EUREKA!

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Cover photo: Mauchline patent safety lamp with bullseye glass lens used to illuminate the work area. This lamp was briefly owned by Dave Thorpe and is now owned by a collector in China.

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Full Moon Saga

by Doug Miller

The following article is the product of the research that I did and the help that I received from several prominent collectors of mining artifacts, including their websites and books, during the course of deciding whether to purchase a Full Moon carbide lamp that was offered to me in July 2014. This research was initially the subject of my extended August 2014 post on the *Eureka Forum.* I was asked to follow up on that post with an article in order better to preserve the information that I gathered during my research. I have done my best to do that here. However, much of the credit for the content of this article belongs to those collectors who shared their invaluable knowledge, time, photographs and resources with me, and helped steer me in the right direction, in particular Neil Tysver, Tony Moon, Hal Post, Larry Click, Paul Kouts, and Dave Thorpe. Any errors or omissions in this article are mine alone.

Full Moon Acetylene Lamp.

The Full Moon acetylene lamp shown in the accompanying cut is manufactured by F. E. Baldwin, 101 Duane street, New York, and is specially designed for bicycles, carriages, etc. It is made of nickeled brass, is $5\frac{1}{8}$ inches high, has a reflector 3 inches in diameter and weighs empty only 9 ounces. Water is introduced through a screw cap at the top and the flow controlled by turning the wire indicator right or left.

The main difficulty in burning carbide is to keep the channels clean and free from any obstructions. This is accomplished in the Full Moon lamp with regard to the water feed by a simple and ingenious contrivance, by means of which the water tube is automatically freed of any accumulations of carbide powder every time the water indicator is moved. Car-

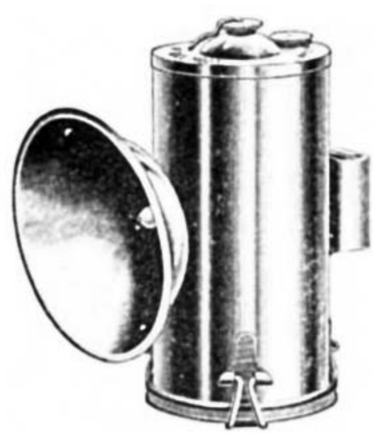
bide is placed in a cylinder fastened to the bottom, the cylinder being 2 inches high and 2 3-16 inches in diameter. Above the carbide is a perforated disk and tube, the latter wound with muslin and the charge held down by a brass spiral spring attached to a solid metal disk above. The carbide chamber is clamped to the bottom of the lamp by three hinged eccentric clamps, which keep it rigidly in position. It will be seen the flame is projected straight ahead from a lava tip and there is no lens or glass in front, the reflector being placed at a sufficient angle to throw the light on the road in front of the wheel. The main points made by the manufacturer are its extreme simplicity, lightness and ease with which it can be maintained.

The Full Moon Acetylene Lamp

This is the name of the lamp as it appears in the earliest, known literature. A July 29, 1899 issue of the periodical *Iron and Steel* included the above advertisement and illustration (Iron and Steel 1899, 13). *Iron and Steel* was a trade publication "Devoted to the Hardware and Metal Trades." The next earliest reference is found in an October 10, 1899 issue of *Hardware,* another trade publication that billed itself as "A Review of the American Hardware Market" (Hardware 1899, 30). I have enlarged this advertisement and converted it to Word format so that it is easier to read.

The Full Moon Acetylene Lamp

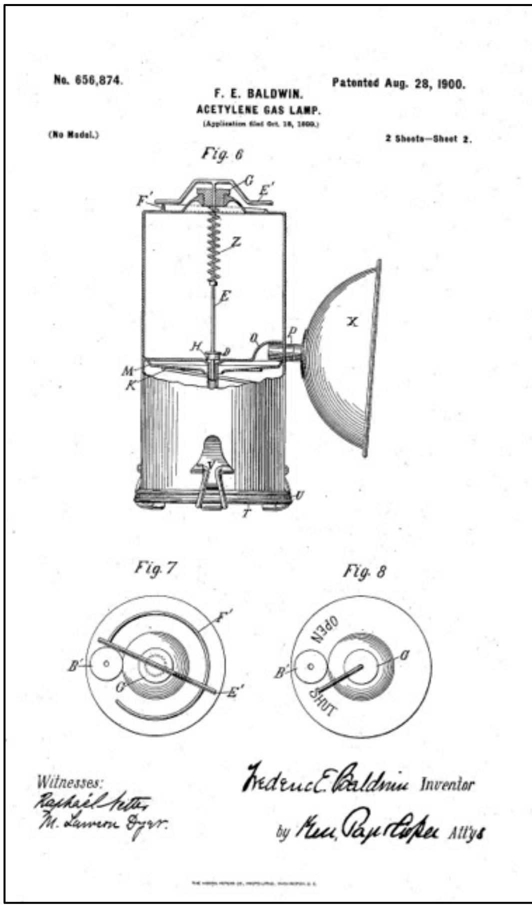
We present herewith an illustration of a new Acetylene Lamp which is manufactured by F. E. Baldwin, New York, and is placed upon the market and before the Hardware trade by Hermann Boker & Co. No. 101 Duane Street, New York, who are sole agents for the sale of the same. This lamp is specially designed for bicycles, carriages, etc. It is made of brass nicely nickeled, is 5 1/8 inches high, and has a reflector three inches in diameter and when empty, the lamp weighs only nine ounces. Through a screw cap at the top, water is introduced and the flow entirely controlled by turning the wire indicator, which is shown on the top of the lamp, either to the right or left. One of the principal difficulties in burning carbide is in keeping the channels clean and free from ordinary obstructions. In the "Full Moon" lamp this is accomplished with regard to the water-feed by a very simple and ingenious device by means of which the water tube is automatically freed of any ordinary accumulations of carbide powder every time the water indicator is used at all. The carbide is placed in a cylinder fastened to the bottom, the cylinder



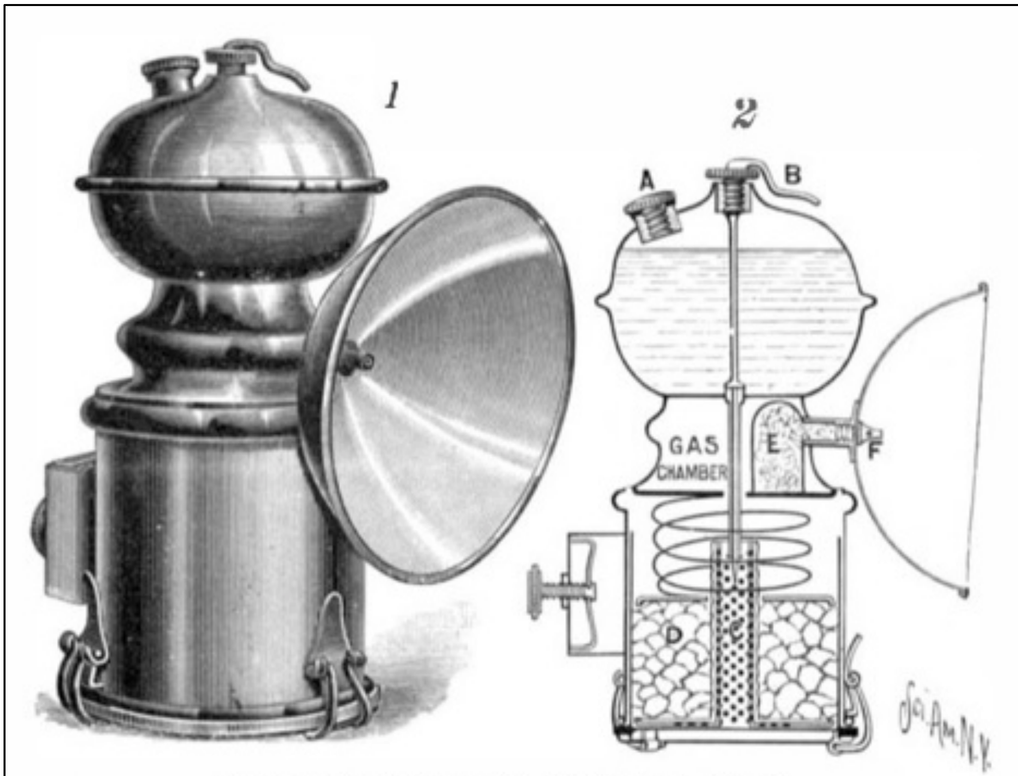
being two inches high and 2 3-16 inches in diameter. Above the carbide is a perforated disk and tube the latter being wound with muslin and the charge of carbide held securely in its place by a brass spiral spring attached to a solid metal disk above. Three hinged eccentric clamps, which are shown in the illustration, secure the carbide chamber to the bottom of the lamp, and keep it rigidly in its position. It will be noticed that the flame is projected straight ahead from a lava tip, and there being no lens or glass in front, the reflector can be placed at a sufficient angle to throw the light on the road immediately in front of the wheel. The main points claimed by the manufacturer are its extreme simplicity, its great lightness, and the manifest ease with which it can be maintained when in use.

The physical descriptions of the lamp in these two short pieces are invaluable. They are almost identical. Both pieces are written much like press releases of today. They seem intended to market the Full Moon to potential buyers, in particular to distributors of tools and hardware for sale to their customers. That suggests that they were likely written by Fredric E. Baldwin, himself, the inventor of the lamp. Interestingly, the later piece, published in *Hardware* on October 10, 1899, notes that the lamp "is placed upon the market and before the Hardware trade by Hermann Boker & Co, . . . who are sole agents for the sale of the same."

Another thing of note is that both of the advertising pieces describe the lamp as being specially designed for "bicycles, carriages, etc." Both then go on to extol the virtues of the reflector, noting "the reflector can be placed at a sufficient angle to throw the light on the road immediately in front of the wheel." Finally, the illustrations of the lamp show a square bracket on the back of the lamp, rather than a cap hook or handles.



At the same time as Baldwin developed and introduced the Full Moon, he also introduced the Baldwin Acetylene Bicycle Lamp, which was "noteworthy for its simplicity, cleanliness, and efficiency over earlier models" (Clemmer, 17; Scientific American 1900, 394). The same patent that was issued to Baldwin for the Full Moon covers that lamp as well.



TWO VIEWS OF THE BALDWIN LAMP.

In December 1899, Hermann Boker & Co. was marketing both lamps to cyclists and the bicycle industry. The December 21, 1899 issue of *The Wheel & Cycling Trade Review* (The Wheel 1899, 29) contains this beautiful advertisement for the lamps.

By June of 1900, A. H. Funke, 101-103 Duane Street, New York City, was marketing Baldwin's Bicycle Lamp (Scientific American 1900, 394).

Baldwin did not patent his lamps until 1900, and did

not file his patent application until after his Full Moon lamp was already being marketed. His patent, No. 656,874, was issued on August 28, 1900, based on an application filed October 29, 1899. Based on the many carbide lamps that are marked “patent pending” or “patent appl’d for,” it would appear to have been a common practice to manufacture and market a lamp before a patent was granted, but I was surprised to learn that in the case of the Full Moon that apparently occurred even before a patent application was filed. That might explain why there is no marking on the Full Moon referring to a patent or patent application.

Baldwin’s patent application notes that he had invented certain “new and useful Improvements in Bicycle-Lamps.” The application goes on to state “the invention [that is the] subject of my present application for patent is an improvement in lamps more especially designed for use as bicycle or carriage lamps, but capable also of general use and a dapted to burn acetylene or similar gas.” Baldwin was anticipating that the lamp might be marketed and used for other purposes.

