The subject of household lighting comes to mind every time heavy weather events approach our area. This part of the Missouri Ozarks is subject to a variety of potentially dangerous weather events: Tornadoes, Super Cell Thunderstorms, Flooding, Ice Storms, and so on. Each is capable of knocking power out for days at a time. Most of us rural folks keep candles and kerosene lamps for those times we are without power.

That does, though, bring to mind the question of what people did before electric lighting came along. That is an interesting question since electric lighting has been available in the US for only about a century and much less than that for most rural areas. What did people do before that? I became interested enough to do a little research on the subject. This article covers much of what I learned in the process. First a little light duty and maybe somewhat superficial history:

Some Lighting Background
Television and movies typically show ancient and historic household lighting as candles and kerosene lamps. Of course, that does present a problem historically. The first oil well was drilled in the 1850’s. Kerosene lamps were a new technological innovation introduced in the US Civil War in the 1860’s. Clean, scent free Paraffin wax is a byproduct of petroleum oil processing. Those lighting methods obviously are not what folks used before the mid 1800’s.

Use of candles was very limited. The cost of candles was sufficiently high that even tallow candles were used very sparingly. Lighting more than one per household was considered an extravagance of the rich. Oil and grease lamps were the choice for inexpensive household lighting.

Depictions of ancient temples and homes in movies often include continuous burning, non smoking, torches or pots of oil. That is what is called ‘literary license.’ The real lighting in those ancient buildings would have been too dark for filming. Being able to walk around without tripping over a dog or some other obstacle would have been considered adequate lighting.
Prior to the mid 1800’s, homes and building were lighted by a variety of natural fuels. Burning wood for heat and light is an obvious choice. In densely wooded parts of the world, that is quite practical. Wood fires are not terribly efficient as light sources considering the amount of wood used. When wood is burned for heat or cooking though, the light given off is free. Much of the world does not have the luxury of plentiful wood so other sources of lighting were needed. Note: Wood is used in some parts of the developing world even today for cooking even though wood may be scarce in the immediate area. Those cooking fires are made using only a few small sticks and burned only long enough to provide the necessary cooking heat.

So, let’s go much farther back in history. Before electric and petroleum based lighting, nights were DARK. A moonless, cloudy night could be dark enough that you could not see your hand when touching the end of your nose. You could sit or sleep near a carefully built heating or cooking fire and have a little light. Going to sleep soon after the sun went down was the norm. Getting up to answer a call of nature during the night might have been an adventure though.

My first impression was that advancement of oil lamp technology was awfully slow for the thousands of years they have been in use. Depending upon the archeological authority, lamps have been in use for 50,000, 30,000, or 15,000 years. Lamp designs evolved very slowly over that vast time span. As my study of lamp technology progressed, my view changed. It turns out that those ancient folks knew what they were doing. The evolution of lamp designs was limited by, but also optimized for, available fuels and fabrication materials technology.

**Phase 1: Open Bowl Lamps**

Those ancient folks were not dummies. They were equipped with the same brains we have today. (There is some speculation that those earlier folks might have had slightly bigger brains simply because it took smarter people to survive without the advantages of modern technology.) Archeological investigation of very old human habitations from 50,000 years ago has found sea shells and hollowed out rocks with charcoal stains in patterns that indicate they were likely used as lamps. Oils from animal fats and grease can be burned, using a fiber wick, to produce light. Folks back then were not distracted by TV shows or electronic gadgets so had plenty of time to work out how best to do this.

In many parts of the world, the walls of caves were decorated with some beautiful and impressive paintings. This was up to 30,000 years ago. Many times these paintings are found much farther into those caves than daylight could ever reach. The soot found on the ceilings of the caves was analyzed and determined, for the most part, to be from burning animal fat. Light from an oil lamp would be much
better than building a wood fire for that purpose. There would be much less choking smoke for the amount of light produced. Earliest oil lamps were simply small bowls, sea shells, or hollowed out rocks with a fiber wick laid at the side. This simplicity is hard to beat. This kind of lamp was necessary for burning grease and fat before fluid vegetable oils, primarily Olive Oil, became commonly and inexpensively available.

The lamp in the photo above is over 5000 year old. While the quality of the pottery may be low compared to modern technology, it is certainly good enough to last for a very long time. You will also see that the folks that made this lamp had already figured out the features needed for an open bowl lamp. It has the necessary sloping sides and wick notches. Modern temple oil lamps operate no better than this ancient artifact would if used today.

My guess is that burning raw animal fat might have an aroma that would take some getting used to. Maybe for folks who normally cooked their meat over an open fire this was likely a familiar scent. Actually, animal fat, when rendered into tallow, can be burned with relatively little objectionable odor. Tallow dish and stick candles were a lighting choice that was only displaced by the availability of Paraffin wax. Bee’s wax was also available but its supply is inherently limited and expensive.

While tallow candles have been in use for very long, their use depends upon access to animal fat not needed for culinary purposes. In parts of the world where wood and animal stock are in limited supply, other mean of providing lighting were developed. For thousands of years the Mediterranean and Middle East part of the world has used oil lamps for light. Oils derived from crushing plant material were used. The most common oil was obtained from Olives. While other plants provide sources for lighting oil, Olive Oil was king.

