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50th Issue

Gold of the Pharaohs

Was Tutankamun murdered? Case re-opened

- Amenhotep III a tale of two heads
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Pharaoh's Gold

*Geologist and Egyptologist **Colin Reader** looks at ancient Egyptian methods of finding and mining gold.*

To the modern observer, the lavish use of gold in ancient Egypt seems as much of a hallmark of that civilisation as pyramids, the sphinx or hieroglyphic writing.

In comparison with neighbouring states, the Egyptians had access to gold in abundance and it would appear that much of the power and influence that ancient Egypt wielded in the region was associated with the desire of those neighbours to trade with Egypt for their gold. Tushratta, the King of Mitanni, wrote in diplomatic correspondence with Amenhotep III, "Gold in Egypt is more plentiful than dirt; one simply gathers it up. Why are you so sparing of it?"

Although unable literally to 'gather it up', the Egyptians obtained their gold from the geologically ancient rocks of the Red Sea Mountains to the east of the River Nile. As the yellow metal was more readily available than iron or silver, it is clear that gold was not cherished because of its rarity. We must, therefore, look to its other qualities – the fact that it is easy to work and difficult to tarnish – if we are to understand the special affinity that the Egyptians had with gold.

As well as the practical issues, however, it is also necessary to consider the religious significance that gold had for the ancient Egyptians.

Gold was regarded as the flesh of the gods and

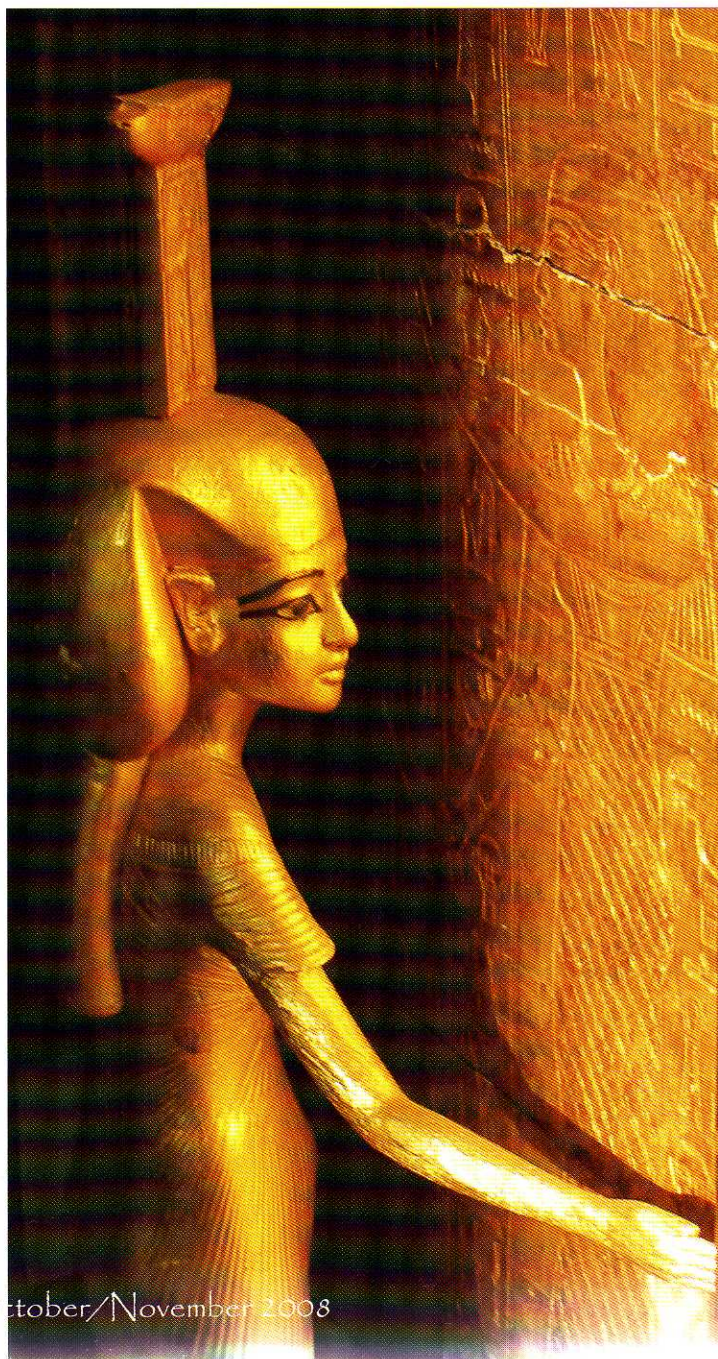
many deities had names which made reference to gold in some way. For example, one of the many titles of Ra, the sun god, was 'mountain of gold' and the goddess Hathor had the epithet 'the golden one'.

