HOW COULD ANCIENT GREEK ATHLETES JUMP 16 METERS AND WHY MODERN ATHLETES NOT? A MULTIDISCIPLINARY APPROACH TO UNRAVEL THE TECHNIQUE OF THE ANCIENT GREEK *HALMA*

Abstract – The *halma*, which the ancient Greek pentathletes performed, included a standardized 10,5-meter run-up, which means that they still had to jump at least 5,5 meters with *halteres* in their hands in order to reach a record length of more than 16 meters. So the question is whether our modern record holders of the long jump are able to jump such a distance with *halteres* in their hands? They are probably capable to do so, but -as the English saying states that "The proof of the pudding is in the eating"- the proof of the jumping with *halteres* is in the testing! Which faculty or department of physical education or kinesiology will prove that such a jump is feasible?

Keywords: *Halma*; Ancient Olympic Games; Sport; Anthropology.

COMO OS ATLETAS GREGOS DA ANTIGUIDADE PODIAM SALTAR 16 METROS E POR QUE OS ATLETAS MODERNOS NÃO? UMA ABORDAGEM MULTIDISCIPLINAR PARA DESVENDAR A ANTIGA TÉCNICA GREGA DO *HALMA*

Resumo – O *halma*, realizado pelos pentatletas gregos da antiguidade, incluía uma corrida padronizada de 10,5 metros, o que significa que eles ainda tinham que pular pelo menos 5,5 metros com halteres nas mãos para alcançar um comprimento recorde de mais de 16 metros. Portanto, a questão é se nossos recordistas modernos do salto em distância são capazes de pular essa distância com halteres nas mãos? Eles provavelmente sim, são capazes de fazê-lo, mas - como o ditado inglês afirma "a prova do pudim está em comê-lo" - a prova do salto com halteres está em testá-lo! Qual faculdade ou departamento de educação física ou cinesiologia provará se esse salto é viável?

Palavras-chave: *Halma*; Jogos Olímpicos da Antiguidade; Esporte; Antropologia.

¿CÓMO PUEDEN LOS ATLETAS GRIEGOS DE LA ANTIGÜEDAD SALTAR 16 METROS Y POR QUÉ NO LOS ATLETAS MODERNOS? UN ENFOQUE MULTIDISCIPLINARIO PARA DESARROLLAR LA ANTIGUA TÉCNICA GRIEGA DE HALMA

Resumen - La *halma*, realizada por pentatletas griegos de la Antigüedad, incluía una carrera estándar de 10,5 metros, lo que significa que todavía tenían que saltar al menos 5,5 metros con pesas en las manos para alcanzar una longitud récord de más de 16 metros. Entonces, la pregunta es si nuestros modernos poseedores del récord olímpico de salto de longitud pueden saltar esta distancia con pesas en sus manos. Probablemente puedan hacerlo, pero, como dice el refrán inglés "la prueba del budín es comerlo", ¡la prueba del salto con mancuernas es probarlo! ¿Qué universidad o departamento de educación física o kinesiología demostrará si este salto es viable?

Palabras-clave: *Halma*; Juegos Olímpicos en la Antigüedad; Deporte; Antropología.

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Introduction

When Bob Beamon jumped 8.90 meters at the 1968 Olympic Games of Mexico City, it was said that this Olympic and world record could last until "… around the year 2020 AD (p.56)"[1]. Today, Beamon's Olympic record still stands, but Mike Powell broke the world record by jumping 8.95 meters during the IAAF World Championships in Tokyo in 1991. These two extraordinary performances of the longest jumpers in modern sport history remind us of two extraordinary long jumpers from Greek antiquity. Chionis of Sparta was famous for having jumped 16.66 meters at the Olympic Games (7th century BC) and Phayllos of Kroton for his jump of 16.31 meters at the Pythian Games in Delphi (5th century BC). These two spectacular jumps from ancient Greece are hard to compare with the modern jumps. As ancient Greek athletes were made of the same "… muscle and blood, skin and bones …" [From the 1955 number-one hit 'Sixteen tons' by Tennessee Ernie Ford] as our modern top athletes, there must be another 'rational' to explain these incredible differences in performance.

