

REVIEW ARTICLE

On the origin of *Ammon's horn* ☆,☆☆

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Abstract

Introduction: Greek and Roman worship of their gods and myths go back to Ancient Egyptian times. Images engraved in Greco-Roman coinage range from references to the assassination of Caesar and legendary stories like the arrival of a snake shaped demi-god Aesculapius to save the Romans from the plague, to invocations of major deities including Apollo the physician or Ammon the protector.

Development: Depicted with the horns of a ram, Ammon was adopted by the Greeks as an epithet of Zeus and later incorporated by the Romans as Jupiter. References to the cult of Ammon appear on tetradrachms minted for Alexander The Great and on provincial Roman coins struck under Claudius. It is thrilling to hold a coin depicting Marcus Aurelius with Salus on the reverse and think that it could have been handed to Galen in payment for his services. However, it is rare to find figures other than rulers on coins and the physician of Pergamum is no exception. Inspired by the Renaissance school of Padua, French anatomists in the Enlightenment (Garengot in 1742 and Flurant in 1752) continued reviving ancient myths and named the curve-shaped-inner portion of the temporal lobe *Ammon's horn*. Outstanding scholars who studied this primitive structure of the brain included Lorente de Nó and his mentor Cajal, whose portrait appeared on fifty-pesetas notes issued in 1935.

Conclusions: As primary sources of great archaeological and artistic value, Greco-Roman coins provide information about the origins of the myths and gods of classical antiquity and continue to inspire the arts and sciences to this day.

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PALABRAS CLAVE

Asta de Amón;
Historia de la
neurología;

Sobre el origen del *asta de Amón*

Resumen

Introducción: El culto a los dioses y su recreación artística en Grecia y Roma se remontan al Antiguo Egipto, según podemos comprobar al estudiar las monedas antiguas. Grandes

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☆☆ This article presents an extended version of different lectures on numismatics and medicine delivered in the 3rd and 7th Neurohistory Sessions organised by the SEN. It also draws from the abstract *On the origin of Ammon's horn*, which was accepted for presentation at the 26th Congress of the EFNS, Stockholm, 2012.

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Lóbulo temporal;
Numismática médica

efemérides como el asesinato de César o leyendas como la llegada de Asclepio transformado en serpiente para liberar a Roma de una plaga, alternan en la numismática grecorromana con invocaciones a deidades mayores como Apolo el médico (en épocas de grandes epidemias) o el egipcio Amón.

Desarrollo: Caracterizado con las astas de un carnero, Amón fue asimilado como epíteto de Zeus en Grecia y de Júpiter en Roma, tal como reflejan los antiguos tetradracmas de Alejandro Magno y las medallas consulares de Claudio. Resulta emocionante sostener un denario de Marco Aurelio con La Salud personificada y pensar que acaso fue entregado a Galeno como pago por sus servicios. No obstante, apenas existen tributos numismáticos a personas alejadas del poder como el gran médico de Pérgamo. Los anatomistas ilustrados franceses (Garengot en 1742 y Flurant en 1752), heredando la costumbre de la escuela renacentista de Padua de recuperar mitos y dioses de la Antigüedad Clásica, denominaron a la retorcida corteza temporal *asta de Amón*. Entre los estudiosos de esta primitiva estructura cerebral destacan Lorente de Nó y su maestro Cajal, cuya divinizada efigie domina en los billetes de 50 pesetas emitidos en 1935.

Conclusiones: La numismática grecorromana, en tanto que asequible fuente arqueológica y artística de primer orden, nos informa acerca del origen de los mitos de la Antigüedad, los cuales continúan inspirando a las artes y las ciencias.

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Introduction

“Jesus held up a coin/with Tiberius in profile./A profile without love—/power in circulation.”¹

According to an ancient African legend, mythology and history become indistinguishable after seven generations. Throughout its long history, Greco-Roman civilisation followed the custom of using metal images to immortalise the fortunes, ephemerides, patron saints, monuments, allegories, and diverse symbols, especially during the high Roman Empire. This resulted in the creation of numerous coins regarded as having great artistic and archaeological importance, and these pieces shed light on both the history and legends of ancient times. Pivotal deeds such as the assassination of Julius Caesar on the ides of March, the conquest of Judea, the eruption of Vesuvius, and the arrival of the Greco-Roman demigod Asclepius, in serpent form, to Tiber Island to save Rome from an epidemic mingle with the achievements of emperors or invocations of major gods such as Apollo the physician (during great plagues) or the Egyptian god Amun.