All of this information, including the nature of the trade journals in which the descriptions of the lamp were first published (hardware journals rather than mining journals or catalogues), seems to show conclusively that the Full Moon originated as a bicycle or carriage lamp and only later was modified to serve as a mining lamp.

The earliest known reference to the marketing of the Full Moon as a mining lamp is contained in the September 15, 1900 issue of *The Engineering and Mining Journal*. *The Engineering and Mining Journal* contains an article entitled "The Baldwin Acetylene Lamp for Mines" (The Engineering and Mining Journal 1900, 312-13). The accompanying illustration of the Full Moon lamp is exactly like that shown in the 1899 issues of *Iron and Steel* and *Hardware*, which advertised the bicycle lamp. Nevertheless, *The Engineering and Mining Journal* describes the lamp as a "portable acetylene lamp adapted for use in mines" (Engineering and Mining Journal, 312). *The Journal* says that, "A handle – not shown in the drawing – is attached to the catch shown at one side." According to the *Journal*, Albert H. Funke of New York was making the lamp under the Baldwin patent. The *Journal* also contains a drawing that shows the internal parts of the lamp.

The description of the lamp is as follows:

"Fig. 2 [is] a section of the lamp. The lamp as usually made is 5 in. high, weighs about 9 oz. and will burn 4 hours with one charge. A handle - not shown in the drawing - is attached to the catch shown at one side. The construction is readily seen in the sectional cut, the upper chamber containing the water, the lower the carbide. The flame projects directly out of the front of the reflector. . . . The bottom fastens on with three clutches, which make an extremely tight joint, but are easily loosened by the fingers; thus it is never difficult to open these lamps, which so often happens where the bottoms are screwed on."

The article neither describes nor illustrates the "handle" for the lamp, but presumably it was secured to the lamp with the screw-down clamp at the back.

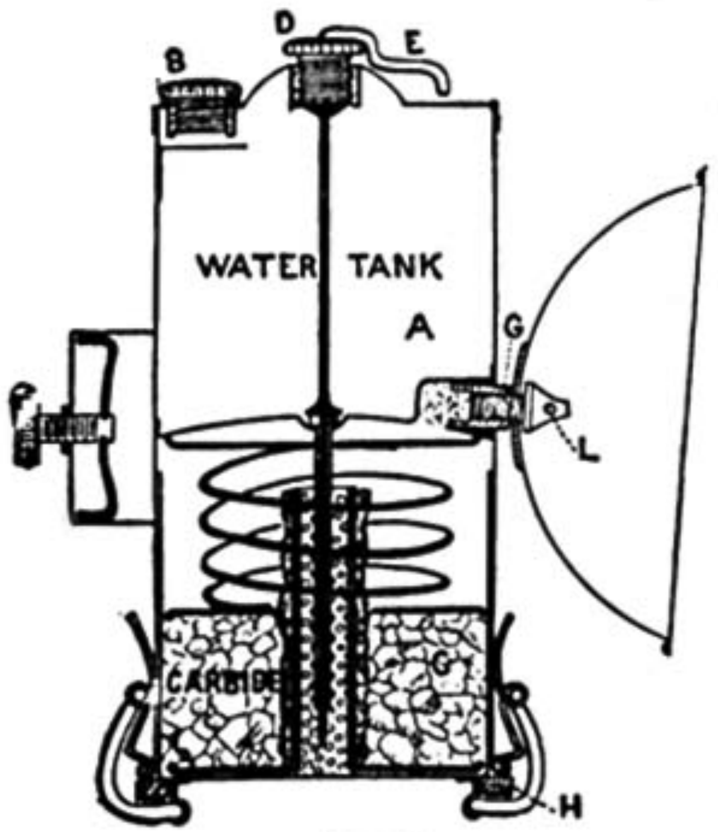
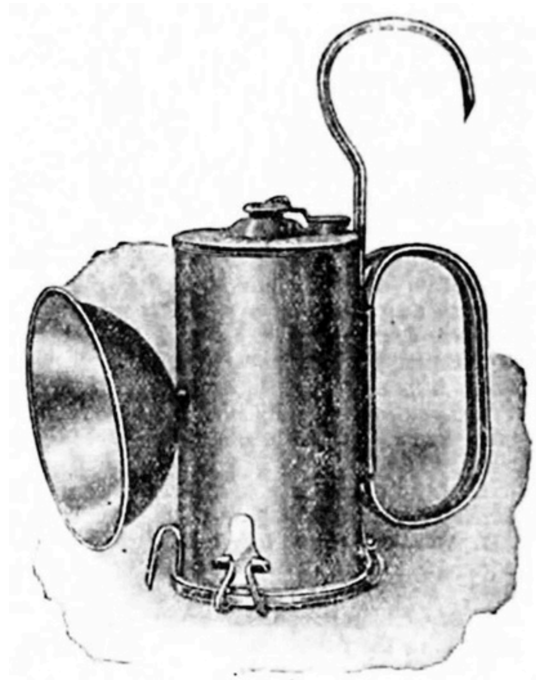


FIG. 2.
THE BALDWIN ACETYLENE LAMP.

The earliest known description and illustration of the Full Moon specifically in a mining version is in an article in the May 23, 1901 issue of *Iron Age* (Iron Age 1901, 66)

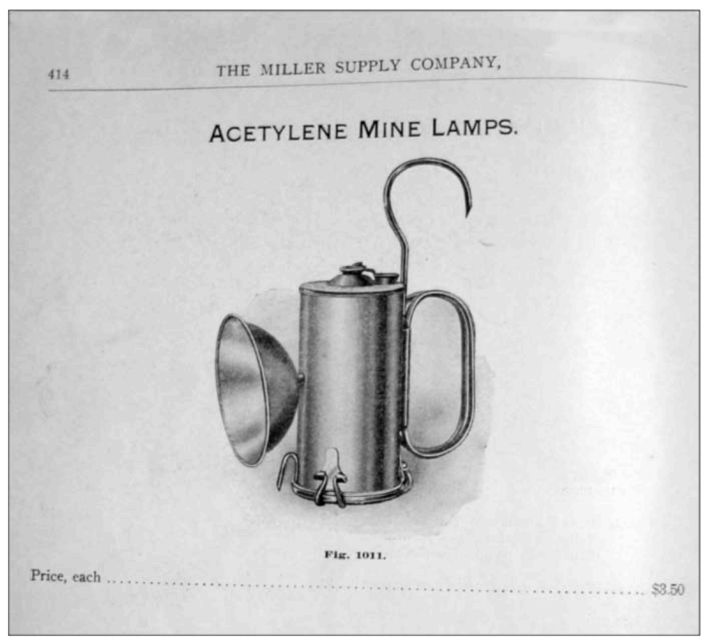
Baldwin Acetylene Mine Lamp

A. H. Funke, 101 Duane Street, New York, has recently put on the market the Baldwin acetylene miners' lamp, as here illustrated, which in construction is an adaptation of his Full Moon bicycle lamp. It is designed principally for use in coal mining and is particularly useful in surveying. The curled pointed wire under the reflector gives the center of the flame in running lines, &c., in the mine. When looked at through surveying instruments, the flame, pencil-like in appearance, gives certainty as to the exact point. The surveying pole can be seen distinctly for a long distance when the light is thrown upon it. At the back of the lamp are two swinging oval handles and a hook, which revolves laterally. The hook forms a handle with which to carry it, and also allows of the lamp being hung up in the mine or on the person at will. There is no smoke or odor, and the strong, brilliant white light, it is stated, makes possible examinations 50 feet distant. One charge of water and carbide lasts four hours, costing less than 2 cents, and it can be quickly recharged. The carbide is held in a removable inner chamber fast to the bottom, and held by three eccentric clamps. Water is introduced above and regulated by a movable indicator. The reflector has no glass, and the flame is projected horizontally an inch or more in length, according to the amount of water fed to the carbide. The lamp is very simple, is made of nickeled brass, weighs 9 ounces, and has been tested for several seasons for other purposes.



The most distinct differences between this lamp and the bicycle lamp illustrated in the 1899 issues of *Iron and Steel* and *Hardware* are the "shepherd's crook" style of hook, the swinging, oval handles, and the odd, little curled wire below the reflector – the "surveyors' hook," although the assertion that this little curved wire would aid in underground surveying seems dubious at best. Gone is the relatively bulky, square bracket at the back of the lamp. Instead, the mounting bracket for the hook and handles appears to be soldered on, like those of other superintendents'-style lamps collectors are familiar with. Otherwise, the profile and inner workings of the lamp remain unchanged.

Until Tony Moon's recent discovery of the above article, it was believed that the earliest illustration of a mine version of the Full Moon was contained in an advertisement from an August 1902 catalogue published by *Miller Supply Company* of Huntington, West Virginia. Tony sent me a copy of this illustration, as well.


414 THE MILLER SUPPLY COMPANY,

ACETYLENE MINE LAMPS.

Fig. 1011.

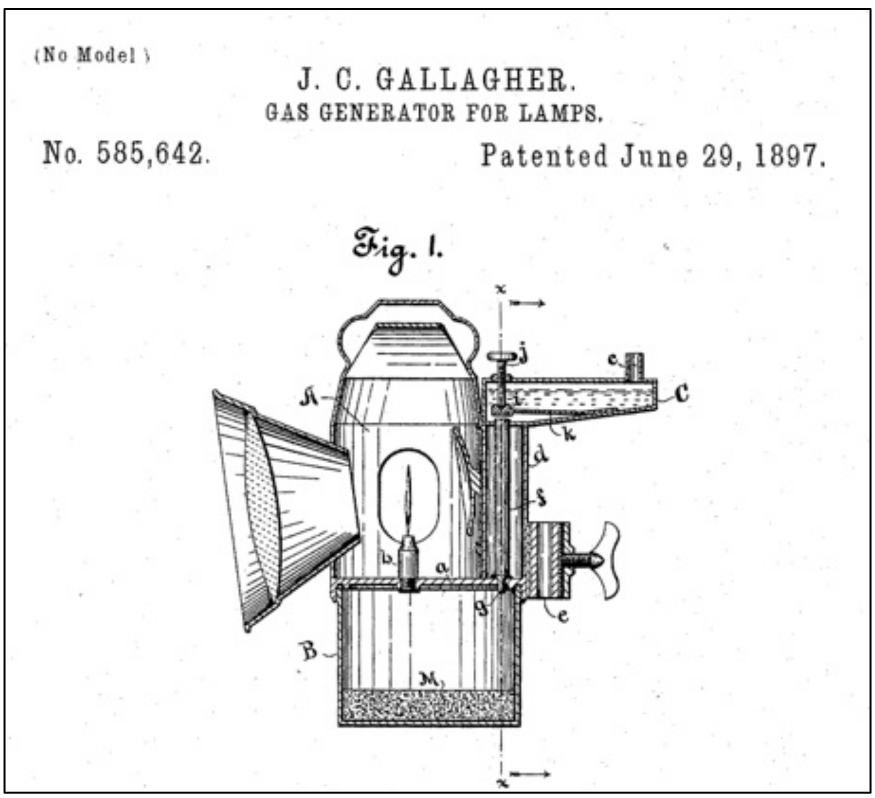
Price, each $3.50

1902 Catalog page from Miller Supply Co., Huntington, WV

This appears to be same lamp that is described in the May 1901 issue of *Iron Age*. The price, $3.50 apiece, seems somewhat high for a mining lamp of the time, especially in comparison to oil-wick lamps. For example, this same page of the *Miller Supply Company* catalogue also advertised the A.H. Funke "Indestructible" oil-wick lamp for $1.50 apiece. This, together with the relative lack of utility of a superintendent's lamp as compared to a cap lamp, may help explain the rarity of the Full Moon today.