Greek philologists, archaeologists, sport historians, as well as sport biomechanists, have tried to unravel the enigma of the *halma* or ancient Greek long jump. The *halma*, from the verb *hallomai* (to jump), was practised with dumbbells or *halteres*, ranging from 1.5 to 2.5 kg, in each hand. The *halma* was a quintessential part of the pentathlon, from *pente* (five) and *athlon* (prize), a combined contest of five athletic disciplines: discus throw, long jump, javelin throw, *stadion* run and wrestling. Athletes where thus 'prize contesters' and these prizes could be highly symbolic like olive wreaths in Olympia or laurel wreaths in Delphi, but also valuable material and financial rewards as well as honorific statues or inscriptions and honorary functions in the athlete's home city.

The *halma* has raised many controversial questions about its technique because the athletes jumped with *halteres* in their hands while leaping spectacular distances. Through a review of the ancient primary sources, which are rather scarce, a first 'status questions' will be made. Publications from the Renaissance period are not included in this contribution, but a big leap is made to the modern secondary sources, which appear from the beginning of the 19th century. Biomechanical studies concerning the technique of the ancient Greek long jump will also be critically examined. Unfortunately, an in-depth research on the iconography of ancient Greek vase paintings could not be

included in this publication because of the multitude of images. However, these images were shown and amply discussed during the author's presentation at the IX Seminario de Estudos Olimpicos: A dimensão imaginária de esporte on 14 November 2019 at the University of São Paulo.

The present contribution is amply based on the author's Sarton Chair Lecture for the history of sciences of the University of Ghent (6 May 2019), which was entitled "The enigma of the *halma*: an iconographic approach to unravel the technique of the ancient Greek long jump" of which a synthesis was published in the *Sartoniana* yearbook[2].

Images from Roman mosaics and Etruscan frescos were not included in this analysis.

Ad fontes: Ancient sources on the *halma*

In the chapter Nemea 5 of his *Epinikea*, Pindaros (522-443 BC) cites "So prepare me the ground for a jump, which will carry me far from here; agile is the momentum of my knees (p. 94)"[3,4]. The ground for the jump was the so called *skamma* or landing area.

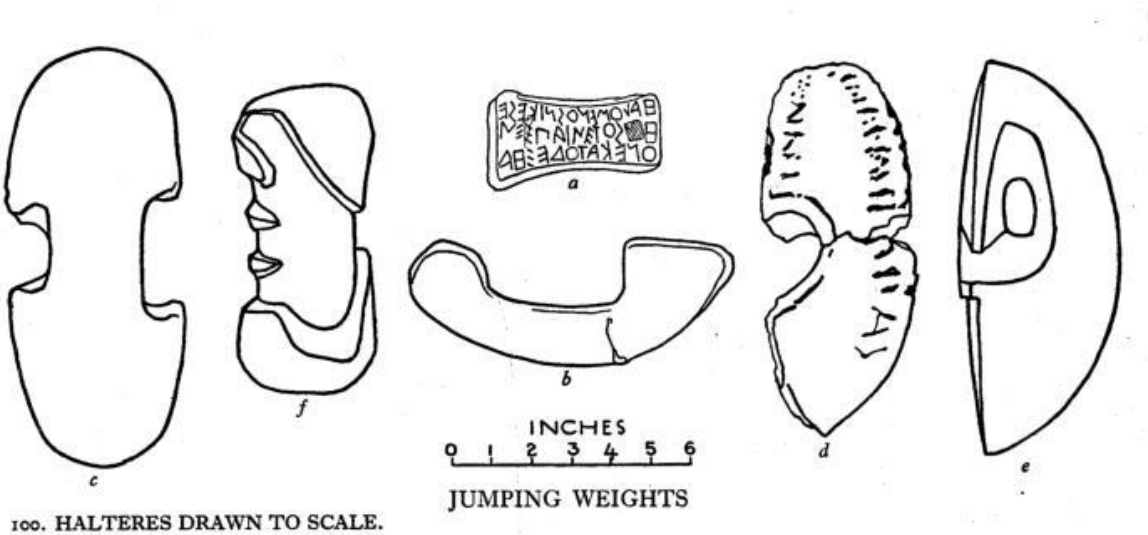
Well known is the epigram dating from the 5th century about the famous Phayllos from Kroton (Southern Italy), who won three victories in the Pythian Games in Delphi, where he was honoured with a statue. He once jumped 50 + 5 feet (ca 16.3 m) and threw the discus 100 - 5 feet (24.7 m). Thus, he landed outside the landing pit and - according to some sources- broke his leg[5].