Nevertheless, devotional practices and the artistic depictions of the gods in Greece and Rome are rooted in Ancient Egypt. As such, temples dedicated to Egyptian gods were not uncommon in the Roman Empire. One example is the Temple of Isis in Baelo Claudia in Hispania; its ruins are found next to those of the Forum and the garum factories around the Bay of Bolonia in the province of Cádiz.

Procedure

“I swear by Apollo, the healer, Asclepius, Hygieia, and Panacea...”²

The sixth century BCE witnessed the rise of a new current in opposing disease, one that went beyond folk empiricism or

mere superstition and which took the healer Asclepius as its reference.³ A century later, along the western coast of Asia Minor and its nearby islands, we find a type of medicine based on rational ideas inspired by pre-Socratic philosophers: the *tehkne iatrike* (τέχνη ιατρική) of the Hippocratic physicians, later known as *ars medica* among the Romans, consisting in taking action based on knowing why that action should be taken. The ideas of rational medicine and irrational religious beliefs coexisted harmoniously in ancient times; both forms were opposed to charlatanism, and both sprang from the same source. Together, they represent the basis of Western medicine. As the cornerstone of its ethical foundation, the precursor to modern deontological codes, and a faithful reflection of reason devoted to the service of medicine, the Hippocratic Oath recalls how the rational approach was incorporated into the irrational and religion-based earlier practices by invoking the Greek (and Roman) gods in its opening paragraph.⁴

Medicine in Greco-Roman numismatics

You, who were the embodiment and ensign/ of Hispania, the Matron holding/ in her right hand, your symbolic harvest/ on the denarii and bronze coins of Hadrian,/ who with Italica honoured this land...⁵

Among the many numismatic references to mythology, we can find personifications of provinces including Hispania, Germania, Britannia, and Gallia, and also representations of traits or virtues such as Hope, Loyalty, Nobleness, or Health. Greek coins minted from the fifth century BCE typically represent Asclepius as a bearded man with a serpent (identified as *Zamenis longissimus*) entwined around his staff. A tetradrachm piece struck in Athens in the second century BCE (Fig. 1) features the god of medicine as described above with the Athenian owl on the reverse. Hygieia, the Greek goddess of health and the mythological daughter of Asclepius, was worshipped from the third century BCE and



Figure 1 Tetradrachm struck in about 135 BCE. Obverse: Pallas Athena. Reverse: Asclepius leaning on a staff with an entwined serpent beside an Athenian owl perching on an amphora.



Figure 2 Aureus of Nero minted about 66 CE. Reverse: personification of Good Health, seated.



Figure 3 Consular medal minted in 245 CE by Philippus Arabs (244–249 CE). Obverse: Philippus Arabs with Philippus II. Reverse: standing Hygieia feeding a serpent, Asclepius leaning on a staff with an entwined serpent, and a hooded Telesphorus between them.

later adopted by the Romans as the personification of health (Salus). As such, she appears holding a patera (Fig. 2) and/or feeding a snake on the reverse side of many imperial coins.⁶ Hygieia is the main deity of healing, along with Asclepius and his helper Telesphoros (a late addition to medical mythology from the second century CE). Certain provincial coins or consular medals, beginning in the rule of Caracalla (198–216 CE), feature the sacred triad of Greco-Roman medicine with their symbols (Fig. 3). Meanwhile, the physician Apollo was invoked by depicting him on imperial coins during major epidemics, such as the Plague of Cyprian in the middle years of the third century CE.⁶ As the Roman Empire converted to Christianity, pagan gods of medicine gave way to the Christogram as the symbol for health.