Olive Oil burns clean with little or no scent, it is edible, and it safe to handle. Olive trees grow well in the warmer Mediterranean part of the world. Oil is roughly half the weight of a raw olive. Only simple equipment is required to produce large volumes of high quality Olive Oil. This oil has been a major trading commodity for around six thousand years.
Olive Oil is great as a fuel for lamps. It has a high flash point so it is quite safe to use in a household. Olive Oil’s flash point is about 450 degrees Fahrenheit versus Kerosene at 100 degrees Fahrenheit. A spill normally does not present a fire hazard. Since we use it for cooking and as a salad dressing, it is obviously not toxic. It is also used as a skin conditioner.

Anthropologists tell us that this open bowl lamp has been in use for most of human history. It is still in use today with many variations. Above is an example of a modern take on that theme. It is simply a ceramic spoon holder, a cotton shoe string, and a little olive oil.

Open top oil lamps remained in use throughout history for specialized purposes such as the brighter multi-wick, frequently refilled lamps found in shrines and cathedrals. In the Americas and Europe, the iron Crusies grease lamp was used up to the mid 1800’s for obtaining light from animal fat and grease.
The iron lamp above is a Double Crusie or Phoebe lamp. This design began in Scotland and was popular in the Americas. Its metal conducted heat from the flame to help liquefy grease. The matching lower bowl served to block cooling drafts from the upper lamp and collect grease dripping from the upper lamp. That metal needle hanging on the lamp is a pick for adjusting the wick and was traditionally called a “Pickwick.”

**Phase 2: Partially Closed Reservoir and Nozzle Lamps**

By the time consistent viscosity Olive and similar oils became available, pottery technology had advanced enough to produce lamps specialized for that fuel. It is handy to be able to carry a small oil lamp for portable lighting. Partially enclosing the oil reservoir minimized spillage.

With the sides of the oil reservoir raised and curled inward over the oil, a hole was needed for the wick. That hole had the benefit that it allowed better control of the flame on the wick. The oil on the wick was exposed to adequate combustion air only outside the wick hole thus limiting its size. That hole evolved into a more distinct nozzle. A lamp with a nozzle can be burned for hours without having to trim or adjust the wick.
This lamp design with separate filling and wick hole became the standard for vegetable oil lamps. Many variations in appearance and number of nozzles were produced but the differences were superficial. A 2200 year old Terracotta Egyptian oil lamp operates exactly the same as 200 year old Arabian brass lamp. This design is simply optimal for the fuel and available manufacturing technology.

Oil lamps are not always made from pottery. You can see that though it is made of metal, its operational design is identical to the pottery lamp above.

An interesting period in oil lamp history was during the time of the Roman Empire. Trade flourished around the Mediterranean and beyond. The first, second, and third centuries AD was the time of the Roman factory lamp. Pottery manufacturing cities like Modena, Italy mass produced millions of lamps that were sold and used throughout the empire.
The lamps on the previous page are replicas of what were likely the two most popular factory lamps. The one on the left is from the Fortis factory and was popular because of its channel that helped retain excess wicked oil in the reservoir and nozzle area. You will notice that these lamps have almost completely enclosed the oil chamber. The central disk is dished so that any oil that misses the central filling hole while filling the lamp simply drains into the chamber.

**Phase 3: Advanced Designs**

It was really not until the 1700’s that any really significant innovations in lamp technology began to appear in oil lamps. Those innovations were possible because of advancements in metal fabrication technology. Configurations of reservoirs and wick assemblies that were not practical in Terracotta became possible with metal parts. Those innovations were things such as providing a siphon oil reservoir for longer lamp burn time and the Argand hollow oil wick assembly for greater light output. Once cast iron and nickel plated sheet metal lamps became affordable, they usually replaced pottery lamps in homes.

A common problem with grease and oil lamps is that often a wick can draw up oil faster than it will be burned by the flame. That excess oil can dribble out over the lamp’s nozzle and drip down on things below the lamp. The Betty Lamp worked around that problem by attaching an internal wick holder that allowed this oil to simply drain back into the oil reservoir.
In the photo above, you can see both a Pickwick and a spike for hanging the lamp. When log built buildings and homes were common, the spike could be pressed between the logs to hang the lamp.

You can see the wick holder installed in the Betty Lamp in the photo above. Betty Lamps could be used to burn Whale Oil, Vegetable Oil, and animal fat and oils. Other than a small number of high tech (for that period) and expensive lamps, the Betty Lamp and metal versions of all the previously mentioned pottery lamp designs were the household lamps until the mid 1800’s.

Another factor fed into the rate of innovation in lamp technology. Olive Oil was very expensive in the Americas and many Northern European countries. Whale Oil provided a replacement for Olive Oil, especially in North America. At its peak, Whale Oil production reached 200,000 barrels per year. Whale Oil is less viscous than Olive Oil. Wicks could be placed above fully enclosed oil reservoirs.