The famous philosopher Aristoteles (384-322 BC), founder of the so called Peripathetic School, wrote in his *Problemata* (V 8), "One jumps better, he who has *halteres*, as the one who does not have them (p. 23)"[6]. The importance of the *halteres* is stressed here and images of the *halma* with such dumbbells in each hand are omnipresent. *Halteres* weighed between 1.5 and 2.5 kg and were made out of stone, lead or bronze and varied widely in shape (See figure 1).

An *halter* made of lead, weighing 2.199 kg, carried the inscription "Epainetos won the jump and therefore [dedicated] these *halters* (p. 47)"[7]. The Spartan pentathlete Akmatidis, after his Olympic victory at the end of the 6th century BC, donated a heavy

stone *halter* to the Olympic sanctuary, where it was found. This 'ex voto' *halter* weighs about 4.6 kg and mentions that Akmatides won the pentathlon "*akoniti* (p. 82)"[7,8].

Figure 1: *Halteres* drawn to scale



100. HALTERES DRAWN TO SCALE.

a. Leaden halter found at Eleusis. Athens, National Museum, 9075. 4⅛×1½ in., weight 4 lb. 2 oz. 6th century. Inscription: *Ἀλλόμενος νίκησεν Ἐπαίνετος οὕνεκα τοῦδε*: *d*, 'Epainetos by means of this won the jump'.
b. Leaden halter, one of a pair. British Museum. The type is that usually depicted on fifth-century vases. Length 8½, width at grip 1¼ in. Much worn, about 2 lb. 3 oz. A similar pair found at Athens are shorter but weigh 3¼ and 3½ lb.
c. Stone halter found at Olympia, 11½ in. long. Weight more than 10 lb. (4.629 kg.). Olympia.
d. Marble halter found at Sparta. 9 in. long. About 3 lb. Inscription: *τᾶι Ἀθαναίαι Παιτιάδας*, 'Paitiadas to Athene'. 5th century. *B.S.A.* xxvii, p. 251.
e. Stone halter. One of a pair found at Corinth. Athens, National Museum. 10¼×4×3 in. About 4½ lb. *c*, *d*, *e* are of the type commonly shown on sixth-century vases.
f. Stone halter found at Rhodes. British Museum. 7½ in. long. Nearly 5 lb. This is the type represented in later art, e. g. Fig. 70.

For *halteres* see *J.H.S.* xxiv, p. 181; *Gk. Athletics*, p. 298; Jüthner, *Ant. Turn.* p. 3. The cylindrical halteres are fully discussed by Jüthner in *Röm. Mitt.* xliii, p. 13. He conclusively disproves the conjecture of Bruno Schröder that they were a sort of weapon used by boxers.

Source: Gardiner (p. 140)[9]

This means that he was proclaimed as victor before the last of the five events, namely the wrestling in the sandpit, and thus finished "without any dust on him". He had thus either already won three of the foregoing events or he had no opponent, or his opponent accepted defeat instead of competing against him in wrestling[10].