And just as the pagan gods listed in the first paragraph of the Hippocratic Oath were censored in later Byzantine versions, no coins were struck with their images as of the fourth century CE. These later coins lacked the beauty and relevance of the coins invoking medicine that were crafted in high imperial Rome.⁶

Ammon in the transition from Egypt to Greece

The etymological roots of the larger part of medical vocabulary are found in the so-called dead languages. A basic knowledge of Latin and Greek is often sufficient to dilucidate the meanings of such terms as *hypo-glossus* (beneath the tongue); *syn-kinesia* (coordinated movement); *dys-kinesia* (movement disorder); and many others. However, simply translating a medical term may be complicated by having to trace the origin of a proper name used in that term, as in the case of *Cornu Ammonis* or Ammon's horn.

Amun Kneph, Amun, or Ammon the Protector, was the supreme deity in the theogony of Ancient Egypt. Also known as Amen, meaning obscure, mysterious, or cryptic, Amun was the main deity of Thebes with a cult that reached its apex during the twelfth dynasty (20th century BCE). Before Amenhotep IV banned the cult of Amun, and temporarily dictated a monotheistic religion under the sun-god Ra, the Priest of Amun held the highest rank within Egyptian society.⁷ However, an evolved form of Amun, portrayed with a ram's horns to denote the fertility and warlike nature of the ancient animal of the temple, made a forceful return as the supreme god of the New Empire; 4 pharaohs of the 18th dynasty took his name, including Tutankhamun, which literally means the living image of Amun. After the Egyptian conquest of Nubia (the region currently occupied by the Republic of the Sudan and corresponding to Ancient Ethiopia), a temple to Amun was built in the capital city of Napata at the foot of the sacred mountain of Jebel Barkal.⁷ In addition to his horns, Amun typically bears a sceptre and an ankh, the symbol of the universal soul.

His place of worship, an oasis in the Libyan desert where the oracle of Siwa resided, was visited by successive waves of Greek pilgrims, a process which favoured Amun's incorporation into Greco-Roman theogony. In his description of Greece, Pausanias recalls the presence of many temples to Amun throughout Ancient Egypt, especially those in the capital city of Thebes and in Sparta.⁷ During the fifth century BCE, Pindar contributed to spreading the cult of Amun from Cyrenaica in Libya to Greece; a cart bearing a statue of the god was raised in Delphos. However, the first place in Greece where the god was depicted with a ram's horns was in Megalopolis, the capital of the southern province of Arcadia.⁸

Amun on Greek and Roman coins: medical connotations

What less can I do, but evoke the deeds/ sober and fertile, of the mule-drivers;/ labourers who preserve the trace/ of those priests with their pairs of oxen yoked/ moulding the contours of the Roman cities/ cast in bronze on dupondii of Obulco.⁵



Figure 4 Tetradrachm of Lysimachus, minted in Thrace circa 285 BCE. Obverse: diademed head of Alexander the Great depicted as Zeus Amun. Reverse: Pallas Athena.

latromathematics or astrological medicine was another invention of Hellenistic Egypt. Of the 4 fundamental parts of the human body, according to the doctrine of astral melothesia, Aries corresponds to the head. The *latromathematica of Hermes Trismegistus to the Egyptian Ammon* (subtitle: *Mathematical prescience of bed-ridden diseases, taken from astrological science*) is related to the *Sacred Book of Hermes to Asclepius* in that they view man as a microcosm.⁹ While we cannot overlook Amun's role as a physician in his capacity as supreme god and protector, the main god of medicine in Egypt was Imhotep, a deified doctor linked to Asclepius.⁷

Egypt was overrun by the Persians in the fourth century BCE but then fell into the clutches of Alexander the Great. After the conquest, he proclaimed himself the son of Amun and was deified before the oracle of Siwa.⁷ A tetradrachm minted under Lysimachus in the northern Greek province of Thrace in the third century BCE bears on its obverse the diademed head of Alexander, triumphant conqueror of Egypt, portrayed as Zeus Amun (Fig. 4). But the cult of the Egyptian god did not disappear once Greece and Egypt were under Roman rule; as in countless other occasions, it was adopted by the new civilisation, as can be seen in the example of a coin dating to the rule of Claudius. Its reverse side bears the influential Alexandrian symbol of Zeus Amun as a figure assimilated into Roman mythology as an epithet of Jupiter (Fig. 5).