The illustration here shows the goddess Nephtys from the canopic chest of Tutankhamun. The use of gold to cover both the figure and the reliefs on the shrine in this way signifies that the deities have both flesh and clothing of gold.

The use of the gilded, or even solid gold, death masks in burials, such as the well-known example from the tomb of King Tutankhamun, symbolised the transition of the dead pharaoh into a god.

"In Egypt, gold is more plentiful than dirt"

(Letter from Tushratta, King of Mitanni, to Amenhotep III)



The Geological Origin of Gold

Although gold is widespread within the Earth's crust, it is generally present only in low concentrations. Gold 'deposits' form as a result of natural geological processes which, under certain conditions, will locally concentrate the native metal, usually into workable veins of quartz or other similar minerals.

In Egypt's Red Sea Hills, gold generally occurs in quartz veins associated with certain types of granite-like igneous rocks. The presence of gold as a 'native metal' owes much to the fact that it is chemically very stable and does not generally react with other elements; however, some natural alloys of



driven away from the focus of the melting sea-floor strata and, in so doing, was able to leach metals out of the molten rocks with which it came into contact. The metal-rich watery fluids were driven some distance into cracks and fissures in the cooler surrounding rock, where the mineral content of the fluids was released from solution, depositing gold amongst white crystalline quartz veins as the fluids cooled.

Gold is not, however, the only metal associated with the the light-coloured mineralised veins that are a common feature of the Eastern Desert landscape. Most veins will contain metals, such as iron, copper, lead or zinc.

The other common form in which gold is found is in 'placer deposits'. Placer deposits are found in many gold-bearing regions and result from the weathering, erosion and transport of any exposed gold-bearing material, usually by flowing water.

In Egypt's Eastern Desert, erosion of gold-bearing veins in the walls of seasonal wadis will have resulted in small fragments of gold being washed downstream to mix with the sand, gravel and other alluvium that accumulated along the wadi floors. The presence and distribution of placer deposits in alluvium can often be used to locate the nearby gold-bearing strata from which the placer deposits were eroded.



Top:
mineral veins (arrowed) cutting through Pre-Cambrian strata in the western foothills of the Red Sea Hills. Although not gold-bearing, these veins are similar in appearance to those that the ancient Egyptians will have mined for gold and electrum. The inset shows the crystalline matrix in close-up.

Above:
a gold dish given as a reward by Thutmose III to one of his generals. New Kingdom. Now in the Musée du Louvre, Paris. Photo: RP.

gold with other metals are known. Amongst the rocks of the Red Sea Hills, gold occasionally formed a natural alloy with silver, to produce a light-coloured form of gold (known as electrum) that the Egyptians valued in its own right.

In Egypt, the gold mineralisation is thought to have occurred some five hundred million years ago, long before the more familiar limestones and Nubian sandstones, which characterise most of the current surface of Egypt, were laid down. The gold mineralisation is associated with geologically ancient earth movements, during which huge sections of sea-floor were dragged beneath ancient continental land masses. As the rocks of the sea floor plunged deeper, they began to melt and water (possibly sea water) that was associated with these huge earth movements also became heated.

As a result of the immense pressures involved, the super-heated water was

Prospecting for Gold

Over the three thousand years or so during which their culture flourished, the ancient Egyptians used the incredible variety of natural resources that was available to them with absolute skill and artistry. The ability of the Egyptians to recover such a range of natural resources from within their borders (and beyond if necessary) indicates that these people were intimately familiar with the landscape that they inhabited. Recent studies have identified up to two hundred and fifty locations in the Eastern Desert at which gold is known to occur. Of these, it seems that the ancient Egyptians found and exploited most, if not all.

The earliest known use of gold in Egypt was in small decorative pieces found in elite Predynastic burials. Initially, it is probable that placer deposits provided most of Egypt's gold

and, whilst the earliest prospectors may have understood the spatial relationship between placer deposits and the gold-bearing veins from which they had been eroded, it seems certain that other prospecting techniques came quickly into use in these early periods.

Geo-archaeological studies have shown that as early as the late Predynastic and early Dynastic Periods, the Egyptians were actively quarrying gold-bearing quartz from veins within the Red Sea Hills.