Introduction of cheap and even less viscous Kerosene (known as paraffin in Europe and the UK) in the mid 1800’s allowed even more innovation and effectively eliminated nearly all use of grease and Whale Oil lamps.
As you might imagine there were many variations in styles between regions and over time. We are talking about thousands of years. Above you can see a 21\textsuperscript{st} century lamp design.
My Interest
Well, with all that out of the way, let’s get to what I have been interested in. There were two parts to what I was looking for. The first was simply how the things worked from a technological perspective. The second was what was special about the 1st, 2nd, and 3rd century Roman factory lamp design. That design became a worldwide commodity. Lamps before and after the Roman period differed noticeably in design from the Roman discus style lamp. I was curious if that difference was functional or merely one of style. That brought me to looking into oil lamp technology. I’ve included here a light duty bit of background on ancient oil lamp engineering. It is far from comprehensive but it should be helpful in understanding the technology.

The Technology
At first glance, it might seem like there is relatively little to say about the technology. Oil lamps are just pots of oil with wicks. An open bowl has worked just fine from as far back in time as 50,000 years ago or so. Newer designs just enclosed that bowl to keep the oil from splashing out when you carry the lamp around like a flashlight. Simple.

The first practical issue is that Olive Oil and similar lamp oils are viscous and do not reliably wick much more than about ¼ inch (a few millimeters) above the surface of the oil. Olive Oil lamps have shallow oil reservoirs and place the wick low. This resulted in a noticeable similarity in lamp designs across the millennia and across cultures. The differences were primarily artistic style variation and decoration, sometimes made as political statements to allow a cultural group to differentiate itself from others.

Every lamp design was constrained by the nature of oil lamp operation. Let’s look at some of those constraints and solutions to those constraints:

The Oil Reservoir
As mentioned above, early oil lamps were simply shallow hollow dishes of some sort. Sea shells worked quite well. Stones with hollows chipped into them would have worked adequately. Oil, grease, or easily melted tallow would supply the fuel. Mosses or any convenient dry plant fiber would serve as a wick.

With open dish lamps, the shape and dimensions of the hollow area becomes an issue. Recall that the oils available for use in these lamps was typically moderately viscous. The flame on a wick can be only a few millimeters above the surface of the oil in the reservoir. As the lamp consumed the oil in the bowl,
the wick must burn down (or be manually slid down) to maintain adequate wicking action or control flame height. A steep sided bowl would begin blocking part of the light from the oil flame. Shallow, wide mouth reservoirs work best for open bowl oil lamps.

There is an interesting and beneficial aspect to oil lamp operation. The flame has much less of a tendency to be blown out as an oil lamp is moved about than when moving modern wax candles. However, carrying an open bowl lamp around invites spills. This spill problem was apparently considered as, starting around 3000 years ago, the sides of the oil reservoirs were often curved up and inward, partially enclosing the oil.
Roman era lamps often carried that enclosure theme to an extreme. Those lamps often had only a small oil filling hole. To reduce the difficulty in filling a lamp through a small hole, the top surface of the reservoir was dished.

You may be wondering how large these lamps were and how much oil they could hold.

As you can see from the photo above, lamps were typically not large. Their oil reservoir size was usually such that 2 to 6 hours of burn time was available per filling. Lamps were made that could burn longer and some could burn multiple wicks for more light, but the most commonly used lamps were of this smaller size.

**The Wick**

A wick is a key feature of oil lamps. A pool of high flash point oil, such as Olive Oil, cannot be ignited by a flame unless it is heated above several hundred degrees Fahrenheit. That is why an open bowl type Olive Oil lamp may be used safely. A wick is required. The wick in the lamp draws a small amount of oil up away from the oil pool. It is the thin coating of oil on the wick that an external flame can ignite. It is the job of the wick to continuously refresh that thin layer of oil to maintain the lamp’s flame.
Wicks have been fabricated using a wide variety of materials. Early wicks were likely lumps of moss or twists of dried rushes or reeds. As they became available, woven natural fibers have been used. When they came available, the most commonly used fibers were Flax and Cotton. Wicks differ in diameter, fiber, and twist or weave. Wicks also differ in how they perform.

As you might expect, thinner wicks draw less oil and produce smaller flames than thicker wicks. Tighter woven or twisted wicks draw oil more slowly and produce smaller flames than looser wicks. Wicks intended for kerosene lamps generally are too tightly woven to support a flame more than an eighth of an inch (2 or 3 millimeters) or so above the surface of the reservoir oil. They usually do not work well in the kinds of oil lamps considered in this document.

To work with Olive Oil lamps today, it is not necessary to search for any kind of exotic wick material. Standard hardware store materials will usually work quite well. Common all cotton cordage or small diameter rope works well. One eighth inch or three sixteenth inch diameter cotton rope works well if you first pound or flex it to loosen the weave.

Probably the cheapest and most effective wicking material at the hardware store is a simple cotton mop head. One mop head would likely supply a lifetime of wicks. Each cord on the mop head is typically made up of four separate strands twisted together. It is not necessary to use all four strands in a wick. Even a single strand works well for producing a small flame and providing a longer burn time for the lamp.

Oil lamp wicks are not consumed by the oil fire, or, at least not very much. The end of the wick will be charred by the heat of the flame but as long as the rate of wicking of oil matches the rate that the oil is being consumed by the flame, the wick will not burn. A small length at the end of the wick will be burned if the flame is not extinguished before the oil supply is depleted. In that case, the flame is merely following the available oil down the wick until it smothered by the lack of oxygen in the lamp’s wick nozzle.