Tony Moon has also discovered a wonderful photograph of a Full Moon in use in an underground mine. The photograph was taken underground in the Ontario Mine, Summit County, Utah, ca. 1902 (USGS Photographic Library). The miner's lamp was included for scale.

As Gregg Clemmer notes, it is difficult to determine who developed the first portable acetylene lamps. However, the development of acetylene bicycle lamps appears to have preceded the development of acetylene mining lamps. In 1897, American inventor J. C. Gallagher patented one of the first acetylene bicycle lamps (Clemmer, 15). His patent, No. 585,642, shows a lamp that bears some similarities to later mining lamps.



To summarize, in 1899, the Full Moon was marketed as a bicycle lamp. By September 1900, however, the Full Moon was also being marketed to the mining industry, as the *Engineering and Mining Journal* article shows, though it did not appear with its hook or folding handles until 1901. In less than two years, the Full Moon went from bicycle lamp to mining lamp. By June of 1901, the Full Moon was probably in use in American mines. This likely makes the mining style of the Full Moon lamp the earliest American carbide, mining lamp. This, together with its funky, but cool, design, its rarity, and the fact that Baldwin designed the lamp, makes the Full Moon highly desirable among lamp collectors today.

<u>My Quest for a Full Moon</u>

In fairness, it can't truly be said that I went on a search, much less a quest, for a Full Moon. Instead, the Full Moon that I discuss in this article came to me. In June 2014, my long-time friend, Wendell Wilson, contacted me about a lamp that he described as a "Moon Lite." Wendell and I have known each other since college, and are fellow collectors, initially of mineral specimens, then of mining artifacts. Wendell is the Illustrator of Gregg Clemmer's book, *American Miners' Carbide Lamps*, and the coauthor with Ted Bobrink and illustrator of *Collector's Guide to Antique Miners' Candlesticks*. Among mineral collectors, Wendell is best known as the long-time editor of *The Mineralogical Record*, a preeminent and beautiful monthly periodical on minerals and mineral collecting.

Wendell (right) and Me (left) at the Harquahala Mine, ca. 1968

At the time Wendell contacted me, he was trying to decide whether to purchase the lamp he asked me about. After some back and forth, I told Wendell that the lamp was probably a Full Moon, that it was a very rare lamp, and that, depending on condition was potentially valuable and expensive. At that point, I didn't know whether a Full Moon was strictly a hand lamp or was also made in a cap lamp version. I asked Wendell to send me pictures of the mystery lamp, and I began to correspond with other collectors and to do some more research. I contacted Neil Tysver, Tony Moon, and Larry Click. I also consulted David Thorpe's invaluable *Carbide Light* and Hal Post's indispensable website.

All were tremendously helpful. Kudos especially to Neil, Tony, and Larry for the time they took advising me. All three told me that Full Moons were made only as hand lamps. From Neil I learned that Full Moons come in the "mine style" with the attached handles and hook, or the "carriage style" with the handles attached by a screw clamp in the bracket on the back. The following pages illustrate the Full Moon lamps in the collections of several prominent collectors who assisted me and contributed to this article.

It is likely that, of all the Full Moons for which I was sent or collected photographs, the one in Hal Post's collection is the earliest mining version of the lamp. Hal's Full Moon most closely resembles the one pictured and described in the September 15, 1900 issue of *The Engineering and Mining Journal*.

In this photograph, you can see the square bracket on the back that originally appeared on the bicycle version of the lamp, in which oval handles have been clamped. In fact, the handles are the only apparent difference between this Full Moon and Baldwin's bicycle lamp of 1899. *The Engineering and Mining Journal* calls this lamp "The Baldwin Acetylene Lamp for Mines," and describes it as a "portable acetylene lamp adapted for use in mines." Thus, while there may be a tendency among collectors to refer to this style of lamp as a "carriage" or "bicycle" style of Full Moon, it should probably still be regarded as a mining lamp. That was clearly Baldwin and Funke's intention.

This truly is a beautiful lamp. The top stamping is unique, quirky, and gorgeous. You can't help but admire the name of the lamp, "Full Moon," possibly referring to its large, round reflector, and you have to smile at the use of the words "Open" and "Shut" rather than "on" and "off," as are used in so many later lamps to indicate the way that the water valve operates. Baldwin added a "finger pointer" to show whether the valve is opened or closed (*see* Scientific American 1900, 394).

Another significant feature of Hal's lamp is the lack of the curious, little surveyors' hook, indicating that Hal's lamp belongs to the first generation of Full Moon mining lamps. The following photo also shows the bottom of the lamp, and how it is secured to the top by the three clasps on the base of the lamp.

Hals' website also shows the correct internal parts of the lamp. From the descriptions of the lamp in Baldwin's patent application and various journals, we can deduce their function.

The muslin-wrapped water feed protector, with the disk-like base, was first placed in the base of the lamp. Baldwin's patent says the purpose of the perforated cylinder and its muslin wrapping is to better distribute the water to the carbide. The base of the lamp, with the water feed protector in place, was then filled about half full with calcium carbide. The spring-actuated disks ("a spring-pressed follower") were placed over the water feed protector, to prevent the carbide from being jolted out of its base (Scientific American 1900, 394). The entire base was then inserted into the lamp body, being careful to thread the water feed inside the perforated cylinder of the feed protector. The base was then clamped to the top using the three clasps on the base of the lamp. The water tank was then filled with water. While it is claimed that this was a simple lamp to use, the filling and reassembly of the lamp must have been a bit tricky given the fact that the base of the lamp was under spring pressure when it was inserted into the lamp body. However, this is not unlike the spring pressure that must be overcome when reassembling modern semi-automatic firearms, and was probably a good deal easier.

The lamp in Tony Moon's collection probably represents the next generation of the Full Moon mining lamps. Tony's lamp matches the lamp described and pictured in the May 23, 1901 issue of *Iron Age* and the August 1902 *Miller Supply* catalogue. The lamp has the "shepherd's crook" style of hook and handle, folding handles as well, and the surveyors' hook below the reflector. Tony tells me that the "shepherd's crook" handle is removable if it is first rotated by 180 degrees. This was necessary in order to fit the lamp into the neat wooden box that it came in.

Note the hook and handle style and the surveyors' hook below the reflector. Note, too, the height of the lamp in comparison with the lamp box when the shepherd's crook handle is in place.

The photograph on the following page shows the lamp with the shepherd's hook removed and the oval lamp handles folded against the sides of the lamp. (The shepherd's hook is in the background and is partly visible between the lamp and its box, showing how both the lamp and hook fit into the box.)

Some would argue that this generation of the Full Moon is the first true mine style of Full Moon lamp, and perhaps it is. The September 15, 1900 issue of *The Engineering and Mining Journal* says that a "handle," not handles, was added to the bicycle version of the lamp, and describes that lamp, so modified, as a mining lamp. While the singular "handle" was used in the 1900 description, it nevertheless seems likely that Baldwin and Funke added oval handles to the bicycle lamp of 1900 in an attempt to market the carriage style of lamp (with the superintendents' style handles) to miners and the mining industry. Hal Post tells me that the handles on his lamp do not fold against the side of the lamp. They are clamped in place, and so are difficult to move unless the clamp is loosened. Hal tells me that the handles on his lamp were in place when he acquired his lamp, and they certainly appear to be original to the lamp. But the 1901 elimination of the square bracket in the back, and the addition of the shepherd's style hook and folding oval handles undoubtedly made the lamp much more versatile and useful underground. It is this version that is seen in the 1902 USGS photographs of the Ontario Mine in Utah.

In December 1901, Funke attempted to market the Full Moon to hunters and campers, as well. This advertisement appeared in the Christmas editions of several periodicals. I am indebted to Tony Moon for chasing this information down.

Although there is no picture of the lamp advertised, it seems likely that it is the lamp with the hook and handles that was also marketed to the mining community.

Dave Thorpe writes in his beautifully illustrated book, *Carbide Light*, that:

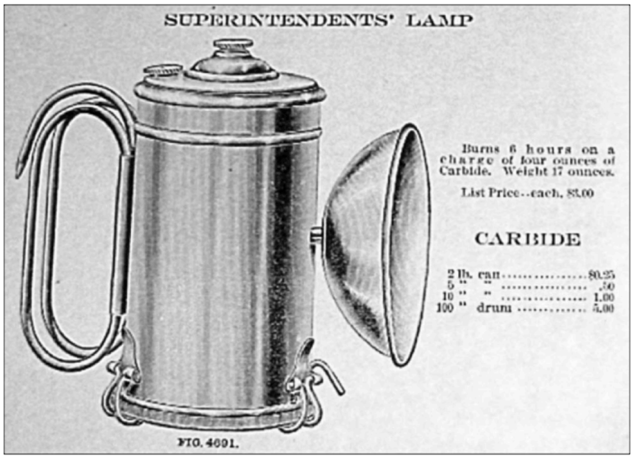
> "Baldwin's interest in bicycle lamps was short-lived, as was his relationship with Funke. An article in the October 1901 *Engineering and Mining Journal* reveals that Baldwin's lamps were now 'being offered' by the Ingersoll Sergeant Co., a manufacturer and supplier of drilling equipment. In this article, the Full Moon superintendent's lamp appears beside a new, large, stationary 'gang lamp' . . .. By the spring of 1902, Ingersoll Sergeant declared themselves the 'sole agent' for the Baldwin mine lamp." (Thorpe 2006, 20, footnotes omitted).

Sometime between mid-1902 and the fall of 1906, the Full Moon superintendent's lamp underwent further modification. The Full Moon in Neil Tysver's collection probably represents this version of the lamp, what I would call the third generation of "mine style" lamps. The next three photographs are of Neil's mine style Full Moon and a box that Neil found for it on eBay. With its more traditional looking hook, as you would find on a later Baldwin hand lamp, Neil believes that his Full Moon was made slightly later than Tony Moon's lamp, and based on the documentation that has been found, I would tend to agree.

Note that, on Neil's lamp, the superfluous surveyors' hook has been eliminated and that the shepherd's crook style of hook has been replaced with a simple wire hook.

This configuration is much like that seen on later Baldwin hand lamps, one of which is shown to the right. Although difficult to see in the above photographs, Neil's version of the Full Moon lamp also has a spade hook. The folding oval handles have been retained, but they are housed in a bracket that is soldered to the back of the lamp, like those found on Baldwin's Superintendent's Lamp.

Baldwin Superintendent's Lamp
Ca.1910
David Thorpe collection



A lamp very similar to Neil's version of the Full Moon is listed in a 1906 *Pittsburg Gage & Supply Co.* catalogue (Pittsburg Gage & Supply Co. 1906, 1340). That illustration, from Hal Post's website, is shown left.