A possible link between the Egyptian god and medicine, aside from his status as a supreme deity, is the fact that the Theban high priest of Amun (the highest authority in Southern Egypt and the earthly representative of the divine) was credited with a certain degree of empiric knowledge



Figure 5 Consular medal minted in Cassandra, Macedonia, during the reign of Claudius (41-54 CE). Obverse: Emperor Claudius. Reverse: Zeus Amun (Jupiter).



Figure 6 Coin minted in Troas in the fifth century BCE. Obverse: profile of Apollo. Reverse: head of a ram.

of medicine. Another link, although less probable, is that Apollo assigned divine status to the ram, as depicted on a coin struck in Troas (a city located on the coast of modern-day Turkey and renamed Alexandria Troas by Lysimachus after his immediate predecessor, Alexander the Great). On its obverse, we see the profile of the ubiquitous Greco-Roman god, with a ram on the reverse (Fig. 6). This can certainly be explained by the regard for that animal throughout antiquity, and the fact that it was frequently associated with other major gods, including Zeus, Hermes, and even Apollo. However, no clear correlation can be established between the Egyptian god and Apollo the physician (invoked by the Romans in times of plague, along with the other gods of healing in the Hippocratic Oath). On the other hand, the dried distillation of ram's horn produces ammoniac (from the Greek *ammoniakón*, meaning pertaining to Amun¹⁰). The salts of that chemical compound, found in abundance in the Libyan desert, were used to prevent potential epidemics.

Resurgence of Greco-Roman mythology in the renaissance and introduction of the term 'Ammon's horn' during the Enlightenment

The Renaissance was a cultural and artistic movement that sought to return to the origins of classical antiquity by drawing from original sources and avoiding texts filtered by means of adulterated translations into Arabic or Latin during the Middle Ages. Efforts in the medical sphere focused on recovering Hippocratic and Galenic writings in the original Greek. One of the main innovations in Renaissance medicine, as opposed to approaches used in antiquity and the Middle Ages, was the creation of a new anatomical and structural paradigm based on the dissection of human cadavers and animal vivisection. The Galenic functional paradigm, in force prior to that time, was based exclusively on animal dissection since the dissection of human cadavers was prohibited in Greece and Rome. This gave rise to a chain of errors that marched on across the centuries. However, the new school in Padua, whose students included Andreas Vesalius and William Harvey, introduced a novel way of studying the human body in unprecedented detail. Here, the Greco-Roman gods and myths played an important role in that their names were given to different anatomical structures.

Terms recovered from Greco-Roman mythology include *hippocampus*, proposed by Giulio Cesare Aranzio (1530-1589) as the name of the medial region of the temporal lobe

du Cerveau. 251
 faivent aussi le même contour en diminuant toujours de volume, pour se terminer enfin par une pointe moufle qui ressemble assez à une corne de Belier. On prétend que cette pointe moufle fait un petit contour à son extrémité, comme font les extrémités des cornes de Belier. & c'est pour cette raison qu'on les nomme alors les cornes d'Ammon.
 Quand on lève la voûte à trois piliers de devant en arrière, je veux dire après avoir coupé le pilier antérieur, & l'avoir renversé vers le derrière, on aperçoit à sa surface inférieure, des cannelures transverses qu'on a comparées aux cordes d'un psalterium; c'est pour cela que quelques auteurs appellent cet endroit le corps psalterial.
 Lorsque l'on a enlevé la voûte à trois piliers dont nous venons de faire une description assez exacte, on voit en plein le lacis choroïde, qui n'est autre chose qu'un entrelacement de vaisseaux sanguins qui sont dans une petite membrane fine & déliée, qui tapise les ventricules supérieurs. Ce lacis choroïde forme aussi deux branches qui suivent le contour inférieur de chaque ventricule, en accompagnant les jambes de la voûte que nous avons dit ressembler aux cornes d'Ammon. Enfin on voit sortir de chaque plexus ou lacie
 L. vj

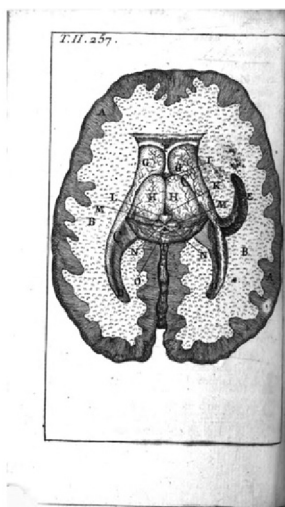


Figure 7 De Garengéot's reference to Ammon's horn in his illustrated anatomical description of the brain, 1742. Transversal slice: E.

