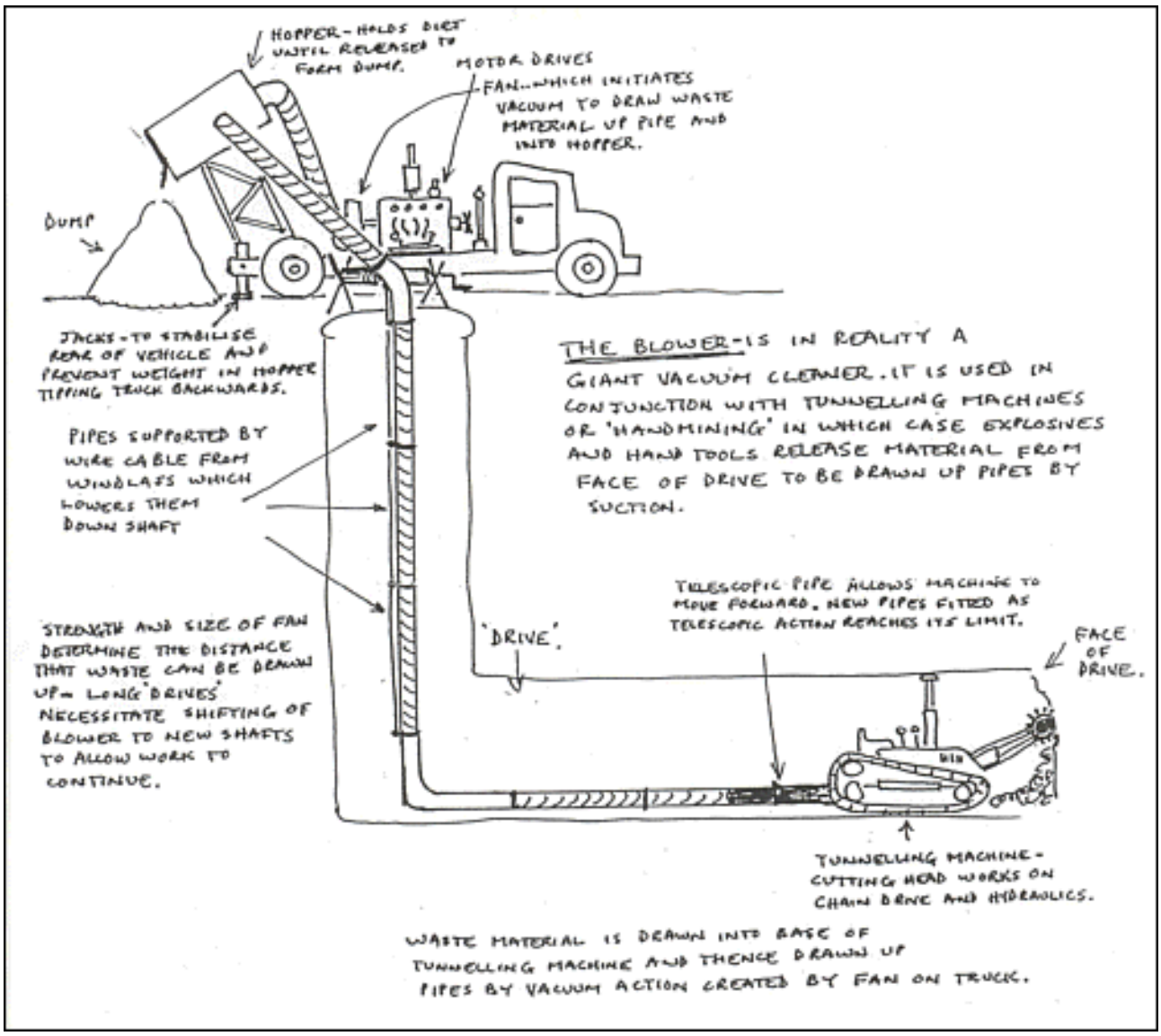
The diagram below summarises the mechanical processes by which dirt, hopefully containing opals, may be extracted from a mine. Instead of the tunneling machine, material can be released from the face of the drive by using explosives and hand tools.

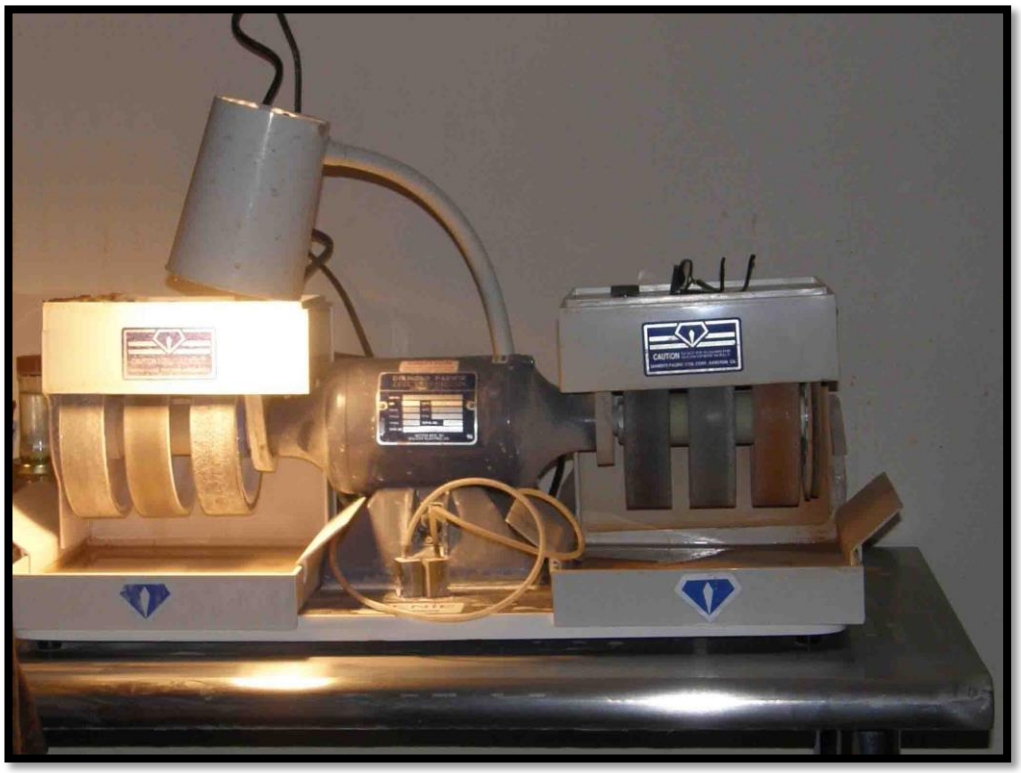


Noodling

This is the process of searching through heaps of discarded mullock for pieces of opal missed by the miners. Many locals make a living off this method and it is popular with tourists. Permission must be obtained from the claim owner to fossick on their claim. The most productive heaps are those excavated by bulldozers where opal may have been crushed or overlooked by careless operators. Noodling machines, in which mullock is passed through a darkroom on a conveyor belt beneath ultra violet lights are also used, and this is another form of mining. The adjacent photograph shows that noodling may produce fragments of coloured opal.