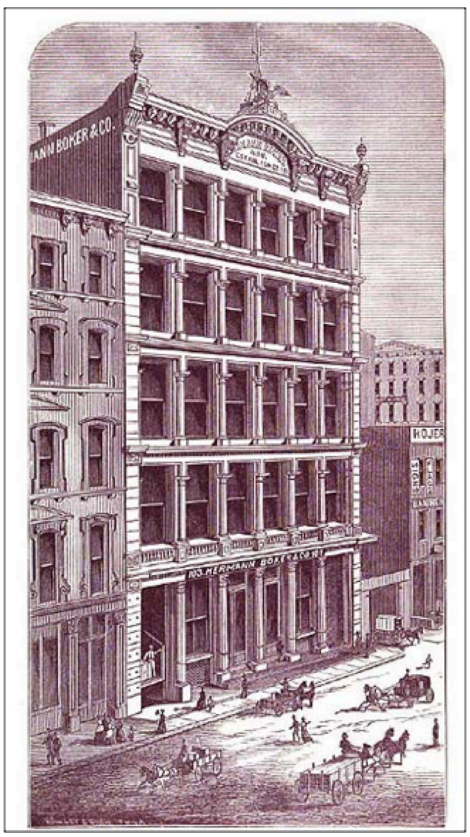
Note the folding handles and simple, curved cap hook, like other superintendents' lamps that collectors are familiar with. Like the second generation of Full Moon lamps, it appears to have the surveyors' hook. Unlike the Full Moon, this version of the Baldwin lamp has a more artfully shaped top, a circular ring just blow the top, and a more traditional style of cap hook. It is also about twice as heavy as a Full Moon; it weighs 17 ounces as opposed to nine ounces, and is a larger lamp. Hal Post's website notes that Baldwin developed this lamp after the Full Moon. Hal writes: "Baldwin teamed with Ingersoll-Sergeant Drill Co. to produce the unmarked Superintendent's Lamp, somewhat larger but nearly identical to the Full Moon, but with both handles and a hook. An ad in the 1906 *Pittsburgh Gage and Supply Co. Catalogue* shows this lamp, but the earliest manufacturing date for the lamp is unknown." This larger lamp has come to be known as the Ingersoll Baldwin. A side-by-side photograph of an Ingersoll Baldwin and a "mine style" Full Moon is shown below. I am indebted to Neil Tysver for this photograph. Neil tells me that the reflectors are the same on the two lamps, but that the Ingersoll Baldwin lacks the top stamping of the Full Moon.

The curved, wire cap hook of the Full Moon is the same as the Ingersoll Baldwin, suggesting that this Full Moon is a later version of the mine style lamp that sported the "shepherd's crook" hook.

It is interesting, too, that the Full Moon lamp pictured above also has a spade hook as well as a wire hook, and that the wire hook can be turned to the side so that the spade hook may be used instead, thus potentially giving the lamp more versatility and marketability. Entrepreneurs of the late 19th and early 20th Centuries behaved much like those of today.

Other versions of the lamp (and they exist) are more difficult to date. For example, the Full Moons pictured on Larry Click's website lack wire hooks, folding handles, and the surveyors' hook, but are said to have spade hooks. Larry believes these lamps to be carriage style lamps, but their exact genealogy is anybody's guess. Using the advertisements and articles that collectors have discovered over the years, it is possible to piece together a tentative chronology for the Full Moon.

Lamp Style	Date	Key Features	Marketing Agent
Bicycle / Carriage	1899	Square Bracket, No Handles	Hermann Boker & Co.
Mine – First Gen.	1900	Square Bracket, Oval Handles	A.H. Funke
Mine – Second Gen.	1901-1902 (?)	"Shepherd's Crook," Oval Handles, Surveyors' Hook	Funke / Ingersoll
Mine – Third Gen.	1902-1905 (?)	Wire Hook, Oval Handles, No Surveyors' Hook	Ingersoll



Hermann Boker & Co, 101 & 103 Duane St., NYC

My assignment of what I refer to as "Marketing Agents" to each generation of Full Moon lamp is somewhat arbitrary. I have been faithful to the information given in the various advertisements and articles referred to herein. However, it may be misleading to refer to Hermann Boker & Co. and A. H. Funke as separate entities. An early guide to New York City links the two. This reference describes Hermann Boker & Co. as "wholesale dealers in cutlery, hardware, guns and metals" (King 1893, 902). It goes on to say that Hermann Boker, a lineal descendant of an old family of Prussian merchants, founded the business in 1837. In 1872, a new building was constructed to house the firm, and the business was relocated to a "large iron-front business building, 101 and 103 Duane Street, extending through to 10 and 12 Thomas Street, just west of Broadway." In 1893, the partners in the firm consisted of Ferdinand A. Boker and Carl F. Boker, both sons of Hermann Boker, and Albert H. Funke, the son of Hermann Funke, and brother of Hermann Funke, Jr., two former partners, who died in 1890. Carl F. Boker and Albert H. Funke entered the firm in 1891, "the former adding his business in steel and metals, which he then conducted in John Street under his own name" (King). The Bokers and the Funkes appear to have been partners in the firm from early on; however, their partnership ended on December 30, 1899, when the partnership "expired by limitation."

Carl F. Boker continued the business of the firm in steel, metals, cutlery, and hardware. A. H. Funke continued the business of the Gun Department and "Bicycle Sundries" under his own name at the same address (Hardware 1900, 19). Funke apparently became the sole marketing agent for the Full Moon at that point, although there was a period of time between 1901 and 1902 during which Funke and Ingersoll-Sergeant probably both marketed the lamp. The point at which

Funke ceased to offer aldwin's Full Moon mine lamp and whether and when Ingersoll-Sergeant may have become the exclusive marketing agent for Baldwin's mine lamps is unclear.

As noted above, an October 1901 article in the *Engineering and Mining Journal* reported that Ingersoll-Sergeant had begun to sell Baldwin's mine lamps. The article carries a photo of both the Full Moon and Baldwin's newly developed gang lamp. The article describes the gang lamp as coming in two sizes, a larger No. 8 lamp and a smaller No. 7 lamp. Dave Thorpe notes that by the spring of 1902, Ingersoll-Sergeant had declared itself the "sole agent" for Baldwin's mine lamp (Thorpe 2006, 20).

Portable Acetylene Lamps

A similar article in the November 1901 issue of *American Machinist* contained this illustration and reported as follows:

"The half-tone shows two sizes of Baldwin acetylene lamp, the smaller being known as the 'Superintendent's lamp and the larger as the 'Gang' lamp. The relative sizes are the indicated by the 2-foot rule which stands between them. The small lamp has swinging handles for carrying in the hand, and both lamps have a hook for suspending the lamp where desired. The hook turns to come over the center of the lamp and then becomes a convenient handle for carrying. The small lamp weighs 9 ounces and burns with full brilliancy for four hours at a cost of two cents. The lamps here shown are designed for mines, tunnels and other underground work, ... The sole agents for the lamps are the Ingersoll-Sergeant Drill Company . . .." (American Machinist 1901, 1256.)

A 1902 New York City business directory lists Funke at the 101 Duane Street address under "Acetylene Gas Lamps" (Trow 1902, 4), but by 1903, Funke has relocated to 325 Broadway, where he is listed under both "Acetylene Gas Lamps" and "Gun & Pistol Importers" (Trow 1903, 6, 648). A January 1903 "Trade Notice" in *Mines and Minerals* indicates that Funke continued to sell Baldwin's mine lamps from his new address. This Trade Notice reported as follows:

> Acetylene, next to the sun, has the greatest actinic power, that is it gives the whitest and most powerful light, other things being equal, of any artificial forms of light. A. H. Funk (sic), 325 Broadway, New York, has taken advantage of this property of acetylene, and uses this form of light in his Baldwin mine lamps, which he states have now been shipped all over the world; 100 No. 8 lamps, he advises, have just been shipped to one party in South Africa, where these lamps seem to be doing good work. (Mines and Minerals 1903, 267.)

The No. 8 lamp referred to in the 1903 notice must be the large Baldwin gang lamp. A similar notice, published in the June 21, 1901, issue of *The Engineering and Mining Journal* reports:

> Ira A. Shaler, contractor for the 34th Street section of the New York subway, has ordered from A. H. Funke, of New York, 15 No. 8 Baldwin acetylene mine lamps having found them efficient and economical, a 50-candle-power lamp costing but 7c. for each 12 hours of lighting. Mr. Funke has also received an order from the E. G. Spillsbury Engineering Company for a number of the hand acetylene mine lamps for the men in some of the mines in which that company is interested. (The Engineering and Mining Journal 1901, 790).

This June 1901 notice distinguishes between the No. 8 lamp, a lamp of greater capacity, and a Baldwin hand lamp, which is almost certainly the Full Moon, most likely the version pictured in the May 1901 issue of *Iron Age*, the lamp with the shepherd's crook hook and folding handles, what I've called the second generation Full Moon.

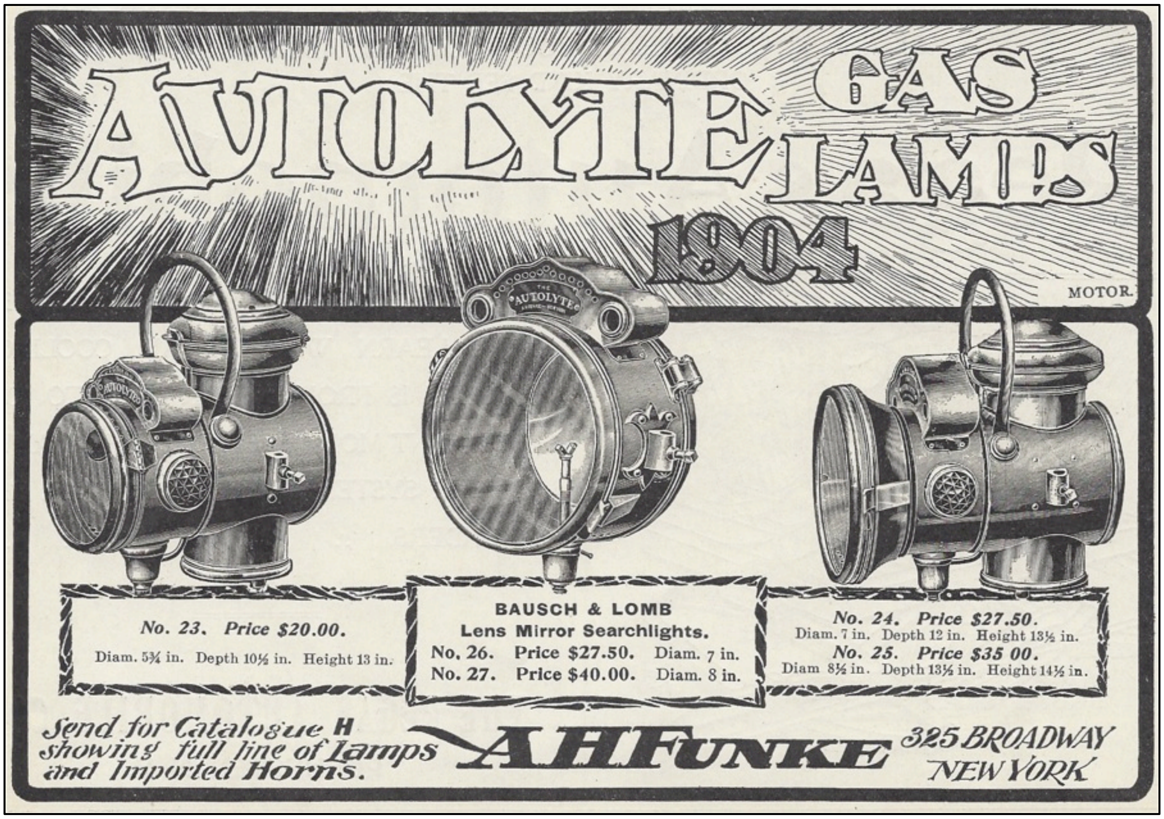
My conclusion that the No. 8 lamp referred to in the January 1903 issue of *Mines and Minerals* and the June 1901 issue of *The Engineering and Mining Journal* is the Baldwin gang lamp also seems to be borne out by a later article in a March 1902 issue of *The Engineering and Mining Journal*. There, a half page article reports on the use of Baldwin acetylene lamps in the construction of the New York subway. The article includes a photograph that shows four workmen working by the light of what appears to be one Baldwin gang lamp. The article reports that the contractor, Ira A. Shaler, "uses the new light with much satisfaction." (The Engineering and Mining Journal 1902, 420.)