because of its resemblance to a seahorse.¹¹ In Greek mythology, Hippocampus was a sea monster that pulled Poseidon's carriage, flanked by tritons and Nereids.^{3,9} The mythological origins of this monster were recently explored from the point of view of the neurosciences.¹²

However, French anatomists of the Enlightenment were the ones to coin the term *Cornu Ammonis* or 'Ammon's horn' to refer, for the first time, to this hidden and convoluted anatomical structure. Anatomists in the times of Vicq-d'Azyr had used the terms 'cornucopia' or 'horn of plenty' to refer to the lateral part of the fourth ventricle attached to the choroid plexus. In Greco-Roman iconography, the symbol is associated with harmony, peace, and happiness, as demonstrated by ancient coins.

Winslow's initial proposal, in 1730, was the term 'ram's horn' to refer to the medial region of the temporal lobe, as Lewis indicates.¹³ French anatomist Flurant was credited in 1752 with using the name 'Ammon's horn' to refer to that brain structure.¹⁴ Nevertheless, another French anatomist, De Garengéot, had been the true source of the term a decade earlier (Fig. 7).¹⁵ Since then, the name of the Egyptian god has been linked to medical literature.

The junction of Ammon's horn and David's lyre

*Ammon, enraged violator, / flees away on his pony. [...] And when the four hoofs / were just four echoes, / David with a pair of scissors / cut the strings of his harp.*¹⁶

According to the dictionary of the Royal Academy of the Spanish Language, a *salterio* or *psalterio* (psaltery) is a stringed musical instrument composed of a triangular resonance chamber, narrower at the top where it is open. It is fitted with multiple metal strings that can be struck or plucked by the fingers. However, *salterio* in Spanish may also refer to the Book of Psalms in the Old Testament containing 150 psalms offering praise to God, most of which were composed by King David.¹⁰ The above verses by Federico García Lorca, inspired by stories in the Old Testament, refer to the

incestuous rape of Tamar by her half-brother Ammon (not Ammon). Both were children of King David.¹⁷

In anatomy, the connection between both medial temporal regions or Ammon's horns is established through the hippocampal commissure, also known as the *psalterium*, *lyra*, or David's lyre. This name was inspired by the Biblical victory of the King of Israel over the Ammonites in Jordan, whose capital city was Rabbath Ammon (modern-day Amman).¹⁷

The base of the corpus callosum, presenting an inferior transversal convexity and anteroposterior concavity, provides the insertion point for the septum pellucidum. At that level, it is intimately attached to the trigone and forms a structure with fibres stretching obliquely like the strings of a lyre. This was what inspired French anatomist contemporaries of Vicq d'Azyr to name the commissure *David's lyre*, as has been highlighted by Bonéll and Lacaba.¹⁸

As always, Cajal

Bordering the surface or limb of the lateral ventricles, stemming from the subiculum, folded in at the end like a garment ready for sewing, and consisting of the intralimbic gyrus, hippocampal digitations, and the hippocampal uncus, the structure known as Ammon's horn, the *Cornu Ammonis*, or hippocampus proper is a narrowing convolution that curls around the dentate gyrus to form the retrocommissural hippocampus. Dominated within by giant pyramidal cells, this winding structure sends numerous efferent bundles to the external part of the adjacent subiculum and septum pellucidum. In contrast, the majority of its afferent cells are axons proceeding from dentate granule cells in the entorhinal cortex.^{19–21}

While studying Ammon's horns, Cajal described the stratum oriens or interneuronal layer wedged between a band of white matter (the alveus) and a layer of pyramidal cells. This gives rise to the distinctive curved shape that lets us identify this part of the brain macroscopically. Filled with polymorphic corpuscles, this interneuronal layer or stratum narrows in its medial and superior segments due to the accumulation of non-pyramidal cells with short axons. These cells were precisely described by the great Aragonese neuroscientist in the late 19th century.²² In addition to the classic *Histology of the Nervous System of Man and Vertebrates*, his other important studies on this part of the brain include *Studies on the human cerebral cortex*. Here, Cajal describes the anatomical details of this convoluted brain structure (Fig. 8).²³