The Nozzle

The nozzle is the part of the lamp where the end of the wick is exposed to support a flame. An open bowl style oil lamp obviously has no separate wick nozzle. Those lamps with partially or fully enclosed oil reservoirs must provide an opening for the wick. There are some constraints to how a nozzle is placed on the lamp.

The opening on the nozzle must be low relative to the oil level in the oil reservoir. The viscosity of vegetable and animal oils does not allow lamp wicks to draw the oil very high. This results in the nozzle being placed at the edge of the lamp instead of the top as with Kerosene lamps. The low placement of the nozzle limits the volume of oil that may be held in the oil reservoir unless that part of the lamp is made very wide and flat.
The design of the area around the nozzle is of some concern. A wick with good capillary action can often draw more oil than is burned. That excess oil can dribble out over the edges of the nozzle and onto whatever the lamp is setting on. Some lamps were designed with channels or lips to retain any excess oil drawn up and allow it to return to the oil chamber. Of course, others designs relied upon the lamp user to either carefully adjust the wick position in the nozzle or to accept the slow overflow with its attendant mess.

The lamp nozzle has another important function beyond simply providing a place for the wick to stick out of the lamp. It also limits the size of the flame. A fully exposed wick can burn all along the length that is above the reservoir oil surface level. The nozzle structure limits the area of the wick exposed to air. This allows control of flame size and burn time for the lamp’s oil.

**The Lamp Pottery**

Lighting was just as important to our ancestors as it is to us. As you might imagine, an oil lamp can be made from just about anything that provides a shallow hollow that can hold oil or fat. Once techniques for producing fired clay pottery bowls were developed, their utility for oil lamps was no doubt immediately recognized. Pottery oil lamps are still used in some parts of the world today.

Of course, various metals have been and still are used for making lamps. However, until industrialization allowed the cheap production of metal lamps, they were too expensive for normal households. Once manufacturing technology advance to where inexpensive metal oil lamps became available, they quickly replaced most pottery lamps.

Until about the 14th century, Terracotta was the fabrication material for almost all household oil lamps. Terracotta is a ceramic that is fired (baked) at temperatures in the 1200 to 1800 degrees Fahrenheit (600-1000 C). These temperatures are achievable with just wood or charcoal in easily fabricated kilns. Archeological investigations indicate that the large Roman factory lamp kilns were typically heated to about 1500 degrees Fahrenheit (800 degrees Celsius). In the 14th century and later additional higher temperature techniques to produce non-porous ceramic were also employed in lamp making.
Terracotta is rugged and long lasting. Museums have examples of Terracotta objects several thousand years old. It does have one problem for lamp use. It is porous. Oil can slowly seep through it. That potentially makes oil lamp use a bit messy. Though paint and or pottery glazes were found on some lamps, their use was likely decorative rather than seepage blocking.

Terracotta, though imperfect for lamp use, is adequate for the job and was the choice for inexpensive lamp production. Ancient texts instructed lamp users to place oil lamps on protective plates to collect the leaked oil and avoid staining the surfaces under them. With that precaution, Terracotta lamps successfully served for household lighting for several thousand years.

However, it should be noted that the oil seepage through the Terracotta gradually slows. This may be due to biological action, evaporation of vegetable oil volatile components, or perhaps trace solids in the oil eventually clog the Terracotta porosity. While the time frame may be variable, within a few weeks or months seepage of oil through the Terracotta approaches zero. This may very well be the reason why bare Terracotta was in use for so long. “Better” materials and techniques might well have been considered unnecessary.
**My Experience with Oil Lamps**

Simply examining various types of ancient oil lamps can supply only a very limited kind of information. It is difficult today to know the significance of lamps to ancient people. Sure we can understand the need for light. We cannot, however, experience the world view of those peoples. While it is interesting to speculate on those ancient times, I won’t delve into the motivations of those ancient peoples. I have limited my study of oil lamps to the technology.

There is a lot more to lamp technology than cataloging variations in designs. While it is easy to speculate about why those variations exist, I felt it was necessary to actually use them. By that I mean burning different kinds of lamps for several hours each at minimum. I included in that testing different kinds of wicks in the different lamps.

During my lamp testing I attempted to work out how each lamp was operated and maintained on a day-to-day basis. I’m sure my efforts would have looked rather clumsy to those ancient people who used these lamps their entire lives. Of course, not having any of those folks around to provide instruction meant I had to learn from experience. Experience takes time.

**My Test Lamps**

*8 Roman Replica*

The first Olive Oil lamp I experimented with was a very inexpensive lamp from a shop in Bulgaria. Its modest cost and quality encouraged me to experiment liberally without fear of expensive loss.

I tested a variety of wick materials over dozens of hours of operation. I was attempting to determine what wick characteristics might be important. Also, of course, I was attempting to understand the nitty-gritty details of oil lamp operation.
My efforts at filling the oil reservoir provided a good example of why the top of the lamp disk is dished. However, I quickly learned that precision in filling the lamp is probably wasted. Terracotta porosity allowed the oil to migrate through and around the lamp. Within a few hours of operation, the lamp became shiny from a complete coating of Olive Oil. This natural leakage, though messy, does not appear to present fire hazard.