6. Processing Opals

Opal cutting and polishing is a very specialised skill. Peter Taubers. one of the owners, of the Andamooka Opal Showroom demonstrated the processes shown in the following text and photographs. His grinder and polisher are shown in the photograph below.



The three left-hand wheels are used for grinding and shaping the opal stones. They are covered with wet and dry sandpapers of different grades. The right-hand wheels are used for polishing the cut and shaped stones. They are covered with diamond fragments, also of different grades.

The raw materials consist of a jar of small stones, fresh from the ground. They had been mined at White Dam Mine, which is 9km south of the town. The stones are stored under water to show the colours that hopefully will be seen in the polished stones.

From the jar a few stones that looked as if they contained colours were selected. The adjacent photograph shows the jar of small opal stones and the few that were selected for processing.

An experienced opal cutter selects stones that they think will have value. Then they begin the process of slicing it, if the is thick enough, or grinding it.

Grinding the Rough Stone

Once a few stones that could be worth processing have been selected, the cutter begins to use the grinding wheels, starting with the coarse wheel, to cut the rough opal into ' rubs' (opal in the rough shape of a stone). During this process, dirt, excess material, cracks and potch are removed , and the piece of opal is cut into a basic stone shape. This clean-up also shows where the colour will be. One side of an opal usually shines brighter than the other, so both sides are cleaned and the best one is selected for the front of the gemstone. A stone that contains too much dirt and too many spots due to impurities is discarded. After cleaning, a promising piece is nicely shaped and shines well when wet, but it does need to be polished. The adjacent photograph shows the rough opal being polished. In the process of smoothing the rough surfaces, probably about 75% of the stone is ground away and wasted.

Naturally, an opal cutter wants to keep the stone as large as possible, thereby minimising waste and maximising the final size of the stone.

The Right Shape

Opal can be 'burned' or may even crack if subjected to extreme temperatures. For this reason, water is always used when grinding opal to avoid overheating due to friction. 'Burning' a stone during polishing results in small pits forming on the surface thereby ruining the smooth surface and polish.

When the cutter is happy with the shape of the stone, as shown in the adjacent photograph, it was ready for polishing.

It is placed on a 'dop stick' that consists of a length of wood dowelling; using heated wax to adhere the stone to the end of the stick. A methylated spirits burner is used to heat the wax, the opal stone is adhered to its end. The opal and the wax are put into the cutter's mouth to cool gently, then they are placed in water to complete the cooling process. Use of a dop stick allows a greater degree of control of the stone on the polishing wheel, especially when the stone is small. The cutter decides which side of the stone will be the face. It will be the side with the best colour, and the best shape. The stone is adhered to the dop stick with its face pointing upwards.

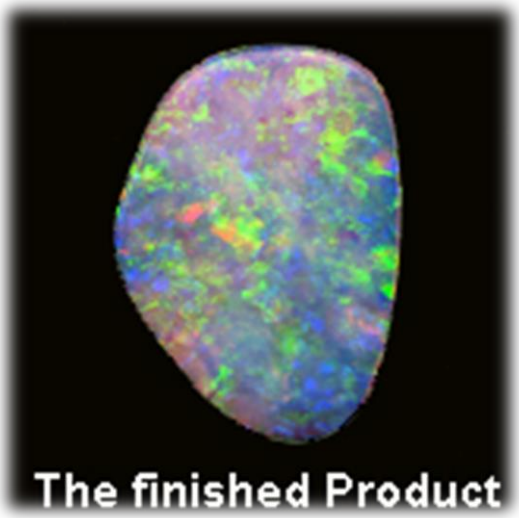
The Stone attached to the dop stick for polishing

A series of three diamond grinding wheels (coarse to fine) are then used to shape and perfect the stone. In this process, imperfections, such as sand spots and rough spots from previous stages are removed The face of the stone is shaped

into a cabochon (dome shape) while the shape of the whole stone (normally oval) depends mainly on the shape of the original stone. Again, the cutter aims to maximise the size of the stone. The adjacent photograph shows the stone being polished while it is attached to the dop stick.
The final stage for the face is polishing. The cutter uses serium oxide as a polishing agent on a felt wheel, using water to give the stone a beautiful polish. This process doe not remove much of the stone's surface. When the cutter is happy with its shape, absence of scratches, grinding marks or imperfections, the stone is removed from the dop stick and stuck back onto the wax with the back facing up.

The back of the stone is cut using the same set of grinding wheels, this time producing a flat bottom for the stone, and an edge which tapers up to the 'girdle'. The shaping of the girdle is an important and difficult part of cutting, and refers to the point on the side of the stone where the top and bottom edges meet. A jeweller will use this edge to set the stone underneath the gold, to provide a secure setting.

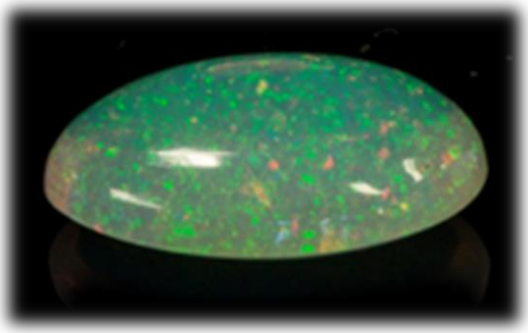
The adjacent photograph shows the finished product. If both sides of the stone are similar in shape and equally attractive, the stone could be used in a double-sided pendant.



