microscope, 1893.

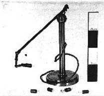

FIG. 40. Electric microscope lamp, 1883.

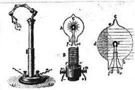

FIG. 41. Electric microscope lamp, 1885.

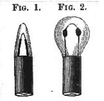

FIG. 42. Electric bulbs for the microscope, 1883.

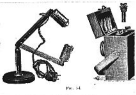

FIG. 43. Baker electric portable lamp, 1915.

It was however the development of the incandescent filament lamp which had an enormous effect, and resulted in the proliferation of electric lighting for many uses. Early examples for use with the microscope are illustrated (Fig. 39, 40, 41, 42, 44).

The first bulbs had carbon filaments, and were produced about 1860. Joseph Swan was the main innovator in this country. In 1878 he produced a 50 volt lamp with a better vacuum inside the bulb, thus greatly increasing the working life. Edison in America was manufacturing large quantities of a similar bulb by 1880.

By 1877 Farranti had solved the problem of a suitable covering for cables, thus making it possible for electricity to be taken to any building, industrial or domestic.

Welsbach turned his attention from incandescent oil and gas lamps to electric lamps, and in 1898 he produced the Osmium filament lamp. Tantalum filaments followed seven years later, but for the microscopist it was Langmuir's invention in 1913, of the coiled filament lamp which proved a noticeable advance. The earlier zig-zag filaments had given an uneven illumination in the field of view, whereas the coiled filament, gas filled bulbs offered a much more even, concentrated light source, especially effective when using higher powers.

Electric arcs continued to be used in microscopy, especially in the fields of photomicrography and projection. The variety of different types of arc was considerable, some being tailored for prevailing systems of electric supply, which made them redundant when uniformity of voltage and supply came in.

Nernst invented an arc lamp in 1897 (Fig. 34), which was both compact and gave a bright light. It had a filament of rare earth, more efficient than the carbon filament of contemporary arc lamps. It required secondary heating before this filament could begin to become incandescent. These lamps were made by Leitz (Fig. 33), Zeiss and the main English makers of microscopical equipment.

Watson manufactured and sold from the 1920's, what was probably the most successful of the small enclosed arcs, the Pointolite (Fig. 35), invented by E. K. Cole. It consisted of a tungsten bead on a thin tube of refractory material, and a short spiral of tungsten wire, the starting filament. The latter was heated by an auxiliary circuit, this caused an arc between it and the tungsten bead, which became white hot and acted as the light source. As it warmed up, the bead on its stem bent to the right transferring the arc to the refractory cylinder.

Of the arc lamps, the only gas discharge tube of interest to the microscopist was the mercury vapour (Fig. 37), which was of considerable intensity and exhibited a variety of spectral lines.

The lamp consisted of a sealed tube, either of hardened glass, or quartz if intended for ultra violet microscopy. The mercury was in a pool at each end of the tube, and traversed from one end to the other when the lamp was tilted and the electrodes in the pools activated (Fig. 36, 38). On returning the lamp to level the mercury stream was interrupted and an arc formed between the electrodes at either end. A small voltage only was required for this arc, and consequently the life of the tube could be from four to six thousand hours.[16]

The catalogues of the makers of optical and electrical apparatus are a most fruitful source of information of changes and improvements in equipment. Watson, probably the leading manufacturer in this country during the first half of this century, shows the choice of illumination for the microscope.

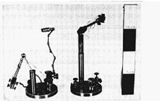

FIG. 44. Electric microscope lamps, 1890.

FIG. 45. Watson New Standard lamp, 1906.

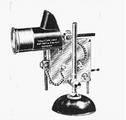

FIG. 46. Watson Argus Arc Lamp, 1930.

FIG. 47. Watson Laboratory lamp, 1924.

FIG. 48. Watson catalogue of lamps, 1935.

FIG. 49. Watson catalogue of lamps, 1935.

In their 1906 catalogue,[17] the electric lamps were limited to two, the New Standard lamp (Fig. 45), and a 16 candle power incandescent lamp which, with hood and iris diaphragm sold for three pounds and ten shillings, the same price as a Nernst electric arc lamp. This was also the approximate cost of Watson's Praxis microscope, and was therefore a relatively expensive piece of equipment, especially when compared to an oil lamp for fifteen shillings, in the same catalogue.