One problem I was not able to find a solution for is that the Olive Oil would wick out of the nozzle. This would happen whether the lamp was lit or not. This, of course, compounded the problem of the oil seeping through the Terracotta. The lamp was always sitting in a thin puddle of Olive Oil. I’m guessing a housewife from 3000 years ago would have shaken her head at my efforts and quickly fixed the problem. Unfortunately, she did not leave me a note explaining how she would have done it!

This particular replica lamp exhibited one deficiency in common with some ancient lamps. A common fabrication method for ancient oil lamps was to press strips of clay into molds of the upper and lower halves of a lamp. The halves were then joined and fired as a unit. Popular lamp designs were ripped off by casting molds of a sample lamp. Some copies were well made but most tended to be cheap knock-offs made with thicker clay to make firing less critical. My lamp was made with thicker clay like those old knock-offs, so has a smaller reservoir than the original higher quality lamps. That meant my burn time was a bit shorter than better quality lamps. Of course, this is not a problem for my experiments but I thought it was interesting enough to mention.

Overall, this lamp worked well, providing 2 to 3 hours of light. The amount of oil seepage did surprise me. I did learn that getting the best operation out of an ancient Olive Oil lamp takes practice and experience. The skill at using these old lamp designs is not common today.
In an attempt of obtain a lamp closer to what a real Roman era lamp might be, I ordered a replica from the British Museum. This replica of a Roman oil lamp is molded from the original in the Department of Greek and Roman Antiquities at the British Museum.

The original of this fired clay lamp was made from a two-piece mould. The base has an impressed planta pedis or maker's mark possibly with the letters CCLOD indicating that the lamp came from the workshop of Caius Clodius, a lampmaker working in Italy. Roman, AD 40-70.

After having experimented with my $8 Roman replica lamp I was a bit surprised when I received this lamp. It is noticeably bigger. 3.25 inches wide for this one compared to 2.375 for the first lamp. That, of course means it has a larger oil capacity. This lamp could easily provide light for an entire evening with one filling. Plus, it just looks like a more professional design.

The technical details of this lamp such as height of the filling hole relative to the nozzle wick hole and the depth of the dishing in the reservoir cover discus make filling and handling the lamp easier. The nozzle opening is above the outer rim of the discus. If the lamp is overfilled so there is pool of oil in the discus, the lamp will operate correctly without oil overflowing the nozzle.

As with the $8 replica, oil seepage through the Terracotta and out the nozzle is a problem with this lamp. Oil seepage completely saturated the lamp within two or three days of operation. As it saturated, the color shifted from the brownish orange color you see in the photo above to a shinny brick red color. With the shine, the Terracotta could be mistaken for molded plastic.

Interestingly, after a few months of occasional use the seepage stopped. I did not notice when it actually happened since I was not watching for that development. I had not come across any mention of that possibility in academic or historic documents on lamps and terracotta. A quick recheck of the $8 replica also showed the same lack of seepage. I suppose surprises like this are to be expected.

I experimented with wicks in this lamp in an attempt to work how to minimize wicking overflow from the nozzle. I find it hard to believe that people using these lamps on a daily (nightly?) basis would not also work on this problem and solve it to some satisfactory degree. I decided I could not claim I had figured out oil lamp operation if I skipped working on this problem.
I tried thin wicks, thick wicks, tight weave wicks, and loose weave wicks. I began to see a pattern. Wicks that touched the upper edge of the nozzle opening would push oil out and over the front of the nozzle. That was reasonably obvious. Good wicking materials such as a mop head cord could push oil out even when a flame is burning. Even my moderately tightly woven 3/16 inch cotton rope would push oil out but at a much lower rate.

Using the 3/16 inch rope wick adjusted so it didn’t quite touch the upper edge of the nozzle opening all but eliminated the oil leak but the small flame of the thinner wick continued to burn down into the lamp about half an inch as the oil burned out. This was not a serious problem but it was a little disconcerting that a flame could be working its way down inside the lamp.

The wick configuration that worked best for me was based upon the ancient Egyptian hieroglyph made of a wick folded in half and twisted. I think this was the hieroglyph for the sound of the letter ‘H.’ I folded a mop cord in half and gave it a couple twists. This produced a thick wick. This wick almost filled the nozzle opening. It was not necessary to pull this wick up as high as thinner wicks for an adequate flame height. The low, thick wick worked best at minimizing wick oil leakage while providing a bright light.

I should mention, however, that even though the folded wick worked well, there was still oil collecting under the lamp. The nozzle area appeared to remain dry. I assume the oil under the lamp had soaked through the Terracotta. Compared with how much oil I used to fill the lamp, the amount of oil under the lamp very small so I declared victory in my pursuit of adequate wick performance. Of course, later testing showed that the seepage eventually stopped.
With the folded wick configuration, the lamp burned nicely with a ¾ inch flame. Adding Olive Oil until the small filling hole was just topped off, the Roman lamp was starting to show indication of running out of oil after 7 hours of operation.