A piece of rough opal can also be shaped to form a **cabochon,** which is a gemstone that has been shaped and polished as opposed to faceted. The resulting form is usually a rounded upper face with a flat lower face. Cabochons are made by cutting a slab of the rough rock with a slab saw, and then stencilling a shape from a template. The slab is then trimmed to near the marked line using a diamond blade saw—called a trim saw. Diamond impregnated wheels or silicon carbide wheels can be used to grind the rough rock down.

Once the piece is trimmed it can be "dopped" or completed by hand. The piece is then ground to the template line, the back edges may be bevelled, and finally the top is sanded and polished to a uniform dome.

The left-hand photograph below shows an opal cabochon, with a dome top and a flat underside. The right-hand photograph shows a cabochon mounted to form a piece of jewellery.



7. Different Types of Opal

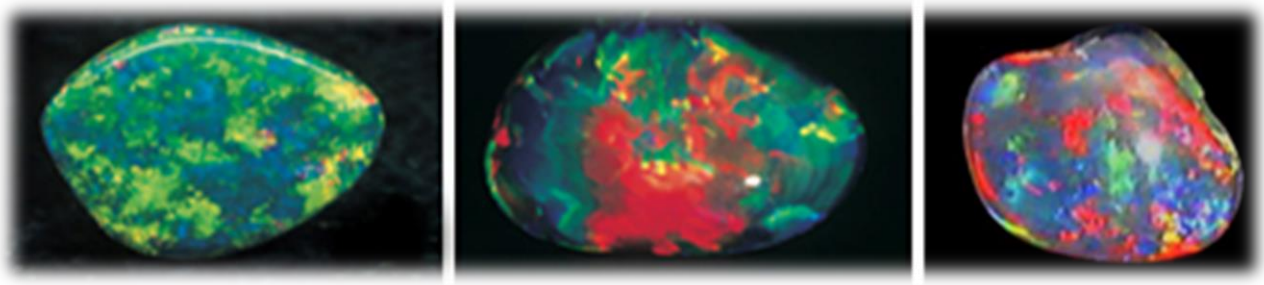
Black Opal

Black opal is a generic term given to any opal that has a dark body when viewed from above. 'Play of colour' within a dark body enhances the brilliance of the colours. Some of these opals have a transparent crystal colour bar overlaying dark opal potch, giving the otherwise light opal a dark appearance. Even expensive black opals may have only a thin colour bar on black potch.

Australian black opals form one of the most valuable and widely known types of opal. Black opal has a dark body tone that can range from dark grey to jet black. However this refers only to the general body tone of the stone, and is not related to the play of colours present in the opal.

Unlike most opals, black opals contain carbon and iron oxide trace elements, and these cause the unusual darkness of the stone. Because of their dark body tone, the rainbow colours in a black opal stand out much better than in lighter opals.

The photographs below illustrate the vibrant colours of the best black opals.



The left-hand and the centre photographs show Queensland opals, while the far right photograph shows an opalised mollusc shell from Coober Pedy.

This vibrancy of colour makes all opals, including black opal, extremely valuable gemstones. Often a black opal will have a natural layer of potch (colourless opal) left on the back of the stone, which can give the stone an extra darkness and vibrancy of colour. The darker this potch backing is, the darker the body tone, which usually makes for greater vibrancy of colour and a higher value black opal. This is the principle behind doublets and triplets, which have similar to solid black opals, but are less expensive.

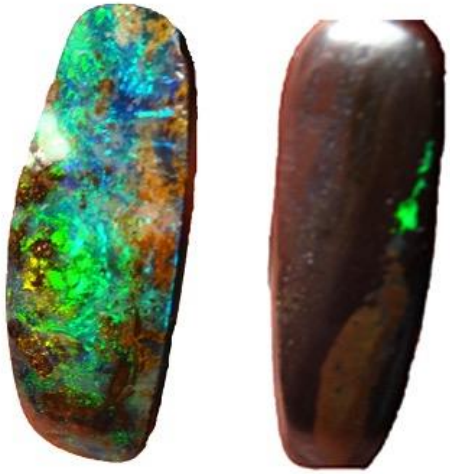
Black opals displaying 'red fire' are the most valuable form of black opal, due to their dark body tone and the resulting vibrant play of colour. Top of the range gem quality black opal can fetch prices up to $15,000 per carat. However, just because an opal is black doesn't make it valuable. There are many factors, including brightness and pattern, which determine the overall value of opal.

Most black opals are mined in Lightning Ridge, in northern New South Wales. Lightning Ridge is famous for its black opals and hundreds of millions of dollars worth have been found there. In 2008, the black opal was named as the 'gemstone emblem' for New South Wales. Black opals have also been found at Mintabie and Coober Pedy in South Australia.

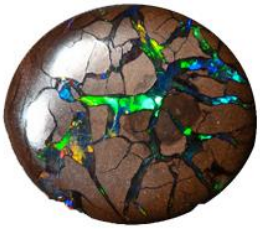
Boulder Opal

Australian Boulder opals also form a valuable type of opal, following black opal. They are mined from large ironstone boulders under the ground. They are easily distinguished by the layer of solid brown ironstone left on the back of the stone. Boulder is a variety of precious opal that forms naturally within the host rock; often a thin vein of precious opal is present. It is formed as the infilling of cracks or hollows, usually in ironstone boulders. It usually occurs in specific locations over a wide area of western Queensland.

Because these veins of colour are so thin, opal cutters need to leave the ironstone on the back of the opal to form a full sized stone, as shown in the adjacent photograph. The thin layer of opal in boulder opals can display any colour of the spectrum in a beautiful play of colour. They can be extremely valuable, depending their colour and perfection of the surface of the stone.



The top surfaces of fine grade boulder opals are covered with precious opal. Light marks and protrusions of ironstone can affect the value of the specimen. Boulder opal is usually cut to the contours of the opal vein, creating a wavy surface and often an irregular shape. The most expensive boulder opals have dark body tones and full faces of brilliant precious opal.



Veins or patches of precious opal closely mixed with the host rock are called boulder **matrix opal**. This increases in value with the brilliance and quantity of precious opal forming the face of the stone. The surface of fine boulder matrix, as shown in the adjacent photograph, always consists of attractive banded ironstone with a high polish.