Quintilianus (ca 35-100 AD) writes in *De institutione oratoria* (10.3.6), "This we see to happen in the jumping contest, the competitors seek a longer attempt and bring themselves in a run to the jumping pit; similarly, in throwing the javelin, we draw back our arms, and in archery pull back the bow-string to propel the shaft (p.43)"[11,12]. Here the run up to the take-off point of the *halma* is explicitly mentioned. The take-off

was made from the *bater* and the jumpers landed in what was called the *skamma*, a temporarily dug up area. Seleukos (1st Cent AD) mentions, "*Bater* is the beginning of the *skamma*" and Symmachos (2nd or 3rd Cent AD) states that, "*Bater* is the middle of the jump (p. 114)"[7,13,14]. These sources confirm that the *halma* was a run-up jump.

The well-known travel writer Pausanias (ca 115-180 AD), wrote in his Description of Greece (*Ellados periegesis*: Elis V, 26, 3) (173 AD), "Among the consecrations of Mikithos, there is *Agôn* carrying *halteres* ... they are made in such a way that the fingers of the hand can pass through, like through the straps of a shield (p. 231)"[15]. This description of the *halteres* is a noteworthy statement because it refers to the military function of the *halma*. Wolfgang Decker[16] has stressed that the *halma* originated from military training and that the halters functioned as "rudiments (p. 93)" of the Hoplite's shield and spear "… with this armament he had to be able to keep his firm position, even in uneven terrain (p. 98)". Also, Judith Swaddling[17] writes that every event was originally intended as training for warfare and "… the long-jump might have been useful for crossing obstacles like a ravine or stream (p. 69)". She also mentions the possibility that "… weights were used not to facilitate the jump at all but to deliberately make the event harder and more physically demanding… (p. 70)"[17].

Pausanias also mentioned the 55 Delphic feet jumped by Phayllos of Kroton[18], but that famous jump of Phayllos (16.31 m) was even 'surpassed' by Chionis of Sparta. Sextus Julius Africanus (ca 160-240 AD) praised Chionis for his jump of 52 Olympic feet (16.66 m)[18]. The same Chionis was listed by Eusebius of Caesarea (ca 260-340) as three times victor of the *stadion* race in Olympia in 664, 660 and 656 BC.

The physical demands of the *halma*, were also paraphrased by Artidoros of Daldis (ca 135-200 AD) in his *Dreambook* (*Oneirokritika* I.57)[15]

> (...) often on the other hand the pentathlon means also sorrows and worries because of the leaps one makes in the jump with the *halteres*: for about people who complain about the sudden misfortunes which happen to them, we say that they leap from grief (p. 228).

A significant observation was made by Julius Pollux (2nd century AD) in his *Onomastikon* (Language *thesaurus*), "The place from which the jump is made is the

bater, whence the expression, 'He has hit the *bater* with a bang' (III, 151)", "... *bater*, but to some the *balbis* (III, 147) (p. 107)"[12,19,20]. Hugh Lee[12] has therefore pointed out that, "The *balbis* also seems to have been the *bater*, the take-off point, for the jump, as well as the foot marker used by javelin and discus throwers (p. 158)".

Phlabios Philostratos[15,21] (ca 170-247 AD) wrote several clarifying details on the *halma* in his *Gymnastikos* (ca 219 AD).

> (...) the pentathlon comes from the union of the two categories: wrestling and discus throwing are the heavy events, whereas javelin throwing, the jump and the run are the light events. Before Jason and Peleus there was a separate prize for the jump and another one for the discus throw (...) (p. 137).

Philostratos[15,21-23] further stated that,

> The pentathlete should be heavy rather than light, and light rather than heavy. He should be tall, well built, with good carriage, and with musculature which is neither superfluous nor inadequate; His legs should be long rather than strictly proportionate, and his hips should be flexible and limber for the backward bending of throwing the *akon* and the *diskos* and for the *halma*. He will jump with less pain and less likelihood of breaking something in his body if he can land softly by letting his hips down gradually (p. 159).

The role of the *halteres* and the assistance of the auletes (double-flute player) were stressed as follows[15,21,22,24]

> The *halter* is a discovery of the pentathletes which was invented for use in the *halma* from which it gets its name. The rules regard jumping as the most difficult of the competitions, and they allow the jumper to be given advantages in rhythm by the use of the flute, and in weight by the use of the halter. This is a sure guide for the hands and leads to a clear and firm landing on the ground. The rules show the

> value of this point, for they do not allow the jump to be measured unless the footprints are perfect (p. 231).