Many of the earliest-worked gold deposits also had associated copper mineralisation, which would weather to produce a green staining on the adjacent rocks. Once the link between the green discolouration and the presence of gold in workable quantities became understood, the Egyptians would be able to locate productive sources of gold with relative ease by seeking out sites with the characteristic green staining.

In the early periods, possibly extending into the Middle Kingdom, most of the sites from which gold was exploited were located in the northern and central areas of the Red Sea Hills, in the areas closest to the Nile Valley. The early importance of gold from these parts of the Eastern Desert is highlighted by one of Pre-dynastic Egypt's most important regional centres. Nagada was known to the ancient Egyptians as Nubt, 'the city of gold', most likely as a result of the site's importance as a gold-trading centre. It is located opposite the mouth of the Wadi Hammamat, a key route into the gold-rich regions of the central Eastern Desert.

The earliest mining of gold-bearing veins was from open pits and deeper galleries, in which the entire vein was dug from the country rock. The application of these techniques in the northern and central Eastern Desert continued into the Middle Kingdom; however, from the reign of Senusret I, this was increasingly supplemented by gold from Nubia.

Like the ancient name for Nagada, the name 'Nubia' may also be derived for the Egyptian word *nub*, meaning 'gold', and Egypt's desire to control the Nubian gold trade may have been the main motivation for the advance of Middle Kingdom pharaohs as far as Semna, some two hundred and fifty miles south of the First Cataract at Aswan.

The occupation of Nubia required enormous effort on the part of the Egyptians, including the development of a series of fortresses that rival mediaeval European castles in their construction and defensive capability. It was from these fortresses that heavily defended expeditions would be sent out to prospect and quarry for gold.

New Kingdom conquests in Nubia allowed the Egyptians to extend their influence even further south and to expand their exploration for gold. In addition, more advanced prospecting techniques were in use by this time, suggesting that the Egyptians had developed at least a basic understanding of the geological principals that controlled the distribution of the gold-bearing rocks in the Red Sea Hills.

As well as expeditions into Nubia, therefore, with better geological skills at their disposal, the New Kingdom Egyptians were able to intensify the exploitation of gold from within the Red Sea Hills of central and southern Egypt itself. The New Kingdom also saw the introduction of operations to recover placer deposits of gold from the alluvium of the Eastern Desert wadis.

Further proof of the continued sophistication of the New Kingdom Egyptians has survived in the form of a map, painted on papyrus and now in the Egyptian Museum in Turin. This is one of a very small number of maps known to have survived from ancient Egypt, but what is astounding about this example is the geographic and geological information that was recorded on it.



Above:
a gold bracelet in the shape of a snake.
Late Period. Now in the Musée du
Louvre, Paris.

Photo: R.P.

Below:
typical wadi landscape of the western
foothills of Egypt's Red Sea Hills.





Above:
typical small-scale extractive industry in the western Red Sea Hills. This site is a Roman talc quarry, but shows many features that are likely to have been seen in early pharaonic gold mines. In the middle ground (blue arrows) are the remains of accommodation and other buildings. In the foreground (red arrows) is a trench, which winds its way up the slope – all that remains of the vein of talc that has been completely worked out by the Graeco-Roman Period miners. Veins of gold-bearing minerals will have been worked in a similar way.

Below left:
a solid gold diadem, made for a New Kingdom Queen. Now in the Metropolitan Museum of Art in New York. Photo: R.P.

Below right:
the papyrus map showing mines, now in the Egyptian Museum in Turin. Photo: R.P.

The map (see photo. below) illustrates an area of the Wadi Hammamat and not only is the landscape of the area represented with such accuracy that the map can be compared directly with modern maps, but the use of different colours on the map has suggested to modern scholars that geological information is also presented. Significantly, a gold mine, known to have been active from the New Kingdom, is shown in a prominent position on the map.

It appears that gold exploitation during the Graeco-Roman period was limited to known areas of gold-bearing strata, close to existing trade routes and within areas of Egypt's Eastern Desert, south of the Qena Bend. Few, if any, new sites were identified by either the Greeks or the Romans and expeditions into Nubia were curtailed by an increasingly difficult security situation south of

Egypt's traditional borders. Gold production at this time largely relied on the 'working-out' of known sites, but this was only possible by following the gold-bearing veins to greater depths, perhaps as much as thirty metres, until ventilation ceased to be effective and naked flames for lighting could no longer be kept lit.