I think I can understand how this style lamp might have been popular enough for millions of them to be sold around the world. Several hours burn time with no attention or adjustment is very nice. The low profile of the lamp allows full 360 degree light distribution. That seems to me to be a good combination for household lighting.
**Byzantine Era Replica**

My next lamp is one from about the 5th or 6th century CE. I was interested in this time frame as it is sufficiently after the Roman period to allow design drift. I was curious if this design was a backward or forward step from the Roman disk reservoir style lamps. I ordered this lamp from Amazon for about $11.

I did not find this lamp design to be an improvement over the earlier Roman flatter discus style lamps. This lamp, however, is not authentic as it is reproduced using modern ceramic techniques. Its sides and top are likely thinner than is found on lamps from the Byzantine era. This is a problem only if you are interested in testing one of these lamps. Not having Olive Oil soak through the bottom and sides of the lamp is an advantage. It is just not ideal for understanding how it may have been used on a day-by-day basis.

What I found was that the larger filling hole allowed me to monitor the oil level easier than with the Roman discus style. The raised top introduced a new variable in wick operation. Smaller, thinner wicks were needed to minimize the amount of Olive Oil pulled up by the wick and spread over the lamp’s outer surface. I did not find a wick arrangement that eliminated the wick driven leakage.

The oil reservoir was large enough for a reliable 4 hour burn – 6 hours with the thin wick supplied with the lamp. In general though, I preferred the Roman design in spite of its Terracotta oil seepage. The Roman lamp allows full 360 degree light distribution plus provides over 7 hours operation on a single filling.
In my searches on the Internet, I came across a brass lamp style that did not appear to be simply a metal version of ceramic lamps. While it obviously was designed within the constraints of oil lamp operation, it had a few unique features. Its top surface is flat and the nozzle is a small funnel. I was curious about its operation. I ordered it from Israel via Amazon for $24.

It is a pretty lamp. Unfortunately, its performance as an Olive Oil lamp was very poor. The main oil reservoir was stuffed with cotton and the wick consisted of untwisted strands and appeared to be unadjustable. It provided only about a 1 hour burn time with Olive Oil even though the cotton in the oil reservoir was still saturated. My guess is this lamp was configured to burn something other than Olive Oil, probably kerosene.

I set about converting the lamp from kerosene operation to Olive Oil operation. This involved removing the cotton packing. I drilled out the nozzle cone to allow for a larger wick. I ended up having to remove the nozzle cone to finish cleaning out the nozzle area of the reservoir. The base of the nozzle cone extended too far down into the nozzle area to allow an Olive Oil type wick to be installed so I had to modify it. That cone modification required the cone be soldered back on instead of simply screwing it in. Overall, it was not a hard or lengthy job but again my workmanship added a certain sloppy patina to the lamp. Oh well, as I said at the start, this is about the technology, not the art!

The only real problem I encountered after modification is that of installing a wick. As you can see in the photo of this lamp, the wick has to be threaded through a narrow neck and then make a sharp 90 degree bend at the nozzle wick hole. It took me a few tries to work out how to do that.

After the modifications, the lamp worked well as an Olive Oil lamp. A full reservoir provided over 3 hours of light. The wick was able to empty the reservoir so the extended nozzle neck was not a problem for operation.

The conical nozzle does eliminate oil leakage. However, nozzle is located out on a narrow neck of metal. The flame heats the nozzle cone which, in turn, heats that part of the lamp. It quickly becomes too hot to touch. That is not a problem with Olive Oil, but I would not be quite as comfortable using kerosene with its 100 degrees Fahrenheit flash point in this lamp.
Open Bowl Brass Lamp

My original interest in oil lamps centered on and around the Roman Factory Lamp period. Having achieved a comfortable level of experience with that style lamp, I decided my experience with oil lamps should include open bowl style lamps. I suspected that even the simple looking open bowl lamps might have some subtle secrets that should be explored.

My first open bowl lamp was an inexpensive brass Diya from India. Though it is of modern manufacture, its overall design is similar to many ancient metal lamps. This kind of lamp is used as part of many religious events and festivals. Lamps similar to this one are produced in large quantities in India and surrounding countries and are very inexpensive.

This lamp appears to be fabricated from brass castings with brass brazing used to connect the bowl, base, and handle. Though its workmanship might not place it in the category of “art” it is certainly sturdy. A lamp like this one could hold up to decades of use - perhaps even centuries.

This lamp does have the advantage of no oil leakage. I was curious about wick operation as the lamp burned. More of the wick would gradually be exposed above the oil level. Would the flame follow the oil level down the wick and eventually completely burn up? That seemed like a good question to work on as a starting point.

It turned out that the flame on the wick did not follow the oil level down if the wick was flush against the side of the bowl. That is, until the oil was almost gone. Without enough oil to draw, the wick gradually dried forcing the flame to move down closer to remaining oil. With any kind of oil lamp, especially open bowl lamps, the flame should be extinguished well before the oil is completely consumed.

Quite a wide range of wick types worked well with this lamp. The slick sides and bottom of the brass sometimes made adjusting wicks a bit tricky. The wicks tended to slide around very easily making it difficult to adjust their position and height. I suspect this would be less of a problem with a rougher Terracotta lamp bowl. Again, experience improved my accuracy.

I did find that oil sloshing while moving the lamp causes the wick to move. This likely explains why the gradual evolution of lamps from circular bowls to those with more definite wick holding slots. It can be
tedious holding a lamp steady while trying to see where you are walking. Of course, this problem was not present in the lamps with wick nozzles previously studied.