Opal nuts consist of precious opal inside an ironstone concretion. The ironstone is usually an attractive red colour and extremely hard, so that it can be polished to a high gloss. These stones are sought after as collection pieces and for jewellery. The photograph on the right shows an opal nut.

Boulder splits are formed when a single piece of rough opal is split along an opal vein to form a matching pair. If the cleaved surfaces are mainly precious opal of brilliant colour, this variety can be very valuable.

A variety of boulder opal also occurs at Andamooka in South Australia, where the host rock is quartzite. These forms of boulder opal are called **'painted ladies'.**

The adjacent photograph shows a matching pair of painted ladies. They were formed from a single piece of rough opal.

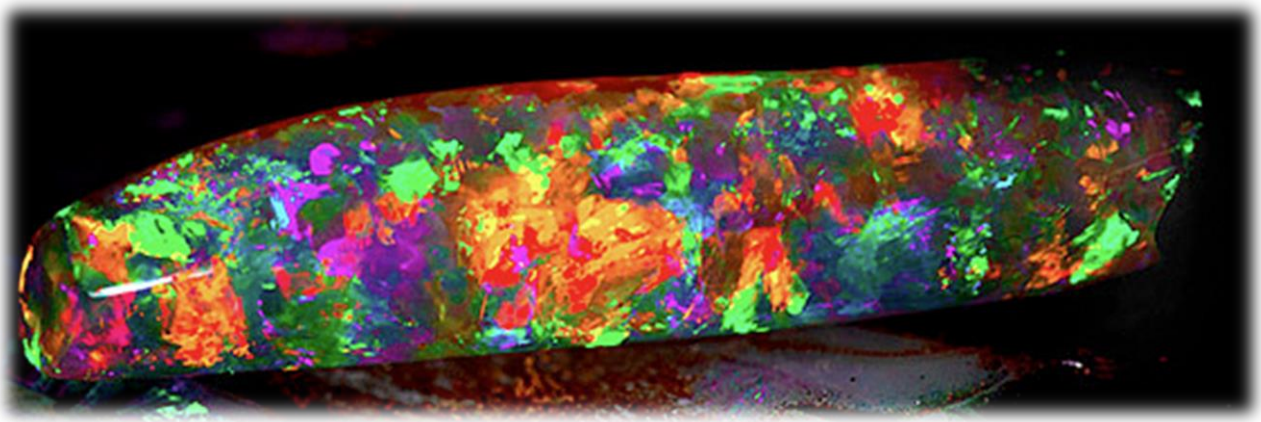
Light Opal and Crystal Opal

Light opal is commonly referred to as 'white', although this term should be used only where the body colour is milky or white. It should not be used to describe the entire light opal family. Australian light opals are distinguished by their pale white or light body tone, which is transparent to translucent with a creamy appearance dominating the diffracted colours. Like any kind of opal, white opals can display any colour of the spectrum in a beautiful play of colour.

Light opal makes up the bulk of precious opal and comes from all fields, but the majority is found in South Australia.

In the past, light opal (or 'milky' opal), formed the highest percentage of opals mined. Some light opals have white potch left on the back of the stone, although the entire stone sometimes consists of colourful opal. Because of their pale body tone, white opals generally have less vibrant colour than boulder opals and black opals. They do not have the advantage of having a dark or black background that enhances the stone and makes the opal colour stand out.

However, gem quality crystal opal and opalised fossils are a wonder to behold, are sought after by investors and can fetch hundreds of thousands of dollars. The photograph below shows an opalised belemnite fossil, called the Virgin Rainbow, owned by the South Australian Museum. It is worth $1m.



Crystal Opal

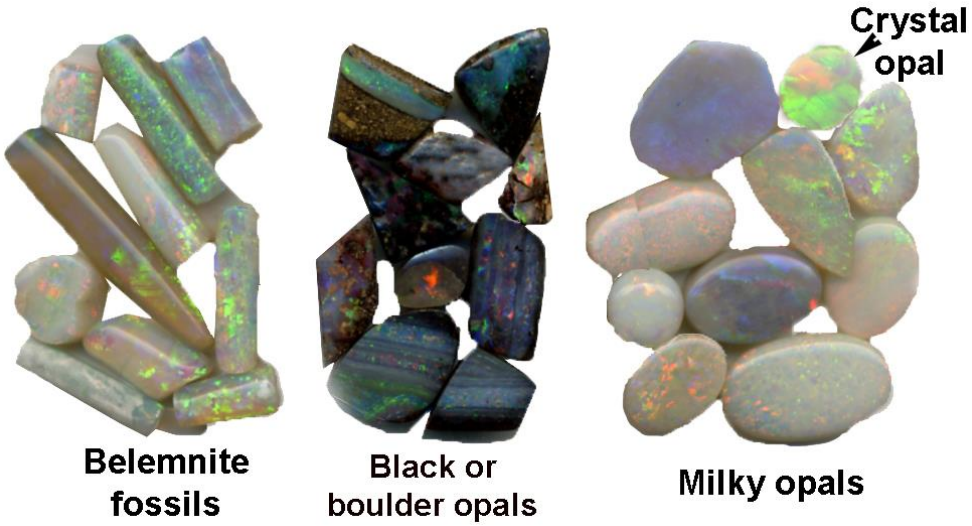
Crystal opals are mined in South Australia and New South Wales, in the same locations as black opals and white opals. White Cliffs in New South Wales is well known for yielding good quantities of crystal opal

The term crystal opal refers to any kind of opal (black opal, light opal) that has a transparent, translucent, or semi-translucent body. If light is able to pass through the stone, or you can see through an opal, then you are probably looking at a crystal opal. Crystal opals can display any colour of the spectrum in a beautiful play of colour. However, boulder opals, which have a layer of translucent opal, are not referred to as crystal opals because of their opaque ironstone backing.

The translucence of a crystal opal often gives it a greater clarity and vibrancy of colour than opaque stones. Pale coloured crystal opals are generally more valuable than opaque white opals, and black crystal opals can often have more beautiful colour than opaque black opals.

Crystal opals are generally cut in a standard oval shape if possible, however if the nature of the stone dictates, sometimes a freeform or teardrop shape is cut in order to maximise the size and carat weight of the stone. Crystal opals are also cut with a high cabochon if possible as it enhances the appearance of the colour.