In contrast to the notices and advertisements for the Baldwin gang lamp, the following July 1901 notice can only refer to the Full Moon hand lamp:

> The Baldwin acetylene mine lamp is described in a little pamphlet sent out by A.H. Funke of New York City. The lamp is stated to weigh but 9 oz., to give no smoke or smell and to throw such a strong light that examinations can be made at a distance of 50 ft. The lamp, it is claimed, will burn 4 hours on one charge at a cost of 2c. per charge, and can be recharged in 2 minutes. (The Engineering and Mining Journal 1901, 75.)

Where does all of this leave us? I believe that it largely confirms the table shown above, which sets forth a tentative chronology of and marketing agents for the Full Moon. Hermann Boker & Co. began marketing the bicycle version of the lamp in 1899. Funke began marketing the first generation of Full Moon mining lamp in about September 1900, and the second generation of Full Moon mining lamp by May 1901. This lamp was probably in use in the mines by June 1901. Funke probably continued to market the Full Moon lamp in its second-generation configuration at least through December 1901. In October 1901, Ingersoll-Sergeant also became a marketing agent for Baldwin's mine lamps, but I think that this new research shows that Ingersoll-Sergeant was not the exclusive agent for Baldwin's lamps, despite Ingersoll-Sergeant's claims to the contrary. Funke appears to have been marketing Baldwin's gang lamp for use in the mines and elsewhere as late as January 1903. I do believe, however, that Ingersoll-Sergeant likely became the exclusive agent for the sale of Baldwin's hand lamps beginning in 1902.

By 1904, Funke was probably out of the business of marketing lamps for use in the mines and was devoting his attention exclusively to marketing acetylene lamps for automobiles. A February 1904 issue of *Motor Age* contains this beautiful, half-page ad by Funke (Motor Age 1904).



Dave Thorpe summarizes much of this history in his newest book, *Beneath the Surface.* Dave writes:

> Baldwin's Full Moon was featured in an article in the June 1901 issue of *Scientific American.* Within months, Baldwin realized his lamp was better suited to less windy conditions of a mine and began advertising to the mining industry. By 1901 he had cultivated a relationship with the mine-equipment manufacturer Ingersoll-Sergeant Drill Company which sold Baldwin's Full Moon acetylene lamp equipped with [folding] handles and a hanging hook for mine use. (Thorpe 2010, 6, footnote omitted).

Why Baldwin and Funke parted ways and Baldwin formed a new relationship with Ingersoll-Sergeant for the marketing of his mining lamps is nowhere explained, but it probably had everything to do with the changing business interests of the two men. Again, Dave Thorpe notes:

> [From the point at which Baldwin formed a relationship with Ingersoll-Sergeant], Baldwin pursued only the mining industry, while Funke's interests moved in the direction of motor sports. Based on Baldwin's design, Funke marketed an open-faced motor lamp called the

Auto-Lyte. The name was first trademarked by Baldwin in 1903, but was later acquired by Funke . . .. (Thorpe 2010, 6).

The period between 1902 and 1906 is largely a mystery so far as the Full Moon is concerned. But by 1905, the Full Moon was probably out of production, although it may have continued to be sold from existing stocks held by wholesalers and retailers. Dave Thorpe writes that, as early as December 1905, Baldwin had developed a new water feed and a cap lamp for working miners that was put on the market early in 1906 (Thorpe, 21). A 1906 article in *The Engineering and Mining Journal* makes reference to this lamp and a "full-shift lamp." The article also refers to a superintendent's lamp, which is not pictured, but I suspect the article is referring to the Ingersoll-Baldwin shown in the 1906 *Pittsburg Gage & Supply Co.* catalogue. Here is an extended excerpt from the article that appeared in Volume 82 of *The Engineering and Mining Journal* (Parsons 1906, 111). The entire article is well worth reading when you have the opportunity.

"The accompanying illustrations were furnished by F. E. Baldwin, ...

"Fig. 1 shows a lamp designed for use on a miner's cap; it weighs 4 oz., when charged, is 4 in. high, and burns 4 hours on a charge of 1 ¾ oz. of carbide. Fig. 2 illustrates a full-shift lamp weighing 18 oz. when charged, burning 12 hours on 6 oz. of carbide, and having a height of 6 in. Fig. 3 shows a section through the full-shift lamp. Besides the lamps shown here, there is a slightly larger one called a superintendent's lamp, and a safety lamp which Baldwin has not yet attempted to introduce."

Fig. 1

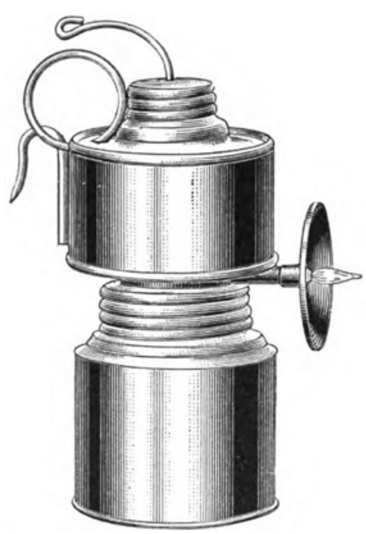


Fig. 2

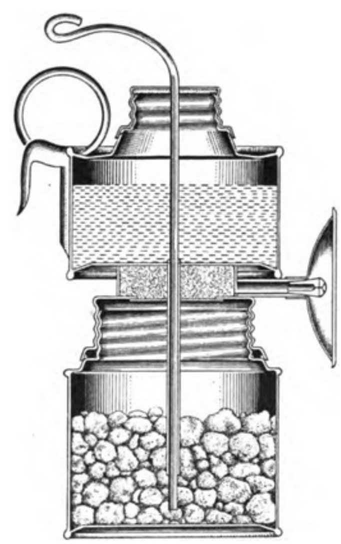


Fig. 3

By the time I had corresponded with the other collectors, gotten pictures from them, and examined their websites, Wendell Wilson had sent me photos of the lamp that was being offered to him, told me he wasn't interested in the lamp, and asked me if I was. Here is the first set of photos that was sent to me of the mystery lamp:

I forwarded these to Neil, Tony, and Larry and asked for their opinion. Neil said: "The hook on this lamp appears to be two smaller wires. Without having [the lamp] in my hand, I have no way of knowing if this is yet another style of hook or just a bad attempt at making a replacement for a missing hook. The other consideration is that you need to see if the internal parts are present when the bottom is removed." Tony said: “The lamp you are considering has good news and bad news. The good news is that the reflector looks correct (it screws on and off – carefully!). The bad news is that the hook looks to be a replacement.” Larry gave me some additional information about the Full Moon, and told me he might be interested in the lamp if I decided to turn it down. Neil and Tony also recommended that I get pictures of the internal parts of the lamp and of the handles folded against the sides of the lamp. All three told me not to worry much about the out-of-round reflector or the small dings in the top. I consulted Hal Post’s website to find a picture of the correct internal parts, and found the photograph shown at the bottom of page 12, above.

I then asked the seller to send me some additional photos of the lamp that showed the things that Neil and Tony had told me about. The seller sent these to me:

The lamp that was offered to me appears to be a second generation Full Moon mining lamp. It has the folding oval handles, and the surveyors’ hook below the reflector. The handles correctly fold against the side. However, it lacks the shepherd’s crook style of hook and the internal parts are incomplete (the disk-like plates above and below the coil spring are missing). Because of the condition problems, especially the questionable hook and incomplete internal parts, I turned the lamp down. Larry also passed on the lamp. As of the date of the writing of this article, I do not know whether the lamp is still available for sale. However, if are interested in the lamp, you may contact me and I will give you the seller’s contact information.

The search for all of this information was intensely enjoyable. Thanks so much to everyone who helped me along the way. As of today, I still haven’t found my Full Moon, but having now studied the lamp with some care and seen the pictures of the beautiful Full Moons in the collections of others, my quest will begin in earnest.

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Other collectors, listed in the Preface, kindly made me aware of many of these references. I am indebted to them. References to materials found on Google Books include a bracketed reference that shows the relevant page number of the PDF document that may be downloaded from the Google Books website. To use Google Books, you must first register with a user name and password, but it is well worth it. Once you have found the document you are looking for, you may save it to your on-line Library and download a complete PDF version to your personal computer. I suggest that you do both. You may edit pictures in the PDF document in Adobe Photoshop (copy the PDF page or picture you're interested in and paste it into a new document in Photoshop). The Smithsonian Institution Libraries also maintain a wonderful website where many documents and illustrations in the public domain may be downloaded and used, with appropriate reference and attribution to the Smithsonian Libraries that includes the URL of the on-line document referred to. One of those references, *The Wheel and Cycling Trade Review*, is noted below.

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Personal Communications

In addition to the above, I benefited from and relied upon numerous personal communications with Neil Tysver, Hal Post, Tony Moon, Paul Kouts, and Larry Click during the course of researching the Full Moon and writing this article. Without their help, and the help of Dave Thorpe and his wonderful books, writing this article would not have been possible for me.

Franz Pieler's Spirit Lamp

by David Gresko

The second half of the 19th century brought significant changes in the coal mining industry. This period was the start of the Industrial Revolution, and the world was hungry for energy and coal was the main source. Coal mines expanded their production by deepening and opening up additional sections. Unfortunately, expanded production brought disastrous explosions on both the Continent and British Isles caused by firedamp. The occurrence of firedamp, or methane, increased as productivity grew.

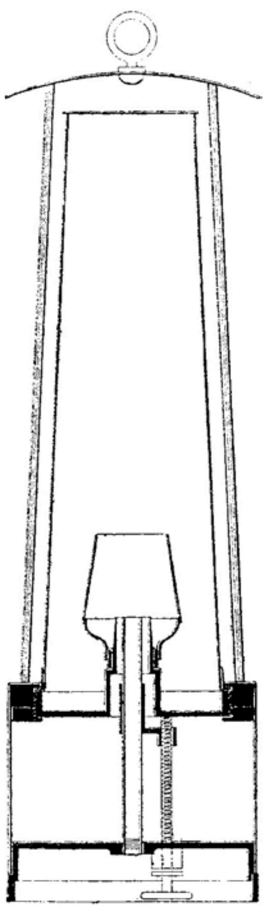

Figure 1:Pieler's Spirit Lamp-Original design from Pieler's 1883 paper. Note the air intake from the bottom through the center of the wick tube.

The fiery atmospheres caused by increased production requirements drove the technology and art of mine ventilation engineering. Large fans, such as the Struve, were installed to drive huge volumes of air through the workings to dilute methane and coal dust below explosion limits. Velocity and total volume increased substantially in underground workings.

Franz Pieler, a Bergmeister (Mine Manager) in Westphalia, was a practical mining man who had experience in day to day production challenges in the Bergbau (Mining Industry). He realized that the same technology that provided increases in air volume to dilute firedamp also masked great dangers. Detection and measuring devices of that time were not accurate below 2.5% methane, and were not useful in well-ventilated workings. It was a classic case of a technology that was developed to solve one problem, creating another. In 1883, Pieler wrote a paper[1] addressing ventilation problems in this new era of coal mining, and discussed practical ways of measuring methane and carbon dioxide in underground coal mines. Pieler indicated that while a typical Davy lamp might indicate a "gas free" atmosphere, great dangers could exist under certain circumstances. Pieler wrote:

"The occurrence of explosive atmospheres in underground workings is mostly observed with the safety lamp, which has been proven to only be accurate down to 2.5 methane to 100 gas mixtures. However, in most cases, the return air in gassy mines can not be observed for changes in methane, which occur in small proportions due to dilution by ventilation. In addition, in the individual sections of a pit that are explosive-free by dilution by ventilation, are not by any means safe. If in such a section, that regularly receives through ventilation 100 cubic meter of fresh air per minute while 2 cubic meters of methane developments, the mixture of 2:100 is not detectable, but it is detectable in less ventilated parts. If a local disturbance decreases the ventilation to 20 cubic meters, then the atmosphere in the section for a short period becomes 2/20=10% of firedamp, thus a explosive atmosphere has already formed and the danger be all the more greater as the entry was thought to be firedamp free."