With a thin wick and about a ¾ inch (20 mm) flame, it was about 4 hours before it was time to refill the lamp. With a full twisted mop head cord and a somewhat brighter flame, about 2 hours was the limit. Overall, I prefer the lamps with wick nozzles. However, even with its limitations, this is a very serviceable kind of lamp. After all, our ancestors got by with them just fine for many thousands of years.
**Lard Lamp Experiments**

After my look at open bowl lamps using olive oil, I decided I should back up and take one more stop on this oil lamp technology study. Vegetable source oils such as olive oil are not the only source of suitable fuel for producing light in an open flame lamp. Some parts of the world have little available plant matter capable of producing significant amounts of lamp oil. Animal, bird, and fish oils, fats, and tallow have all been used, and even longer than vegetable oils.

I began by looking for examples of lamps designed for fat and tallow burning. The Crusie as shown on page 5 was the obvious choice. This style lamp was brought from Europe and reproduced throughout eastern North America well into the mid 1800’s. I could not bring myself to buy and abuse an antique lamp so set about copying the design.

The photo above shows my two test versions of the Crusie lamp. The one on the left is a small heart shaped baking pan with the sides bent inward to make the wick slot. The one on the right is the bowl part of a stainless steel spoon rest. This combination gave me examples of shallow and steep sided lamp configurations. My efforts were crude but photos of historic Crusie lamps indicate many of them were of similar fabrication quality.

My fuel of choice for this part of oil lamp investigation was Lard. Supermarket lard is simply tallow produced with sanitary precautions appropriate for food products. Tallow and animal fat were the fuels used in most North American household oil lamps until low cost kerosene (paraffin) became available in the mid to late 1800’s. That remained the case even when whale oil was available; its cost was much higher than tallow.

A pleasant surprise with burning tallow was, at least in the form of supermarket lard, the lack of odor and smoke. Just as with olive oil lamp operation, care must be taken with positioning and adjusting the wick but once properly set, a clean odor free flame is produced. My fears of filling the house with the odor of burnt bacon and smoke were unwarranted.
Both of my Crusie lamps performed adequately though, of the two lamps, the modified baking pan worked best. Previous experience with oil lamps suggested the wick should stick about one quarter inch (6 mm) above the rim. This guess turned out to be correct. A non-smoking 1 inch (25 mm) flame was produced. That lamp operated with little change in light output for 4 hours without manual intervention. At 4 hours, the rate of lard melting became less that the burn rate and the flame gradually became shorter. The face of the unmelted lard mass was 2.5 inches (6 cm) from the flame.

While lit, the wick slot area of the lamp becomes very hot. It was too hot to hold a finger on. That heat was conducted to the lard, greatly increasing its melting beyond direct heating by the flame.

The lamp made from a stainless steel spoon holder produced only about 2 hours of unattended burn. It appeared that its thicker metal dispersed the heat from the flame too well. The metal around the flame remained much cooler than that of the baking pan lamp. Though functional, this lamp requires significantly more attention during operation than the baking pan lamp.

My most successful wick configuration was simply a strip of cotton cloth. A mop head cord became too stiff when packed with lard. Interestingly, most descriptions of grease and tallow lamps in early North American colonial time were that strips of cloth were used as wicks. I had assumed that was simply from lack of better wick material. It may be that cloth strips were the optimum choice for burning this fuel.

My quick and short assessment of tallow fueled lamps was that it is a much better technology than I had expected. With good quality tallow, a bright flame with little detectable smoke or odor is produced. This kind of lamp is certainly adequate for primary household lighting. An example given in one historic text is that Webster’s night time work on his first dictionary was under the light of a tallow lamp.

There is a caveat to this discussion of lard/tallow lamps. I did not test straight animal fat such as bacon grease or hamburger fat. I suspect problems with odor or smoke may be greater with those fuels. However, as my original interest was in oil fueled lamps, I chose to limit my study of this alternate fuel source. To do a study of fat and tallow lamps justice would involve much work than was intended for this paper.
This last lamp is actually not an ancient oil lamp design. The Betty Lamp has been around for only about 300 years. I was curious if this more modern design represents a significant improvement in Olive Oil lamp performance. Also, I thought it was interesting that I could purchase a reproduction of this style lamp that is historically correct in design, materials, and manufacture – on line for only $30!

As mentioned before, the Betty Lamp is a multi-fuel lamp. It can burn grease, fat, vegetable oil, and even Whale Oil. This capability was an advantage in North America where oils such as Olive Oil were generally very expensive. Even whale oil was a moderately expensive commodity for the average home. The ability to burn cooking grease and tallow made this lamp a favorite for household use in the 18th and 19th centuries.

The Betty Lamp improvements were to add an internal wick support and a closing lid. The internal wick support allowed oil dripped from the wick to fall back into the oil reservoir thus reduced mess and lost oil/grease. The closing lid allowed heat from the flame and the metal wick support to be retained to help keep fat and grease fluid enough to be absorbed by the wick.

This particular replica worked quite well except for a minor fabrication detail. The opening in the front of the lid was too small. The lid could not be fully closed with the wick support in its proper position. I used my tin snips to enlarge the notch in the front of the lid. My workmanship was quite poor but the results are functional.