Mining Techniques and Processing the Ore

Throughout all periods of gold-mining in ancient Egypt, the gold-bearing quartz was pounded *in situ* using hammer stones to reduce the vein to a fine granular material from which the smaller gold fraction could be separated. This resulted in a substantial reduction in the weight of material that needed to be transported back to the Nile Valley. Stone mortars were introduced in the Middle Kingdom, to allow the granular material produced by hammer stones to be worked to a finer powder and, in the New Kingdom, grinding stones, modelled on those used in the Nile Valley for milling grain, were adopted as part of the gold-miners' toolkit.

There is no archaeological evidence from the period before the New Kingdom to indicate that water was used to help with the separation of the dense gold from the lighter quartz fraction. Many New Kingdom sites, however, had washing areas and 'tailings' dumps in which the quartz mass was deposited after the gold had been washed out. Washing was undertaken on inclined 'tables' and it is thought that the surface of these tables was dressed with some form of natural fibrous mate-



rial, which would capture the gold but allow the quartz grains to be carried away in the flow of water. The legendary story of the 'Golden Fleece' may have originated from the use of sheepskins in this way.

During the earliest periods of Egyptian gold-mining, when working was confined to the use of hammer stones to remove the quartz veins at shallow and moderate depth, the need to work in closely-confined, shallow galleries will have made large expeditions impractical and mining expeditions may have been fairly modest in size.

In later periods, and particularly when wadi-workings for placer deposits were introduced, larger processing centres will have been set up with grinding mills and washing tables; the numbers of workers involved in these more industrial quarrying operations will have increased dramatically.

The increased numbers will have been reflected in the need for support services associated with the enhanced processing of the quarried material, the security of the entire operation in more hostile areas, and the provision of food and water for the animals and workforce.

Not least will have been the need for scribes and other administrative staff within each quarry 'settlement'.

The need for an enlarged workforce necessitated well-planned mining towns, with separate areas for production, housing, animal husbandry etc. and the remains of many such sites can be found in the Eastern Desert today (*see photo. overleaf*).

The Achievement

As with a great variety of other natural resources that were so successfully exploited on what increasingly became near-industrial scales, it is clear that the ancient Egyptians put a great deal of effort and resources into winning gold for their Pharaoh.

Gold was highly valued due to its religious significance, its appearance and



the relative ease with which it could be worked.

Most significantly, perhaps, once Egypt found itself involved in increasingly sophisticated diplomatic relations with neighbouring states, the relative abundance of Egyptian gold gave New Kingdom pharaohs greater power than they might otherwise have enjoyed had they needed to rely on military capabilities alone.

It seems likely, however, that the abundance of gold with which the ancient Egyptian state was credited was the result of propaganda as much as it was the result of the extensive gold



mining expeditions that were undertaken in Pharaoh's name.

Recently-published estimates suggest that only some seven tonnes of gold in total was actually recovered from the Eastern Desert areas of Egypt and Nubia during the Pharaonic Period.

Above:
the red granite outcrop of the Gebel el Shellul in the Red Sea Hills of Egypt.

Left:
a gold and inlaid pectoral from the Tomb of Tutankhamun, now in the Egyptian Museum in Cairo.
Photo: RP.

Below:
the entrance to a gold mine in the Wadi Hammamat.
Photo: RP.





Above:
the remains of houses in a remote
valley in the Wadi Hammamat,
probably connected to the ancient
gold mines nearby.

Although not insignificant, if these quantities are correct it would appear that Egypt did not enjoy as great a surfeit of gold as neighbouring states had been led to believe.

We now know that the ancient Egyptians recycled gold; for example, robberies in the royal tombs in the Valley of the Kings brought much 'old' gold back into the system.

If we assume that the short-lived pharaoh, Tutankhamun, enjoyed a

rather poor standard of burial when compared with more powerful monarchs, it is necessary to consider that gold was extensively re-used by successive generations in ancient Egypt.

Do we have to consider, therefore, that the famed wealth of the ancient Egyptians was, in fact, an illusion?

Certainly, to the visitor to Egypt and to observers, outwardly there was an ostentatious show of wealth with gold items being available not just to royalty but to many ordinary Egyptians too.

Whilst, during the Dynastic Period, Egyptian gold may well have, for most of the time at least, remained in Egypt, the Assyrians and Persians certainly removed much as plunder and the Roman Empire exploited Egypt for its food supplies and gold too.