The adjacent photographs show two examples of rough South Australian crystal opal.
The photograph below shows some of light, black or boulder, crystal and fossil opals from Coober Pedy, Courtesy of 'Majestic Opals'.

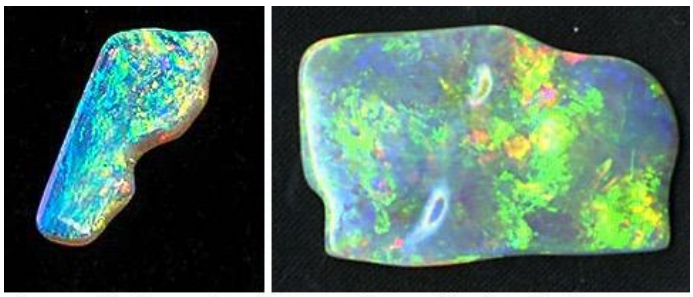


Andamooka Black Opal Matrix

Andamooka Black Opal Matrix is a recognised opal type that is unique, very rare and only found on the opal fields at Andamooka. For this reason, the material is called Andamooka matrix opal. Many of the world's opal experts believe that although the Lightning Ridge black may be the most satisfyingly perfect, the treated matrix is the most brilliant.

As described earlier in this document, opal solidifies from a liquid state in hollows, or cavities. Sometimes the cavities are large, and thick solid slabs or opal are formed; sometimes the opal may solidify in a mollusc shell; and sometimes it may intrude into fine gaps in a hard native stone such as ironstone.

But when opal filters into ancient layers of limestone, something very different occurs.



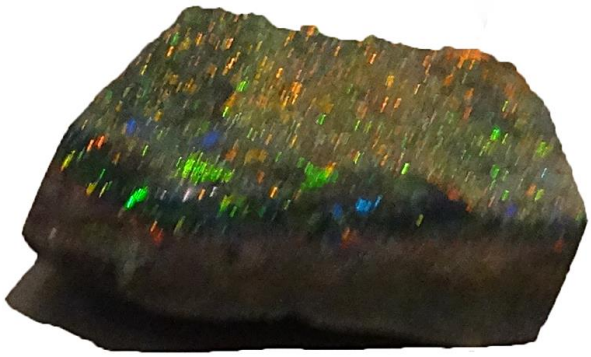
From Andamooka From Coober Pedy

The limestone in the Great Artesian basin was formed over millions of years by the death of countless microscopic plants and animals in the Eromanga Sea. The skeletons or fossils of these early life forms created

microscopic cavities in limestone, which prevented the opal from forming solid opal with thick layers of fire. However, opal did form within the tiny cavities. The opal in these cavities can be seen with the aid of a microscope. **T**he matrix is a host stone and the opal silica has soaked into it. Limestone is usually a very white chalk-like stone. In its natural state, limestone containing opal does appear to have colour, but it is washed-out and faint. For this reason, it was not viewed as marketable when first discovered. But when the matrix is wetted, that unmistakable opal fire is there, and no doubt much time went into thinking about just how this material might be treated.

We don't know exactly when someone discovered that limestone matrix opal could be treated to improve the richness and brilliance of the opal in the limestone. But it wasn't considered valuable at first, and little was seen on the market until about 30 years ago.
The fabulous colours and rich black matrix of the finest stones offer qualities similar to those that make the Lightning Ridge black opal so popular.

The left-hand photograph below shows untreated and matrix opal, while the right-hand photograph shows the effect of the treatment described below.

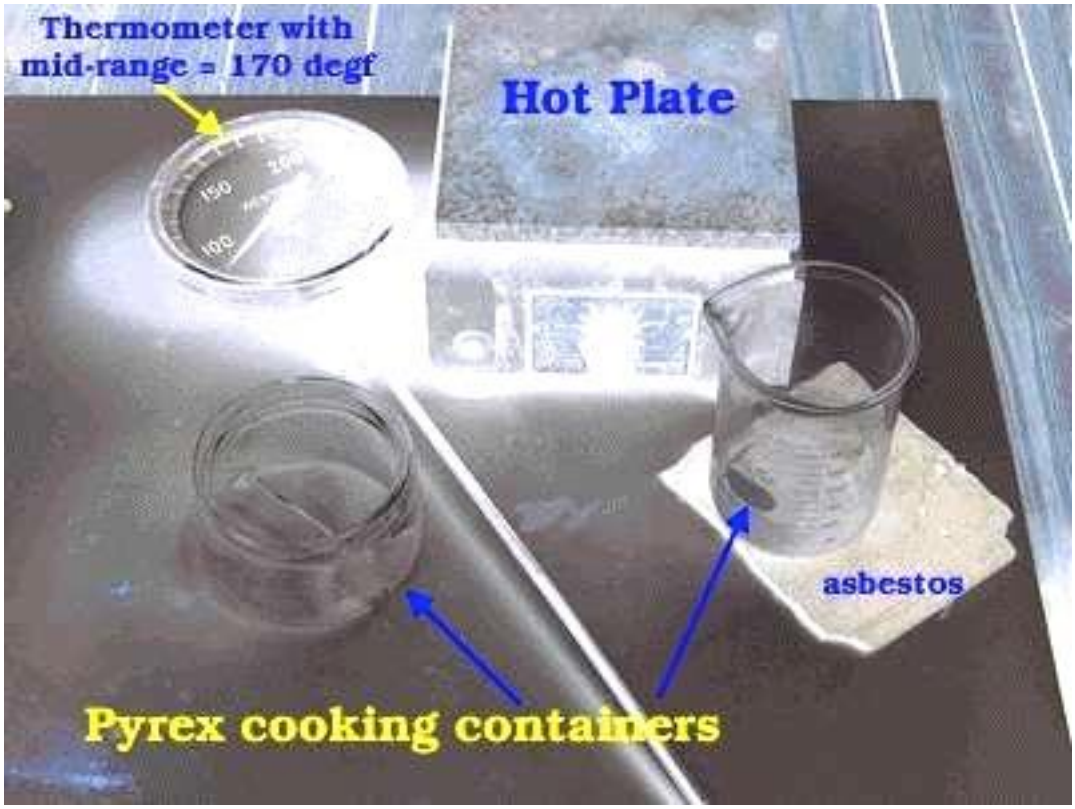


Treating the limestone matrix involves a fairly simple process of simmering the stones in a very rich solution of sugar in water, followed by a period of simmering in a bath of very concentrated sulfuric acid. The sugar penetrates into the holes in the limestone and then the acid 'cooks' it turning the white sugar behind and around the 'pockets' of opal, into black carbon.