With the lamp about 3/4 full of Olive Oil, it provided a nice clean flame for over 8 hours. Once set after lighting, the wick needed no further adjustment. I did notice that the lid was warm indicating that it was keeping the oil inside the lamp warm. This is not a necessity with Olive Oil but it is quite helpful with grease, fat, or tallow type fuels.

This lamp was also very good with lard as a fuel. I filled it about ¾ full of melted lard and allowed it to cool and harden. Using a mop head cord as a wick, the lard burned clean with no smoke or odor. This fuel provided about 7 hours of 1 inch (25 mm) flame. The entire lamp body warmed from the heat of the
flame liquefying the lard. As with the Olive Oil, the wick required no attention after its initial adjustment. The lard remained liquid throughout the burn, enabling its full use.

I should note here that historic descriptions of tallow lamp operation mention that they were serviced and refueled during daylight hours. Betty lamps were filled with liquid oil or melted tallow and set aside until needed. Instructions supplied with some commercial Betty and Crusie lamps indicated that if the tallow is solid or frozen, the lamp could be inverted momentarily when lit to melt sufficient fuel for the wick.

Overall, I would assess the Betty Lamp improvements over ancient designs as very useful. Of my test lamps, this would be the oil lamp I would use in a power outage.
Lessons Learned

Oil Lamps Are Simple, Safe, and Messy To Use
Placing a wick in a lamp and pouring some oil into it is the entire setup process. Lighting the exposed end of the wick once it has had time to soak up some oil will cause light to be produced. This is not rocket science.

As for safety, Olive Oil is difficult to ignite without a wick. Tossing a lit match into an open bowl of Olive Oil will simply put the match out. Olive oil is non-toxic. It is used in food and for cooking. It not harmful to skin and some ancient cultures used it for bathing. (Spread it on and scrape it off kind of bathing though.) Knocking an Olive Oil lamp over will usually put the flame out.

I did find oil lamp operation a little messy. No matter how careful I was, I always seemed to get Olive Oil spread around the lamp. It seemed at times the oil would crawl out of the lamp without my help. I imagine those ancient folks with a lifetime of experience could do somewhat better in this regard. I used a metal pan under my lamps to contain the mess.

Olive Oil Burns Clean
I didn’t know what to expect from burning Olive Oil. I was surprised that it has no scent when burned. Also, with the wick adjusted properly, it produces no smoke or soot. Too long a wick would produce soot but there is quite a lot of latitude in exposed wick length for clean burning.

Tallow and Lard Can Burn Clean
This was a bit of a surprise. Modern descriptions of grease and tallow lamp operation indicate that burning grease or tallow in a lamp would be smelly and smoky. This was not the case. There was no more odor than a modern wax candle and no smoke once the wick was correctly adjusted. However, my experiments have not included cooking grease or raw fat as fuel. Odor and soot might be more likely with them.

Wick Adjusting is a Learned Skill
My earliest experiences with oil lamps were quite amateurish. Whatever I did seemed to create some sort of mess. With practice, I gradually learned the correct wick type and adjustment to minimize the mess while providing a clean bright flame for each lamp. Even subtle differences in wick adjustment can make a very noticeable difference in lamp operation. It takes experience to understand those subtleties.

I noticed many claims about oil lamps producing smoke. That is not an inherent characteristic of oil lamps, at least those burning fuels like olive oil or clean tallow. It is a matter of wick adjustment. Smoking is an indication that too much of the wick is exposed and should be slid a bit further down into the lamp.
Those Ancient People Were Not Dummies
There is a tremendous amount of historical information on ancient oil lamps. Their use for household and religious purposed made them ubiquitous through time and cultures. The design and decoration of lamps found at archeological sites are often used as a dating method.

At first glance, historical information on ancient oil lamps indicates very slow evolution of lamp designs. From the perspective of the rate of technological change we see today, the low rate of change in ancient lamp designs appears strange.

The correct perspective is that ancient lamp designs were the result of decades of experiments with failures and successes. Designs optimal for the available fuel and manufacturing capabilities would have been found within only a short span of time. Little innovation was necessary or practical until fuel or manufacturing methods improved.

Those ancient oil lamp designs were optimal for their place and time!

Oil Lamps Are Not Expensive
I was surprised to learn that oil lamps can be very inexpensive. High quality reproductions of ancient lamps are available on line priced between $5 and $30. Modern designs are available in that same price range. I will very likely keep one or more of these lamps for use in possible future power outages. It might be handy to have lamps that can run on ordinary cooking oil.

Oil Lamps Are Sometimes Hard to Light
Remember that Olive Oil’s high flash point allows it to be kept and used in households safely. That high flash point means that it is a little harder to light an Olive Oil wick than the wick in a kerosene lamp. Expect to have to hold your match or lighter flame on the wick for a bit longer than you are used to with candles or other kinds of lamps

Don’t Refill a Lamp with Olive Oil Until Just Before You Light It.
A Terracotta lamp filled with oil will ooze more oil than an empty one. This is especially true if your wick can push oil out of the bowl or nozzle. Of course, even an empty Terracotta lamp can ooze oil that it has absorbed - just not as much as a full lamp.