1 ÜBER EINFACHE METHODEN zur UNTERSUCHUNG DER GRUBENWETTER (Easy Methods for Examining the Air in Underground Mines) , Fr. Pieler, Aachen, 1883. Pieler describes, practical ways of measuring methane and carbon dioxide. He describes and illustrates an air sampler, carbon dioxide detector, a hydrogen burner and spirit lamp for measuring firedamp.

The “local disturbance” that Pieler mentions is disruptions in the ventilation system encountered everyday in an underground mining. These disruptions can be caused by shot firing, opening a ventilation door, fan failure due to power outage, pillar failure, or simply a train passing through a fresh air entry and blocking air flow.

Pieler advocated in his paper that mine managers not only have to know the percent fire-damp in each section of the mine, but the actual volume of methane released. In addition, the industry was beginning to realize that low percentages of methane mixed with coal dust can cause violent explosions. Pieler wrote:

“For production management, it is in the interest of safety to be able to observe the immediate dangers of firedamp in diluted air where it is not indicated in a safety lamp”.

To accomplish this, many samples, over many days, must be taken in all of the return-air entries and sections and analyzed for methane and carbon dioxide. This was problematic, because up to then only well-equipped labs with experienced chemists were able to accurately measure low concentrations of methane in air samples. It wasn’t practical to collect dozens of air samples in containers from underground workings, take them to the surface and send them out to a lab for testing. Portable and accurate testing devices were needed.

Figure 2: (above and right): This is Pieler’s original design, but with scales added. The gauze is steel with a copper cap similar to a Saarbrücken lamp. The font is complex because of having to facilitate the hallow tube that runs from the bottom of the lamp through the center of the burner. Circa 1887.

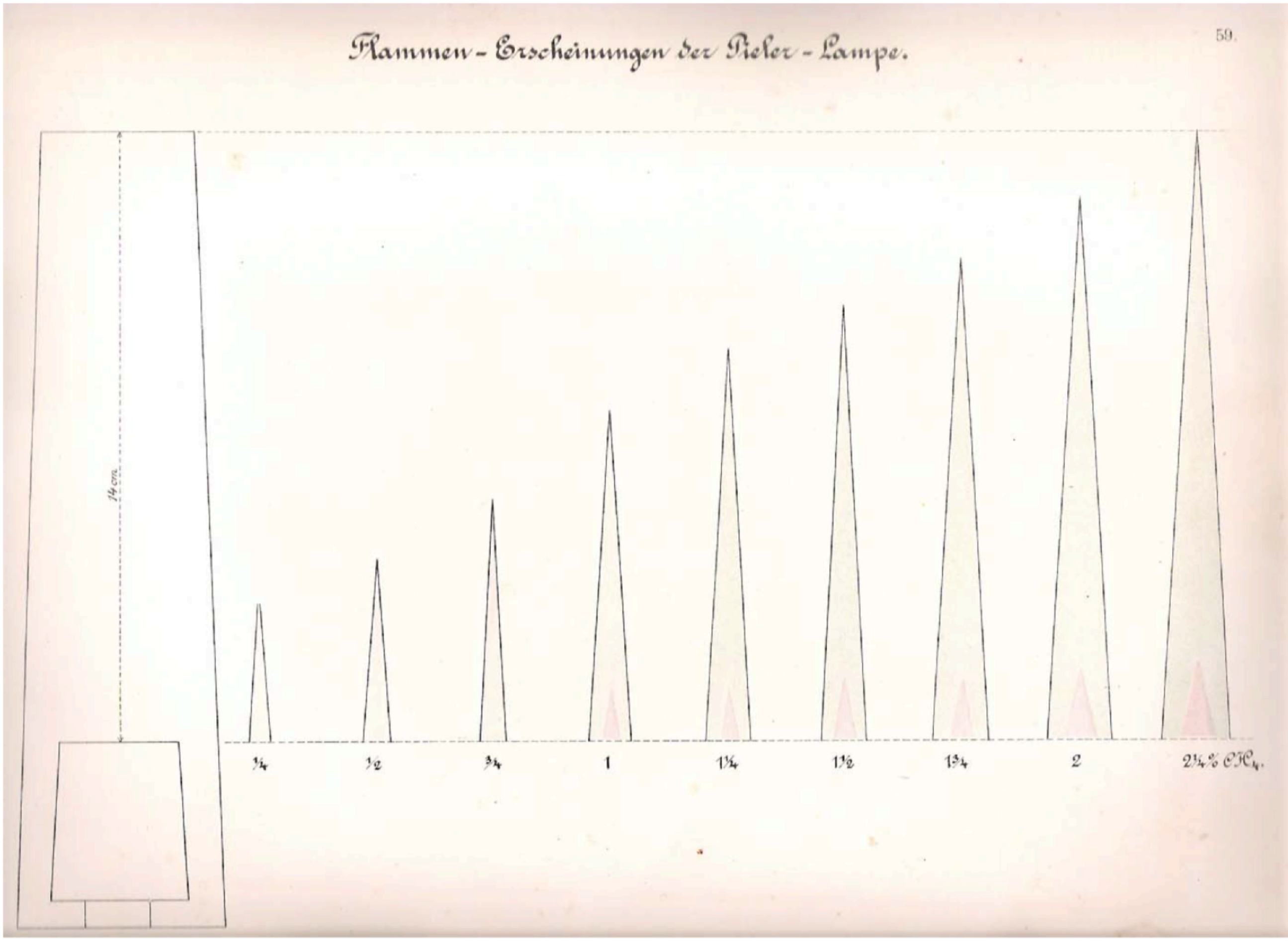

Figure 3: Flame observations using the Pieler lamp. Notice how the height of the flame exaggerates with small changes in methane. From the Prussian Firedamp Commission's 1886 report.

Pieler evaluated apparatuses available at the time for accuracy and portability. He determined Coquillon's apparatus, which was based on the contraction of volume caused by the combustion of methane in an air sample, was not practical because it was complicated to use and could not be used underground at all [2] Liveing's apparatus was based on the well known comparative measurement of the light of two glowing platinum wires, of which one is exposed to the gas mixture being examined, while the other one is surrounded by pure air. No special skill was needed to operate the apparatus, and it could be used underground. Unfortunately, since the platinum wires deteriorated quickly and required frequent replacement, regular use of the apparatus was difficult because the manufacturer was in England.[3]

Figure 4: Early Friemann & Wolf Pieler. Serial #46710; circa 1888. No fixed scale. Notice that the lamp has a pointing device that slides up and down one of the standards for marking the height for the flame. No igniter or flame snuffer.

[2] Over many years, many fire-damp indicators were invented that were based on the contraction in volume or the change of pressure caused by the combustion of the methane contained in an air sample. The indicators of Lewis & Maurice, Monnier, Coquillion, Le Chậteliar, and Burrell were all of this class. Although numerous, this class of indicator did nothing to displace flame indicators.

[3] Liveing's indicator actually saw many years of use. While it did not displace flame indicators, it was used as a comparison to other indicators.

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Because of the widespread use of the Davy lamp, Pieler recognized that it would be more accepted to use a gas measuring device that uses the physical appearance of a flame within a mixture of atmospheric air and firedamp. There had been prior attempts to make the flame safety lamp more sensitive to smaller quantities of methane, but there was not that great of success with oil-burning Davy or Marsaut type lamps.[4]

[4] Before the Pieler lamp was introduced there were numerous well-known studies, both in England and on the Continent, on the effect of small percentages of methane on the flames of the Davy, Marsaut, and Mueseler oil- burning lamps. Although small amounts (<2.5%) of firedamp could be detected, actual measuring was quite difficult due to the minute changes in the appearance of the flame.

Figure 5: Friemann & Wolf Pieler. Serial No. 80643; circa 1890. This lamp shows how F&W customized lamps for particular needs. This lamp has a removable bonnet, two (2) types of observation scales, a flame snuffer and magnetic lock. From the 1880's to 1900, F&W produced Pieler lamps with many variations. After 1900, the basic F&W models were the No. 700, No. 701, and No. 702.

Figure 6: Friemann & Wolf Pieler. Serial No. 201711; circa 1895. Classic Pieler lamp with 2 scales. Fitted with removable bonnet to be used for traveling in mine with the lamp lit. Bonnet has no slot for flame observation, so bonnet must be removed prior to testing. No igniter or flame snuffer. This lamp was exported to America, and has a brass tag on the font that says "Made in Germany."

Mallard and Le Chatellier, while working for the French Mine Ventilation Commission, observed how a hydrogen flame was far more sensitive to firedamp than an oil flame and gave good readings. They tried to manufacture a portable lamp with a hydrogen flame for testing underground, but failed because of construction difficulties.[5] Mallard and Le Chatellier totally gave up on using hydrogen for measuring methane in mine atmospheres. While not practical for tests underground, Pieler realized that constructing a stationary hydrogen burning apparatus, to be used on the surface, offered only a few minor difficulties. A hydrogen flame was easy to read and, with some practice, approximate determinations of the methane content of air sample could be made without a skilled technician. While not portable and could not be used underground, the instrument could be used to measure air samples taken in such locations as main air entries. Pieler describes the construction of a stationary hydrogen burner for testing in his paper.[6]

Mallard and Le Chatellier also tested the effects on the alcohol flame in firedamp atmospheres. It was observed that the alcohol flame was the most sensitive to very small amounts of methane. Since the alcohol flame exaggerates with minute changes of methane in the atmosphere, the height of the flame could be easily measured visually and correlated to a % concentration. Realizing this, Pieler designed a "Spirit Lamp" for underground fire-damp measuring, and introduced it in his 1883 paper (see Figure 1).

5 In 1892, James Ashworth and Prof. Frank Clowes would patent an Ashworth-Hepplewhite-Gray type lamp with an attachment for a hydrogen gas cylinder for measuring small quantities of methane. This was the first practical and portable hydrogen gas testing device that could be used underground. It became commonly known as "Clowes' Hydrogen Lamp". While popular in England, it never gained popularity on the Continent.

6 Pieler also illustrates and describes devices for collecting air samples in his 1883 paper.

Figure 7: J. Mills & Sons Newcastle bonneted and unbonneted Pieler lamps. Pieler lamps were not popular in England as Ashworths and Clowes Hydrogen lamps were preferred. Notice the bonneted lamp has no scale, and has a painted black standard on the viewing glass. The author doubts if another English make exists.