A rather cryptic remark was made by Themistios (317-390 AD) in his Notes on Aristotle's physics 5.3, "For those jumping in the pentathlon do not make a continuous movement, because they interrupt part of the interval in which they are moving (p. 50)"[7]. Could this mean the moment of the take-off, situated between the run-up and the jump? Adepts of the 'multiple jump' thesis of the *halma*, have 'jumped' on this passage as proof of their opinion[25]. Sweet[7] who cited this remark by Themistios, commented, "However, there is no solid ancient evidence, either literary or pictorial, to support the theory of the multiple jump (p. 50)".

After hopping through the ancient sources, let us now make a big leap to the modern scholars of ancient Greek athletics. The secondary sources on the *halma*, mentioned in publications of authors from the Renaissance and Enlightenment period (16th -18th century) are not included in this article, but can be consulted in: The enigma of the *halma*: an attempt to unravel the technique of the ancient Greek long jump[2].

Greek classical philologists and sport historians discuss the ancient *halma* technique

A renewed interest in ancient Greek athletics was stimulated in Germany by the founding fathers of German gymnastics Gutsmuths and Jahn. When Johann Christoph Friedrich GutsMuths (1759-1839), author of Gymnastics for youth (1793), was appointed at the Philantropin School in Schnepfenthal, he became familiar with the so called *Dessauer Pentathlon* which comprised running, jumping, throwing, balancing and carrying exercises. Friedrich Ludwig Jahn (1778-1852) oriented the new physical education trend into the German nationalist Turner movement. After the German archaeologist and historian Ernst Curtius (1814-1896) had travelled in Greece between 1836 and 1840, he obtained in 1874 the exclusive agreement with the Greek government to excavate the site of Olympia. All this stimulated the interest for ancient Greek physical culture in his home country.

Johann Heinrich Krause[26] published in 1838 his Olympia oder Darstellung der grossen Olympischen Spiele, in which he cites the exceptional jump of Chionis of

Sparta and mentions the *halteres*, the *bater* and *skamma* as essential components of the *halma*. In his later publication Die Gymnastik und Agonistik der Hellenen, Krause[27] mentions Phayllos 55-foot jump and adds other elements of the *halma* such as eskammena, *kanoon* (measuring device), *auletes* and *skapheion* (pickaxe for preparing the *skamma*).

Julius Bintz[28] (1843-1891) mentions in his 1878 publication Die Gymnastik der Hellenen a run up to the *bater* and the *skamma* with *halteres*, the role of the auletes and the spectacular 55-foot jump of Phayllos. He stresses the landing on two feet and points out that the *halma* was not a hop-step-jump nor a (Greek traditional) triple jump. He mentions that a German officer jumped 23 feet with *halteres* in uniform and without much training and reminds us that, "The Hellenic antiquity, which was used to quite different physical performances (p. 42)"[28] and "(...) a performance which stood unequalled for centuries among a people, which practiced physical exercises like no other one later (p. 43)".

The German philologist and Turner Karl Wassmannsdorf (1821-1906), on the contrary, explains in Monatschrift für das Turnwesen (1885) the distance jumped in the *halma* as a triple jump, consisting of two steps ('Sprungschritte') and a jump (Wassmannsdorf[*], 1885 apud Gardiner, 1904, p. 74).