Ammon's horn is the archipallial region of a brain distinguished, at this level, by its simple cortex: the archicortex or allocortex. This type of cortex is phylogenetically prior to the layer covering the more complex, evolved, and consequently less organised neocortical framework with its 6 layers or strata. The initials CA, standing for *Cornu Ammonis*, are used to delimit structural borders in Ammon's horn. The reverberating circuits CA1–CA4 were described by Cajal's last direct student Rafael Lorente de Nó, who was in his time the leading figure in Spanish neurophysiology. He presented the trisynaptic loop that integrates this area as follows: (1) entorhinal cortex – dentate gyrus; (2) dentate gyrus – CA3; (3) pyramidal cells in CA3 – axon collaterals

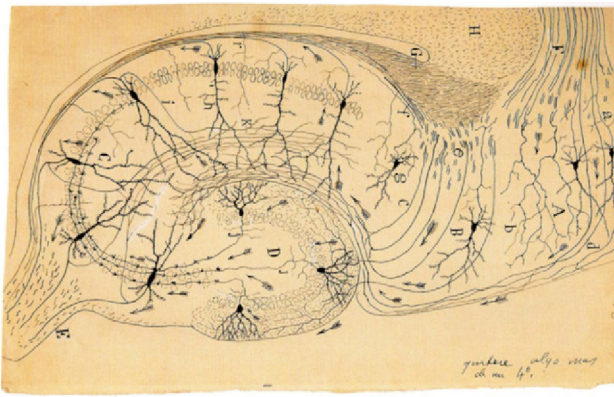


Figure 8 Cajal's sketch of the structure and connections of Ammon's horn. With permission from the estate of Santiago Ramon y Cajal.

linking CA3 with CA1.²⁴ CA1 is also known as the 'Sommer sector' because of the pioneering studies by German scientist Wilhelm Sommer. His predecessors Bouchet and Cazauvielh also produced important works describing atrophy or sclerosis of this vulnerable area of the brain, which is the pathological substrate associated with temporomedial epilepsy.^{25,26}

Numismatics and philately are almost exclusively dedicated to recalling emperors, kings, governors, monuments, ephemerides, deities, or virtues associated with the human condition and its circumstances. Despite serving as the personal physician to three emperors (Marcus Aurelius, Commodus, and Septimius Severus, in that order), Galen of Pergamon (130-216 CE) never appeared on coins; that rare privilege was reserved for Apollo, Asclepius, Salus, and Telesphorus.⁶ Even in our times, it is very rare to see a scientist depicted on currency, but there are examples such as Freud in Austria or Darwin in the UK. With the above in mind, Cajal's appearance on a Spanish banknote issued on the first anniversary of his death should grant us an idea of his legendary social status which transcended his works as a scientist and as the father of modern neurology (Fig. 9). To paraphrase Tranströmer¹ whose quote begins this study,



Figure 9 Banknote issued honouring Dr Santiago Ramon y Cajal (1852-1934) on the first anniversary of his death.

Cajal's numismatic presence can be summarised as wisdom in circulation.

Conclusions

The supreme Egyptian god Amun was assimilated by the Greeks as an epithet of Zeus. Amun was depicted with the horns of a ram, and evidence of his cult remains on Greek tetradrachms dating to Alexander the Great and consular medallions from the reign of Claudius. French anatomists of the Enlightenment borrowed the custom (from the school of Renaissance in Padua) of mentioning myths and gods of Classical Antiquity, and therefore named the curved medial temporal cortex *Ammon's horn*. Just as the god Amun and his attributes represented the universal soul according to ancient beliefs, the known regulatory function of the emotions and memory processes could earn this area of the brain the nickname of "the seat of the soul". Cajal was one of the many researchers of this primitive brain structure. Further proof of this Spanish neuroscientist's significance was that he was drawn on 50-peseta notes issued in 1935. It is now unlikely that we will see the return of Ammon's horn and the face of Cajal on Greek drachmas and Spanish *pesetas*.

Conflicts of interest

The author has no conflicts of interest to declare.

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