Visitors to museums today continue to be impressed by the amount of gold that has survived, most of it locked away effectively in tombs until relatively recent times.

In centuries past, we have to assume that considerable amounts of ancient Egyptian gold were recovered by tomb-robbing, and that, as a consequence,

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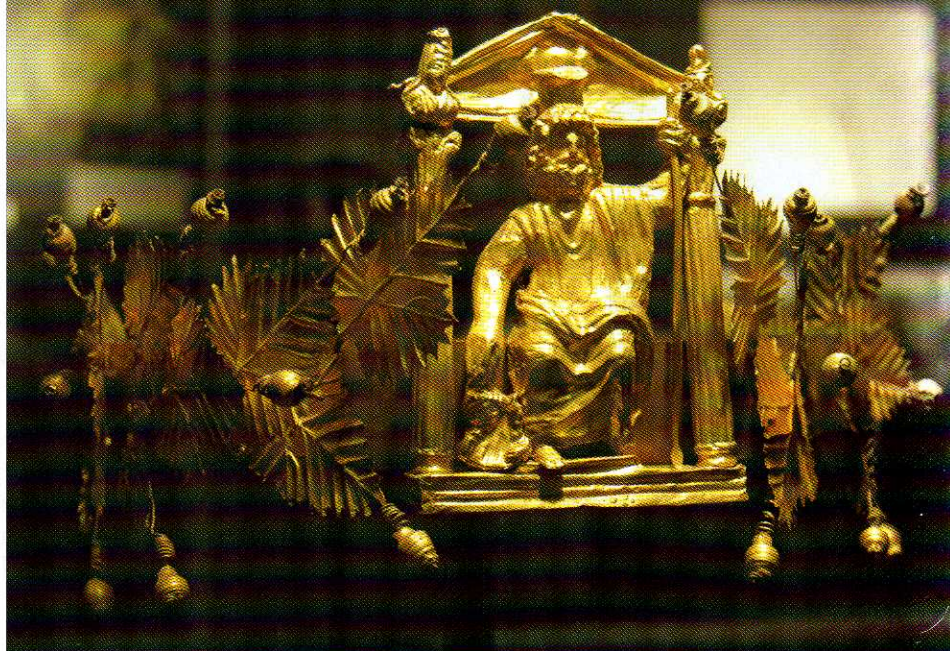
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some of the gold still in use today may well be the gold of the pharaohs.

Colin Reader

Colin is an engineering geologist with an interest in the way in which the ancient Egyptians worked with the abundant geological materials they had at their disposal.



In addition to his occasional publications, he regularly gives lectures on the geology of Egypt and his ideas about the methods of construction in ancient Egypt.

Unless otherwise stated, all photos. by the author.

Further Reading

A Traveller's Guide to the Geology of Egypt
by Bonnie Sampsell.
Ancient Egyptian Materials and Technology
by Nicholson and Shaw.

Above left:
the gold-covered coffin of Nubkheperre Intef.
The Egyptian Museum, Cairo.

Photo: RP.

Above right:
gold treasure from the Roman Temple of Dush in Kharga Oasis.
The Egyptian Museum, Cairo.

Photo: RP.

Coming in Future Issues of ANCIENT EGYPT

Major Articles

Amarna

Barry Kemp, Director of the Amarna Trust, in the sixth and last in a series of articles, looks at why the city of Akhenaten and Nefertiti died.

The Paintings of Nebamun

Richard Parkinson writes about some of the finest tomb paintings from Egypt, now in the British Museum, to mark the opening of a new gallery where the newly-conserved paintings will be displayed.

The Lost Sarcophagus

Paul Boughton tells the story of the removal of the sarcophagus from the pyramid of Menkaura at Giza in the 1830s, and how it was lost at sea on the way to England.

Timekeeping in Ancient Egypt

Nicholas Wernick investigates how the ancient Egyptians kept track of the passing of time.

Solar alignments in the Temples of Egypt

David Furlong reveals that many of the temples in the Luxor area appear to be aligned with the Midwinter Solstice.

The Coptic Museum's Tapestries and Stonework

Jill Kamil visits the recently enlarged and refurbished Coptic Museum in Cairo and examines some of the artistic and cultural treasures to be found there.

Plus our popular **News from Egypt**, from our Egypt Correspondent, **Dr. Ayman Wahby Taher**.

And, of course, all our **regular features**, book reviews, news of Egyptological meetings and events around the country and a list of the many Egyptology societies in the UK and abroad.