The result is that the blackened matrix surrounding the pockets of opal does not reflect light, allowing the colours of the opal shine through. The quality of the finished stone is judged by the brilliance of the fire and the richness and range of the colours.

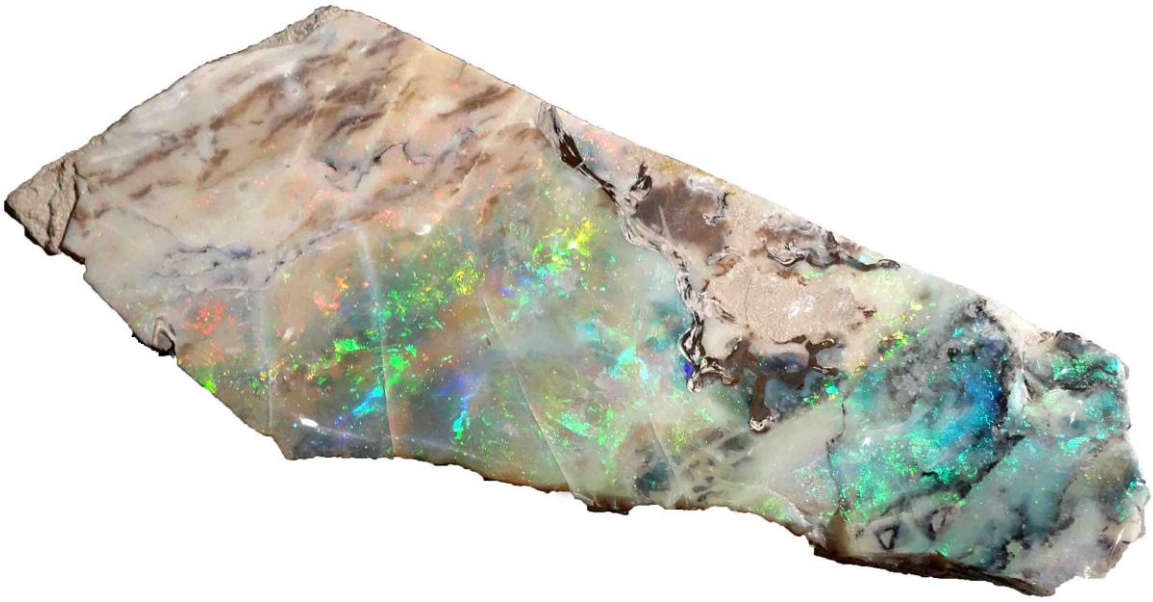
The adjacent photograph shows a beautiful pendant made from Andamooka Matrix Opal.

The process of treating limestone to produce matrix opal is no more difficult than cooking dinner, with the exception that **sulfuric acid is extremely dangerous**. The photograph below shows the equipment required, but **don't even think of trying it yourself!!!**



Composite Opal

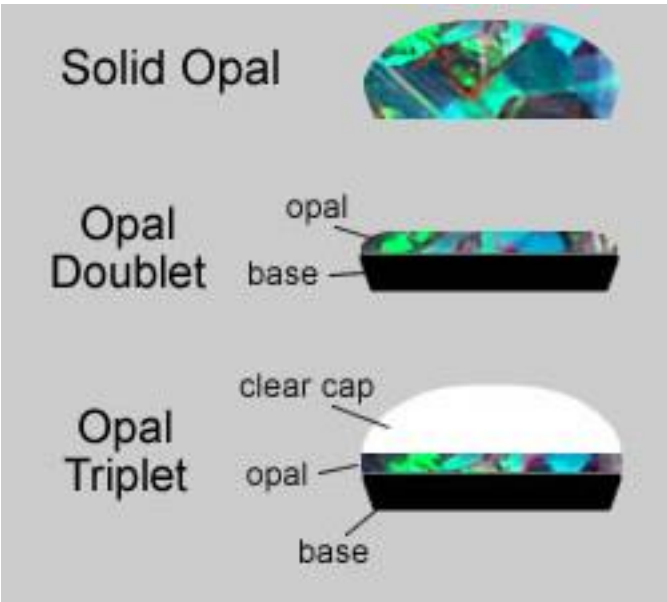
The photograph below shows a specimen of **seam opal**. It was formed when liquid opal penetrated a crack in the host rock. This opal shows an attractive display of colours, but the layer is too thin to be made into a useful gemstone.



However, it can be made into one of the composite ovals described below.

Composite opals comprise natural opal manually attached to another substance.

Most cut opals are solid stones. The entire stone is cut from a single piece of rough opal as shown in the first of the adjacent diagrams.



However, some opal rough, like the specimen shown above, has very thin but brilliant fire layers. Some artisans cut the stone down to the thin fire layer and glue it to a base of obsidian, potch or basalt and then cut a finished stone. These two part stones are called 'opal doublets', (second diagram) illust.

To protect the soft opal from abrasion and impact a crystal clear top of quartz, spinel or other transparent material is sometimes glued onto the opal. This produces a three part stone, called an "opal triplet' — shown in the third diagram.

The adjacent photograph shows two opal triplets, one face up and the other one upside down.

Doublets and triplets are less valuable than solid opals

8. Valuing Opals

No governing body sets the prices of opals. They are a result of what the international market is prepared to pay in order to obtain the gem. Opals are subject to the laws of supply and demand. The supply of opal is never guaranteed — the luck of the miner, variable costs, new discoveries, floods and weather conditions — all affect the supply of the stone. Demand relates to the enthusiasm of the customer for opal, and may be influenced by the world economy, fashion and market trends.

Unprecedented demand over the last three decades for fine quality opal has caused prices to soar. Prices of fine quality opals rival those of diamonds.

The attractiveness and appeal of a particular opal are the important factors at the final point of sale.