Some six years later, in their catalogue for 1912-1913,[18] there had been only one addition, that of the Argus Hand feed arc lamp (Fig. 46), specially designed for working with the microscope. Baker produced a portable electric lamp (Fig. 43) in 1915, which they claimed had a 24 hour capacity, and was usable with a 1/12 inch objective.

A decade later the list for 1924[19] was more comprehensive. It included the Conrady Vertical illuminator, the Laboratory Electric lamp (Fig. 47) as well as the Argus and Pointolite arc lamps, and a new design of mercury vapour lamp with fused quartz envelope, selling at the considerable price of twenty pounds.

By 1935, in Watson's 35th edition of their catalogue there were two pages of lamps and bulbs, ranging in price from fifteen shillings for the basic Service lamp to seven pounds and sixteen shillings for the low voltage, high intensity Vril lamp (Fig. 48, 49).

In the post-war period, Watson's catalogue for 1950 showed few changes from those of 1935/39. The Vril was still listed with a six volt thirty watt bulb and separate transformer, the Universal was on offer with the Pointolite bulb, and the Bench lamp was the bottom of the range.

The additions to the list were a six volt eighteen watt 'spot' lamp, designed for use with stereo microscopes, and the Regulite, a neat six volt thirty watt intensity lamp, with the transformer in the base.

The examples from this firm are typical of the range and development of the other manufacturers in this country, such as Beck, Swift, Ross etc. The leading continental firms typified by Leitz and Zeiss published equally comprehensive catalogues, offering a range of illuminants for the increasingly complex requirements of microscopy.

Until 1945 all the leading makers offered oil, gas and electric lamps for the microscopist.

This paper does not cover the increasing sophistication of either the forms of electric illuminants, or the practical means of their employment with the light microscope since 1950, but it is true to say that the invention and development of the tungsten-halogen lamp has revolutionised the illuminating systems of the light microscopes.

Acknowledgement

I would like to express my grateful thanks to Mr W. G. Hartley, Mr L. V. Martin and Dr B. Bracegirdle for their advice and support, and to Mr A. V. Dodge for all the photographic work and his unfailing help in all manner of ways.

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QMC WEEK-END MEETING AT NORWICH JULY 21ST and 22ND 1990

SOME 65 members and guests attended, much the highest total yet, and all agreed it was the best programme of lectures and meetings to date for which Dr Malcolm Thain as the local organiser deserves our full appreciation.

We are grateful to those University lecturers who gave their time to prepare and present their individual talks, each of which were of exceptional interest and long term value to members through the quite exciting description of the development of the various researches involved.

Some of our own members also gave talks which were very well received so the overall mix of subject matter over the two days was wide ranging and very well assembled. The Saturday evening was spent at Norwich Castle Museum as a combined Gossip' together with a mini celebration of the Club's 125th year. Our President Brian Davidson provided a splendid cake decorated with the Logo of the Club, greatly admired by us all and very fittingly made by Mrs Scott. When the cake was cut a toast was drunk to the future of the Club from wine also provided by our President. Mrs Anne Brewster, Chairman of the Norfolk and Norwich Naturalists Society replied to the toast to welcome the Quekett Club to Norwich and to the Castle Museum. A toast was also drunk to the NNNS, and for future meetings between the Club and the Society.

It was a truly happy occasion and very memorable, especially as we were joined by members of the Norfolk and Norwich Natural History and Microscopical Society who hold their meetings at the Castle Museum. We are specially indebted to the Curator of the Castle Museum, Dr Tony Irwin, for accommodating the meeting there.

The University of East Anglia has a very compact layout which proved most convenient as the accommodation, the lecture rooms, and the catering services were very easily reached. We were well pleased with the services provided and look forward to a further meeting there in a few years time.

Our President, Brian Davidson, opened the first session with a warm welcome to the members and guests who attended from all over the country to enjoy the highly convivial atmosphere of a series of lectures and meetings within the academic environs of a University, and remarked on the very friendly social element that this generated as well as the most welcome extension of members contacts with University Staff.