The "Spirit Lamp", which would eventually be known as the "Pieler Lamp", was for all purposes a large Davy-type lamp with some special design features to accommodate burning absolute alcohol. First, the font was made larger than an oil lamp to accommodate the amount of alcohol needed for operation, and was filled with cotton to stabilize the alcohol (minimize evaporation). Also, the wire gauze is taller than a typical Davy lamp to permit the full development of the flame cap. It was also necessary to design the lamp to avoid the effects of spirit vapors. Hence, the wick is contained in a long neck and all fasteners are well sealed. Air is admitted through a tube containing discs of gauze at the bottom of the lamp. This hallowed tube runs through the center of an Argand burner, which is adjustable by a sleeve moved by a screw in the base. The burner is fitted with a 30mm tall conical sheet-iron shield, "chimney", which hides the flame in normal atmospheres. Pieler went on to write: "The testing of the mine air with the spirit lamp is exactly like the usual Davy lamp. The flame is standardized in pure air, and the height is adjusted to the top edge of the chimney. The cap that appears in air mixed with small quantities of firedamp behaves as follows:

- With 1⁄4 % of firedamp the flame is weakly illuminated; from bluish gray color to faded and approximately 30mm long.
- With 1⁄2% it is 50-60mms long, its lower end is clear while the top is still faded.
- With 3⁄4%, the blue color is more clearly defined; the limitation is sharper and the length of the cone is approximately 75mms.
- With 1% the cone is 90mms long; the limit is sharp and has an intense blue color. On higher amounts, the length of the cone further increases in length, and with 1 1⁄4% 100mms long, with 1 1⁄2% 120mms, and reaches the upper end of the wire gauze with 1 3⁄4%. The illuminating power grows accordingly, and the color becomes deep blue. With 2%, the cap widens at the top, and with higher percentages it continues to expand until the gauze is filled. In this concentration, the cap would

Figure 8: French Cosset-Dubrelle Pieler. Notice scale measures length in centimeters, with no % methane indication.

also be obvious in the Davy type oil lamp if one pulls down the flame until the luminous part disappears. The observations in this lamp are known." [7]

Pieler's Spirit Lamp received quite a bit of attention on the Continent when it was introduced in Westphalia in 1883. In the Prussian Firedamp Commission's 1886 report, the Pieler lamp is mentioned extensively and several tests and comparisons to other flame safety lamps were performed. But, at the same time the Royal Commission on Accidents in Mine[8] final 1886 report quickly points to the lamp's shortcomings:

"The Pieler lamp is obviously a most sensitive gas detector, but in its present form it is quite inadmissible for use in well ventilated mines for the following reasons: the flame is easily extinguished by a very moderate current, and if the lamp happens to come into an explosive mixture of gas and air, an explosion is almost certain to be caused in a few seconds. The lamp could be rendered less dangerous for general use by enclosing it in a case, and, as far as we have been able to observe, its power of indicating the presence of gas would be but little if at all changed." [9]

Figure 9: Unmarked Belgium Pieler. Probably a Gilly. No scale or bonnet.

The Pieler lamp proved to have the following disadvantages:

- Since the lamp would fill with flame at 2.5% methane (for unbonneted lamps), there was a high risk of passing the flame through the gauze in explosive atmospheres with obvious results. It was necessary to test the atmosphere with a regular Davy prior to making a test with the Pieler lamp.

- The oil vessel heated up rapidly and caused excessive alcohol evaporation. Excessive alcohol vapor within the lamp caused false readings. Usually 20 to 30 minutes were required between tests for the lamp to cool down and the vapor dissipated.

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[7] See Figure 3 for flame observations from the Prussian Firedamp Commission (1886) of the Pieler lamp under changes in methane.

[8] The Royal Commission on Accidents in Mines 1886 Final Report contains an amazing amount of information about safety lamps and gas indicators. The Commission tested over 250 different safety lamps, and compiled all the tests results in the final report. The author has actually examined the two Pieler lamps that were tested. They were identical to that shown in Fig. 2, but without scales.

[9] In examining various varieties of Pieler lamps, it is obvious that enclosing it had an effect on the sensitivity. This is obvious by the differences in calibration of the fixed scales of an unbonneted vs. bonneted Pieler lamp.

• The flame from the Pieler lamp was mostly non-luminous and did not provide light for traveling underground. Therefore, it was necessary to carry another safety lamp for lighting.[10]

Figure 10: Belgain Mulkay Pieler. Invented in Lens, France, this particular lamp has the most sophisticated safety features of any Pieler lamp the author has seen. These features include a locking mechanism for the bonnet, double gauze arrangement, and a device to insure the gauzes have been inserted when assembling the lamp. It also has air regulators on the top and bottom of the bonnet. The scale is made of enamel.

There were many manufacturers of the Pieler lamp on the Continent, where the lamp was most accepted. Manufacturers included Friemann & Wolf (Germany), Wilhelm Seippel (Germany), Cosset-Dubrelle (France),.Mulkay (Belguim), Joris (Belguim), and A. Benitschke's Sohn, Joseph Jermar , Kubala (all of Ostrau, which is now part of the Czech Republic). In England, only John Mills & Sons Newcastle made a Pieler lamp, reflecting the lack of acceptance. There were no manufactures in the United States.

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10 There were unsuccessful attempts to construct a combination oil and alcohol Pieler lamp. The theory being the oil flame would be used for lighting and measuring firedamp over 2.5%, and then the flame could be switched over to an alcohol burner for measuring firedamp under 2.5%. The closest that came to this was the Stokes lamp, which was fitted with a small alcohol burner and vessel for taking delicate readings.

Of all the manufactures, Friemann & Wolf was by far the most prolific. Friemann & Wolf probably started making Pieler lamps around 1883, when the Pieler lamp was introduced.[11] Surviving examples circa 1880's to 1900 indicate that many Pieler lamps were special order to the customer's specifications due to the large number of variations. It would not be until 1900 that Friemann & Wolf came out with the No. 700, No. 701, and No.702 that were dominant models.

Figure 11: All brass Pieler made by Joesef Jermar, Ostrau. Sliding bonnet with scale that measures up to 2 1⁄4% methane. Magnetic lock marked "Broucek Patent". Wick "snuffer."

While there were many modifications to the Pieler lamp during its 40+ years of service, the core design remained intact except for one feature. The air intake from the bottom of the lamp through a hallow tube running through the center of the wick did not survive. This was complicated to manufacture, and most likely very little air was drawn through it in comparison to the air entering the lamp through the gauze[12] Modifications/improvements to the lamp can be classified in two (2) groups: 1) Functional improvements were to enhance testing and general operation, and 2) Safety improvements were to enhance the safe use of the lamp.

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11 The first mass manufacture of the Pieler lamp is a mystery to the author. These lamps have Pieler's original bottom feed design that obviously made manufacturing difficult and expensive. The copper cap on the gauze suggests a manufacturer of "Saarbrücken" type lamps. But lamp has none of the manufacturing characteristics of Friemann & Wolf. The author has examined the Pieler that was tested by the Royal Commission in their 1886 report. It is exactly the same lamp as illustrated in Figure 2, but without scales.

12 It appears that only the first manufacture and production model of the Pieler lamp had the bottom air intake. The author has never seen another example of this feature from another manufacture.

Functional improvements include the addition of a fixed graduated scale (to facilitate ease in visually measuring the height of the flame), internal igniters for relighting the lamp, and air dampers for regulating air sampling. Early references that the author has seen do not mention any type of fixed scale on the lamp for measuring flame caps, and there is no mention how the flame was supposed to be measured. The earliest example of a Pieler lamp with a scale that the author has examined, where the lamp's vintage could be verified, is 1888.[13] Scales became more numerous in the 1890's. Some scales just measured flame height (usually in centimeters), while some would indicate a % methane content, and some would show both the length graduations and % methane graduations. It appears that by 1900 all Pieler lamps were manufactured with some type of fixed scale. Internal igniters were introduced to Pieler lamps by Friemann & Wolf around 1900. To the author's knowledge, Friemann & Wolf was the only manufacture to provide internal igniters in Pieler lamps. Air dampers were added only to a few Pieler lamps. The previously illustrated Mulkay was built with both upper and lower adjustable air rings.

Safety improvements to the Pieler lamp were driven by local regulations or requirements These improvements included locks, bonnets and shields, and flame extinguishers. From the first introduction of the Pieler lamp, it was realized that there was a potential for the flame to blow through the gauze in well ventilated mines. Early examples indicate that simple shields, which surrounded half the circumference of the gauze, were probably first used to prevent this from occurring.[14] Bonnets appeared to have been introduced in the 1890's.

Figure 12: Benitschke's Sohn was a well-know manufacturer of mining lamps in what was Bohemia (Czech Republic region). This particular Pieler lamp is fitted with a removable bonnet that has a sliding window for observation.

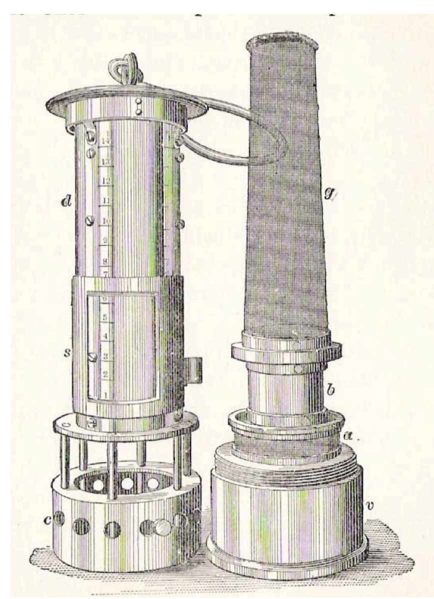

Figure 13: The Chesneau Lamp (right) was a hybrid Pieler lamp.

13 The lamp was a Friemann & Wolf. Serial numbers on these lamps give an approximate date of manufacture. The scale on this example was a simple brass square bar, soldered vertically to one of the standards, that was etched in 1 cm graduations. There were no numbers on the scale. The lamp was very similar to the 1888 F&W lamp pictured previously.

14 The author has examined two (2) Friemann & Wolf lamps of 1888 vintage that have shields.

Figure 14: Friemann & Wolf No. 700, 701, &702. These are the three "classic" and most advanced models from F&W. All have igniters and flame "snuffers."

Usually, the bonnet would have a slot for flame for observation that was covered with glass or mica, with an adjacent scale for measuring the height of the flame. Some bonnets were fixed, others could be removed. Another problem that had to be solved was how to prevent the flame from passing the gauze when the lamp filled with flame at methane >2.5%. Flame extinguishers, or "snuffers", were installed in lamps to quickly extinguish the flame when the operator observed the lamp filling with flame. "Snuffers" were installed at least as far back to

1890, and appeared to be standard in lamps made after

1900. There was at least one manufacture, Mulkay, which installed a device that insured the gauzes were inserted when the lamp was assembled. The Mulkay also had a double gauze arrangement.[15]

In 1892, a hybrid of the Pieler lamp was invented by M. Chesneau, who was the President of the French Firedamp Commission. The Chesneau was basically a Pieler lamp with many improvements to overcome the Pieler's weaknesses. The Chesneau lamp was made heavier duty for rough service, and had a fixed bonnet that allows it to perform safely in air currents up to 2000 ft. per minute. Like the Pieler, the lamp burned alcohol and has a tall gauze surrounding the burner. Instead of using a conical shield around the burner, the Chesneau used a cylinder as a standard for adjusting the flame. Gas measuring was identical to the Pieler. The elongation of the flame while in a firedamp atmosphere is observed through a mica window, and measured with scale attached to the bonnet. The lamp is also fixed with a sliding shield protected the mica window from wind currents that would cause condensation on the mica. To more easily read the caps, copper nitrate and ethylene chloride dissolved in the wood alcohol fuel to give the flame a greenish tint. As in the Pieler, the accuracy of the test result depended on the condition of the cotton being the same as when the lamp was standardized. Besides being safer in greater air velocities, a great improvement was that the Chesneau only required 30 to 90 seconds to cool down between tests instead of 20 minutes.[16]

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[15] To the author's knowledge, Mulkay was the only manufacture that installed automatic extinguishers and double gauzes in Pieler lamps.