These factors are discussed below.

a. Type of opal

Four major types of opal are, black opal, boulder opal, opalised fossils and light-crystal opoals

Price is determined first by the display of how many colours of the rainbow are present in the stone and secondly by patterns produced by the different colours.

As with other gemstones, value also depends on the size or carat weight of the stone, its clarity, presence of any imperfections and rarity.

The weights of gemstones are measured in **carats,** which is the unit of measurement used to describe the weights of gemstones. One **carat** is equal to 0.2g. Five **carats** equals 1g.

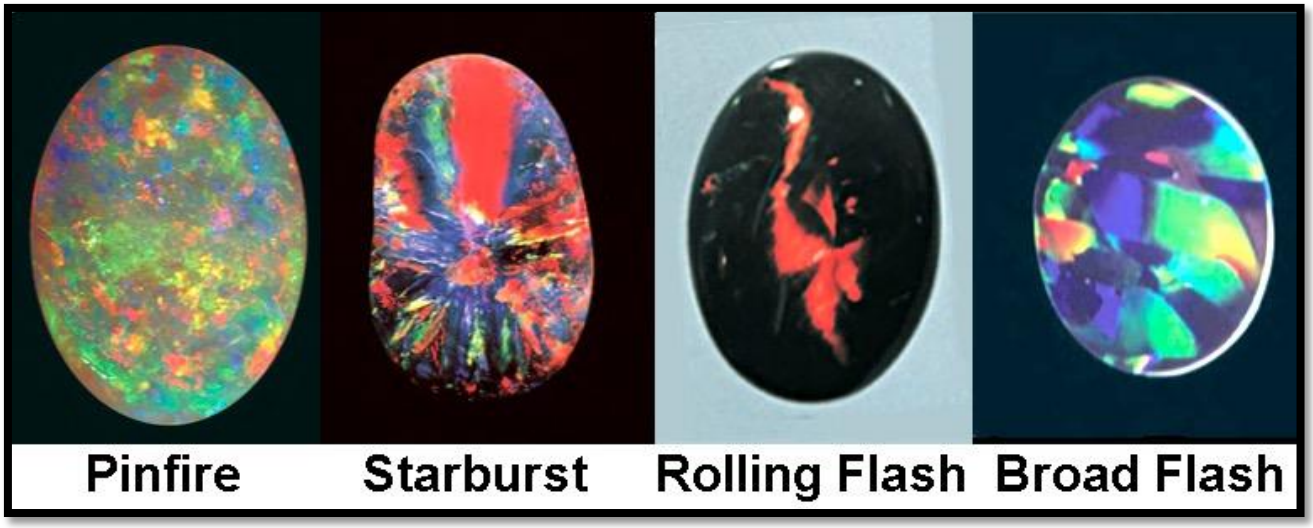
Valuing boulder opal per carat is not generally accepted in the industry due to the large component of ironstone present in the stone. A clean-faced stone with no ironstone spots is generally more valuable than a spotted stone.

b. Brilliance

The degree of brilliance is very important. A gem that glows but is average in all other respects commands a higher price than a dull stone, even if the latter has a very good pattern and range of colours.

c. Pattern

Interesting patterns of the diffracted colours are rare; and when combined with brilliance, have an enormous impact on the value. Pinfire and small type patterns are less desirable than broad patterns or large flashes. Distinct patterns such as rolling flash, straw pattern, Chinese writing, ribbon and harlequin are highly prized. The photographs below show examples of these patterns.



d. Body Tone

In black or boulder opal, the degree of darkness is taken into consideration when assessing the value. When all other factors are equal, a black body colour is more valuable than a grey or light body tone.

e. Transparency

Light opal is more desirable when it has a degree of transparency. The clarity and transparency of a crystal opal often enhance the colour, resulting in lively brilliant colours, therefore giving the stone a higher value than a standard opaque stone.

f. Thickness of the Colour Bar

Black opals and boulder opals have a very thin colour bar, while gem quality crystal opal is coloured throughout. Opals are worth more if they have a thicker colour bar. Thickness of the base enables a domed surface to be cut from the rough, thereby increasing value.

The photographs below show high-, medium- and low-domed opal cabochons.

g. Dominant Diffracted Colours

Great care must be taken when applying this factor, because type and brilliance override all other factors. A blue/green brilliant stone would usually be more valuable than a dull red stone. The value of the dominant colour is in the following order: red, orange, yellow, blue, green, indigo, violet. Strong red colour play in a dark body-toned black opal is the most valuable, as it is in boulder opal and gem quality crystal opal and in opalised fossils.

h. Shapes

Precious opal is usually cut into oval, pear or round shapes. Occasionally other shapes are cut, including marquis, rectangle and hearts. To set the maximum value in a stone, cutters will leave the stone in a free-form shape.

The thinness of the bar of colour in boulder opals means that a high cabochoned surface is extremely rare. Boulder opals usually have a flat surface or an undulating surface. For this reason boulder opals are almost always cut in a freeform shape, to maximise the size of the stone.

9. Caring for Opals

Solid Opals

Australian opal has a typical hardness of 6 to 7 on Mohs' hardness scale from 1 to 10. It is harder than pearl, which has a hardness of 3.5, and glass with a hardness of 5. However, it is softer than most gemstones, such as emerald (7.75), sapphire (9) and diamond (10). Diamond is the hardest substance known.

Opal is fairly resilient, but care should be taken to avoid situations where the opal could come in contact with rough surfaces of the subject to impact. Thick stones are more resilient than thin stones.

If the opal is to be stored for a long time, it should be placed in a sealed container or bag with water or oil. Safes are de-humidified environments and are unnaturally drying.

Doublets and Triplets

It is very important to protect doublets and triplets from impact. On many of these gemstones, the opal is just a thin veneer that is likely to crack if dropped onto a hard surface.

Doublets and triplets consist of very thin pieces of opal glued to another material, and the glue could deteriorate if the stones are submerged for long periods in water and particularly detergents.

Water and detergent do *not* affect solid opals.

In Conclusion

Sophia Provatidis from Majestic Opals says, she is often asked which is the best opal. She replies

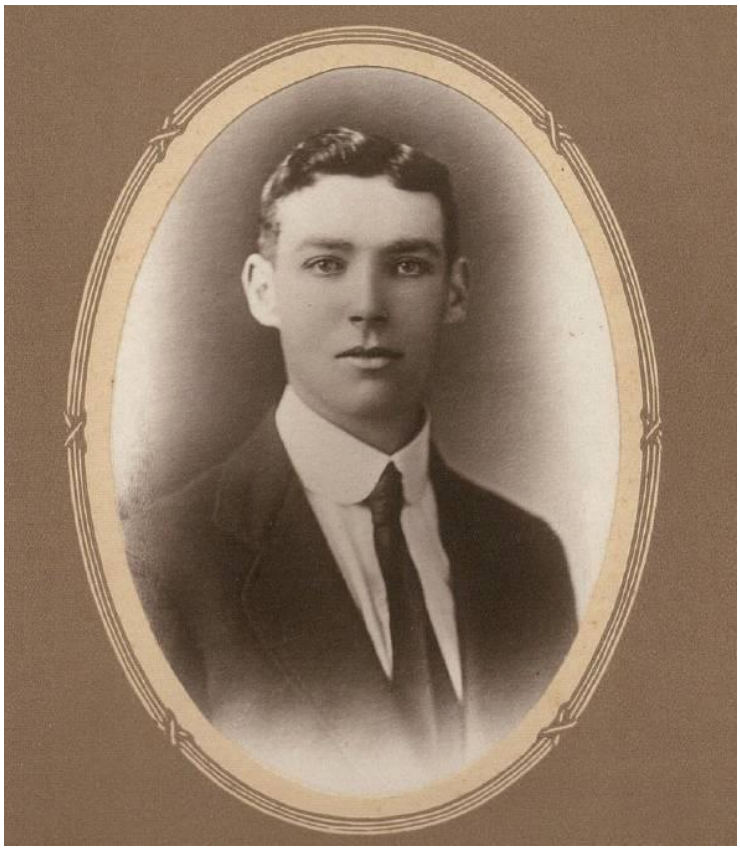
"All the colours of the rainbow can be found in an opal, as well as clarity, size pattern of colour and rarity.

However, beauty is in the eye of the beholder. This depends on what colours you like, and an opal gives you all the colours of the spectrum to choose from."

Appendix — The Boy Who Found Opal

It seems that the discovery of opal in Australia was often due to chance, with many of the discoverers either looking for something else or drilling for water in the outback. Most opal is buried deep beneath the earth and it is only possible to find it on the surface if the earth has been weathered by wind and rain to a level below the opal layer. When this occurs pieces of opal can become exposed. These fragments are called floaters as they can be washed away by the elements and can end up a long way from where they were originally formed. Nevertheless, finding these floaters often led to the discovery of a field. If erosion has not reached the opal level there is no way of knowing if opal exists unless a hole is bored.

Someone actually looking for opal did not find the fields at Coober Pedy. Jim Hutchison, the owner of Padthaway Station near Naracoorte, had previously been a gold prospector. In 1895 he had been on a prospecting trip and noticed some quartz reefs near the low hills of the Stuart's range. He was unable to explore these at that time because of lack of water and had to turn back.



Billy Hutchinson — the Boy who found Opal

In 1914, some Adelaide businessmen formed a company to search for gold in this area. Jim was appointed the leader of the party and he took his son William (Billy), aged 14, and two other men named Winch and McKenzie. They set off in mid summer although the country was in the middle of a drought with no rain having fallen for a very long time.

On 14 January 1915 they reached a place called Long's Creek, where they found a few small water holes and set up camp there. From this base, they set out on forays in different directions looking for gold. They found a few outcrops of quartz but no gold. Lack of water, became their greatest concern and eventually they spent more time looking for water than for gold. Hutchison decided to see if there were any waterholes in the Stuart Range and so, on 31 January, they set up camp among the low foothills of this range. Leaving 14 year old Billy in the camp, the three men set off looking for any other waterholes in the area. Billy had strict orders not to leave the camp. However, he disobeyed these orders and 'went bush', leaving his water bag behind but taking his pick and shovel.

The men returned at dusk to find the camp empty with no sign of Billy. In such a location and in such conditions this was very serious. They were very worried as it was approaching dusk and the ashes in the fire were cold, indicating he had been away from the camp for a long time. They quickly set about lighting a fire to guide him home. Flames can be seen from a long distance at night.

Just as they were lighting the fire, Billy walked quietly into the camp and dropped a large bag of opal specimens at his father's feet, saying: "Have a look at that dad, old dear. You will find some good stuff there". Although his father was very angry for him leaving the camp, he was happy to see the opal specimens and even happier to receive the news that Billy had also found a waterhole nearby. This waterhole provided enough water for them to stay in the area for 8 more days but after that they had to abandon camp and return or face death in the desert.

And that's how Coober Pedy was discovered. It was an unexpected discovery, which resulted in the creation of one of SA's most historic towns and an industry of opal mining. An historical plaque is erected several kilometres south of the town to mark the spot where William found the first opal

William Hutchison did not live long after finding opal at Stuart's Range. He went to Queensland and worked as a drover and while droving in 1921 he tried to cross the Georgina River when it was in flood. He was swept from his horse and drowned.

Although opal was found in 1915, the first real influx of opal miners did not occur until 1917 when the Transcontinental Railway was completed. Some of the men working on the railway decided to stay on and try opal gouging. They were used to working in the very harsh conditions of the outback and so felt quite at home. Men from the Armed Forces also came here to try their luck after the First World War but most did not last long as opal mining was very much a hit and miss affair with some making a fortune but most slaving away for nothing.

The field was originally called Stuart's Range, but the Postal Service objected as there was a Stewart's Range in the south east of the state. The name used by the local Aboriginals was chosen, but it was apparently spelt incorrectly. It should have been Kupa Piti, but was spelled as Coober Pedy. Many people think it means "White Fella burrow" but the South Australian Museum' interprets its meaning as "boy's waterhole".

During the Great Depression of the 1930s, opal prices plummeted and production almost came to a standstill. Typical of Coober Pedy's history of boom and bust, an Aboriginal woman named Tottie Bryant made a sensational opal find at the Eight Mile field in 1946, starting a new rush to the fields. During the 1960s, the mining industry expanded rapidly due to the many European migrants who came to seek their fortunes. The 1960s and 1970s saw opal mining develop into a multi million dollar industry and Coober Pedy has developed into a modern mining town.

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