[16] It is important to note that while the Chesneau had many important improvements over the Pieler, it did not make the Pieler obsolete by any means. The Chesneau was not as sensitive as the Pieler and cost almost twice the price.

Figure 15: Friemann & Wolf. Detail of flame "snuffer" and igniter.

Judging from where examples are acquired today, it appears that Pieler lamps were most popular in Germany, Poland and what was known as the Austro-Hungarian region.

There is not an exact date that the Pieler became totally obsolete, but it appears that they were not in much use past 1930.[17] Its use diminished for many reasons. In some mining districts, safety regulations made them obsolete when Davy-type lamps were outlawed. The main reason for the Pieler's demise was probably the introduction of various electrical devices that were deemed safer and more accurate.

From the perspective of a mining artifact collector, Pieler lamps are quite rare. Since the Pieler lamp was an instrument, and not a lighting device, they were handled carefully by trained people. They were expensive, costing at least five (5) times the price of an ordinary Davy lamp. Mines that use them only purchased a few, and kept them many years. Although it is unknown how many were made, today they are considered a prized piece of coal mining history.

The author would be interested in hearing from collectors who have additional information about the Pieler lamp.

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[17] The Pieler lamp is mentioned in US Coal Mining reference books through the late 1920's.

A Unique Canadian Presentation Ingot

by Bill Collins

This unique ingot was presented to Andrew Trew Wood, Member of Parliament, an Ontario businessman, banker, and millionaire, for his efforts to spur the growth of the steel, nickel and copper industry in Canada. It is a representation of extreme optimism in the field of electrolytic metallurgy and the desire to develop the vast nickel deposits in the Province of Ontario. For some forever unknown reason the date of the award was not recorded on the ingot.

The ingot is pure copper, electrolytically refined from a nickel copper ore of an undefined mineralogical composition. The ingot is 37 mm x 35 mm at the top, 41 mm x 40 mm at the base and 15 mm thick forming an irregular, truncated pyramid. The ingot weighs 7.35 avoirdupois ounces. The inscription has been entirely engraved rather than gang stamped like the Pittsmont blister copper presentation ingots produced by the "Baggaley Process" that were made in 1904 in Butte, Montana. For more information on the "Baggaley Process" ingots the reader is referred to an article by Dave Johnson in the Summer 2001 issue of *Eureka!* Issue 37, pp 28-29.

<u>Evidence Leading to Determination of the Award Date</u>

1897: House of Commons Member of Parliament A. T. Wood introduced a bill to incorporate three nickel refining companies: the Nickel Steel Company of Canada, the Hoepfner Refining Company and the Nickel Copper Company of Ontario. His partners in these ill-fated and controversial ventures were fellow industrialists, John Patterson, John R. Moodie, Sr., Samuel J. Richie (the disgruntled founder, collateralized shareholder, and fired president, he had held the job from 1886 until 1891, of the Canadian Copper Company) and Sir John Morrison Gibson (politician and president of the Cataract Power Company of Hamilton).

1898: The Nickel Steel Company of Canada was incorporated. This venture would collapse sometime in 1900 due to failure of the provincial government to implement tariffs on exported nickel matte. The hopes of the Canadians to keep the treatment of the nickel mattes, and the profits to be made, were doubly confounded by the unwillingness of the U.S. government to implement a tariff on the imported nickel matte. This meant that nickel-copper mattes could be shipped, financially unimpeded, to the United States for refinement at the Orford Refining Company in New Jersey. Orford was a major partner of the Canadian Copper Company.

1899: The Nickel Copper Company of Ontario and the Hoepfner Refining Company were incorporated in the latter part of the year. The Hoepfner Company, with CN$10,000,000 capitalization, was created to mine, and refine zinc, lead, silver, nickel and copper ores. The ores were shipped to the Nickel Copper Company for the production of nickel-copper mattes. Hoepfner built their electrolytic refining plant near the Cataract Power Company generation plant for the needed electrical power for Dr. Carl Hoepfner's Process for the production of metals; Patent No. 507130 (dated October 23, 1893) but found it was unable to refine the nickel-copper matte provided to them by the Nickel Copper Company on an economic large scale. The Hoepfner process was designed to separate the copper and silver from the ore but never designed to handle nickel. The extreme levels of nickel sulphide material mined in the same copper bearing orebody ruined the planned process. The copper was intended to be recovered as a copper chloride solution, the silver as a silver chloride solution with the sulfur as a light weight slag. Electrolysis would then deposit the copper and silver at different cathodes. Nickel bearing ores required the nickel to be dissolved in a different electrolyte for deposition on the cathode. Refining problems were not limited to the Nickel Copper Company:

- The Canadian Copper Company located a desirable copper sulfide deposit and tried to recover the sulfur (as sulfur dioxide) from the ore but found it not to be economical with their process. At the same time they found that there was too much nickel in the ore to provide for an effective recovery of the copper. They were eventually able to overcome the metals recovery problem.

- The Lake Superior Power Company located a desirable nickel sulfide ore body, tried to recover the nickel and found they had too much copper. Titus Ulke apparently developed a process to alleviate this problem although its success is not recorded. During this time, William Koehler, a competing, combative metallurgist, provided nothing but professional interference to Mr. Ulke. The battle between these two metallurgists continued for years.

By this time John Gibson had become president of the Hoepfner Refining Company. Considering the unspecified cost expended in building the plant and rather than abandon it, several shareholders decided to lease it and have additional pilot testing done on processing the mattes. They then enlisted the assistance Mr. Hans A. Frasch in this operation.

1900: Mr. Frasch (a U.S. citizen) demonstrated a small scale application of his yet unpatented electrolytic process for separating metals at a public exhibition on September 3, 1900, and applied for a patent for his process on September 14,1900 (accepted September 15, 1900). The process worked satisfactorily on a laboratory or small scale basis.

1900: A.T. Wood fails to be re-elected to the Ontario House of Commons in November.

1901: On January 1, Mr. A.T. Wood was appointed to the Canadian Senate to represent the senatorial division of Hamilton, Ontario in Parliament.

1901: Mr. Hans A. Frasch was granted a patent (Patent No. 669,442) for his **Process of Recovering and Separating Metals by Electrolysis** on March 5; this is better known as the "Frasch Process" and the subject of this ingot. Nickel sulfide ores required outdoor heap roasting with coke to drive off the sulfur and allow for electrolytic removal of the copper first using a different dissolving agent than the Hoepfner process. Once the copper has been plated out, any iron could be removed chemically and the nickel could be electrolytically removed from the solution for refinement. [Frasch was also granted a patent (Patent No. 689,391 for producing nickel through chemical means on December 24, 1901, which was much too late to save the company.]

1901: A miniaturized display of the "Frasch Process" to separate nickel from copper (and other metals bearing) ore was provided for public viewing in the Ontario Building at the Pan-American Exposition at Buffalo, New York. For all practical purposes the display was "prettily shown" according to Harriet Brown.

1901: An experimental industrial plant was erected at Worthington Station, Hamilton, Ontario for the purpose of conducting a practical trial for processing the nickel-copper matte using the newly patented "Frasch Process" which was now under the control of The Nickel Copper Company.

The primary metal of interest to the Nickel Copper Company of Ontario was nickel. Production of nickel required the copper in the ores to be removed first. The complex nickel-copper ores in the Sudbury District contained varying amounts of iron, cobalt, gold, silver, platinum, palladium, and occasionally arsenic and antimony as potential contaminants. Some Sudbury ores also contained minute percentages of tin, titanium and tellurium. The source of the ore was not identified but it did come from a company mine. John Kershaw expressed concern about the presence "of even small amounts of impurity" in the nickel-copper mattes and their deleterious effects upon the metal produced at the cathode even before experimental operations started. Because of this potential problem it was feared that the "Frasch Process" would be a failure. Frasch's patent indicted that impurities of cobalt and iron would present no problem. Roasting the ores to produce mattes apparently eliminated some contaminants.

In the end the "Frasch Process" failed to be capable of large scale production. No definitive reason was given for failure. Several others electrolytic refining processes, possibly more than dozen, were being used or potentially available at the time for treating nickel-copper; four examples were:

- The Balbach-Thum process. The Balbach Smelting and Refining Company in Newark, New Jersey used this method until 1900 to separate silver from the copper when operations ceased.

- The Orford process. This was used at the Orford Copper Company at Bayonne, New Jersey. At this time Orford was processing Canadian Copper Company mattes; this most likely made the process unavailable for trials.

- The Browne process. Browne's process was being reviewed for patent at the U.S. Patent Office (1899-1902) but Browne had assigned the patent to the Canadian Copper Company.

- Ulke's process. His early process was controlled by the Copper Refining Department of the Lake Superior Power Company.

Both the Nickel Copper Company and the Hoepfner Refining Company operations came to an end in 1901; the former because of the failed "Frasch Process" and the latter because of the complete failure of a new self-roasting plant erected near Worthington Station to produce suitable nickel-copper matte from the available ore. The insignificance of the Hoepfner Refining Company and the Nickel Copper Company of Ontario in the development of the Sudbury Mining District was documented by their very brief mention in both volumes prepared by Alfred Ernest Barlow for the Canadian government. "Although these ventures ultimately failed, from 1897 to 1901 Ritchie and his associates were publically able to maintain the façade of their competitive viability and thereby keep pressure on the Canadian Copper Company" [Bray, page 4].

1901: This the most probable date for the creation of this ingot. Mr. A.T. Wood, the chief promoter of the Nickel Copper Company of Ontario was still an M.P. (Member of Parliament). Mr. Frasch had recently received his patent. And more importantly the copper used in the creation of this ingot most likely was derived from the mattes used in the development of the patent process.

Soon after the production of this ingot and any other presentation ingots it most likely became evident to this small group of investors that the collapse of the matte production facility and the failure of the Frasch Process to work on a larger scale was inevitably an ineffective combination for the production of nickel. To cap it all off the group was at least CN$10,000,000 poorer with nothing to show for their efforts. They were essentially broke.

It is likely that no more than a total of six personalized ingots were produced and presented to the process inventor and the principle officers and owners of the company assuming that John Moodie was still alive in 1901:

- Hans A. Frasch, Inventor and chief engineer, c. 1856-? No exact dates are available but he was still at work on nickel recovery patents in 1905 and later on other patents regarding distillation and dye manufacturing until at least 1919.

- John R. Moodie, Sr., Hamilton businessman, 1841-?

- Sir John Morison Gibson, President, Hoepfner Refining Company, 1842-1929

- John Patterson, Hamilton businessman and a director of Cataract Power Co., 1857-1913

- Samuel J. Ritchie, Hamilton businessman, 1838-1908

- Andrew T. Wood, M.P. and Hamilton businessman, 1826-1903

Herman Frasch, 1851-1914, was <u>*not*</u> *part of this process but rather a producer and refiner of oil, alkali soda and sulfur. He was the inventor of the "Frasch Process" for mining sulfur. Hans and Herman were brothers and both had received training as pharmacists in Germany.*

<u>Acknowledgment</u>

I want to thank Tony Moon for taking the time to review and discuss, by email and phone calls, two drafts of this article both in general for its readability and primarily for his assistance in getting the metallurgy correct.

He also provided me with copies of several Frasch patents, the Hoepfner and Browne patents, and several of the more obscure technical papers. For a retired geologist this was an enjoyable exercise in metallurgy and history. Little treasures turn up in strange places; I found this ingot at an Orlando coin show within 10 minutes of walking in the door. Keep your eyes peeled, there may be another five out there and they will all be unique.

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