The Czech-Austrian classical philologist and archaeologist Julius Jüthner (1866-1945) has made some of the most valuable contributions to our knowledge of ancient Greek athletics. In his 1909 publication Philostratos über Gymnastik[21] he quotes, "(The pentathlete) should rather have long than proportional legs and mobile loins [...] for he will jump painless and not break any body parts when he, lowering his hips slowly, ends in a firm position (p. 159)". He further cites Philostratos[21], who saw, "War as preparation for gymnastics and gymnastics as preparation for war (p. 171)" and who stated that, "The halter is an invention of the pentathlete [...] (p. 181)". Friedrich Brein edited in 1965 and 1968 two volumes of Jüthner's earlier publications under the title Die athletischen Leibesübungen der Griechen. In his description of the *halma*, Jüthner[14] speaks of a small spreading start position, the arms forward, *halteres* in the hands, a run up to the *bater* (according to Seleukos for take-off, according to Symmachos 'in the

[*] Wassmannsdorf Karl, 1885, Monatsschrift für das Turnwesen 4: 270-275. p. 270.

middle'), the *skamma* as landing pit and *eskammena* as end, the kanoon not as a rod but as the standard length of the jump, the musical assistance by the auletes, the jump as a triple jump (either hop-step-jump or hop-hop-jump), landing on two feet, the *halteres* swung back but retained, the marks (*symeia* or *symata*), the *skapheion* (pickaxe) and -of course- the two 'record jumps' by Phayllos of 55 Delphic feet (16,28 m) and Chionis of 52 Olympic feet (16,66 m). Moreover, the 1965 and 1968 (re)editions of Jüthner's[14,29] 'oeuvre' by Brein, contain a large overview of Greek vase paintings, depicting crucial scenes of the complicated Greek long jump, which make this publication a 'sine qua non'.

Also, the modern sport movement in Great Britain, which originated in the elite Public Schools and fostered the ideal of amateurism, tended to 'project' their amateur sport ethos on the ancient Greek athletic '*cultus*'. Percy Gardner[30] (1846-1937), a classical archaeologist who is considered the founding father of the British ancient Greek sport historians, wrote in 1880 an article 'The pentathlon of the Greeks' in the Journal of Hellenic Studies (1: 210-223). He made the strange statement that, "The leap would appear from the numerous representations which we possess of it on ancient monuments to have been taken standing (p. 210)". This is moreover contradicted by the image shown in his article (Plate VIII) of four pentathletes with the jumper in a run up or take-off position with legs spread forwards and the arms with *halteres* swung upwards. He[30] further cites the expression "to jump over the *eskammena*", which he interpreted -referring to Pindar, "[…] as the marks drawn with a fork to mark the distance of the jumps [...] (p. 213)". Both David Young[31] and Donald Kyle[32] have seriously criticized Percy Gardner and his 'follower' E. Norman Gardiner, who claimed that early Greek athletes were all idealistic noble amateurs and that athletics degenerated with professionalism in the fifth century, which was nothing else than a vision "[…] seen through the gentleman amateur's eye (p. 204)"[32].

The British sport historian E. Norman Gardiner (1864-1930), who was generally considered as the leading authority on Greek athletics in the Anglophone world, published in 1904 an article on 'Phayllus and his record jump' in the Journal of Hellenic Studies (24: 70-80)[33]. He describes the function of the *halteres*, the bater, the fact that the *skamma* and *eskammena* were the same landing pit, the pegs used as markers of previous jumps and the kanoon as measuring rod. He[33] stresses that there was a short

run-up, "[...] the Greek jumper [...] takes a few short, springy steps [...]" and that it was "[...] not possible that the Greek long jump was a series of three jumps. [...] The various attempts to explain such a jump are unsupported by any evidence (p. 75)" (See figure 2). He[34] repeated the same vision in 1925 in his well-known Olympia: Its history and remains 1925. In Athletics of the ancient world 1930, Gardiner[9] further explained that there was a one-foot take-off and that a regular impress of the feet was required at the landing. He[9] mentioned the role of the auletes and commented that a jump of more than 50 feet was, "Either [...] not a single jump or the record is pure fiction (p. 152)". Strangely enough, he[9] accepted the existence of a "standing long jump without weights" (p. 145; 151) as depicted on an Attic red figure krater and an Attic red figure *pelike* (two types of vases). The latter picture which was later also shown by Finley and Pleket[35] although it does not represent the starting position of a jump but of the *stadion* run, "errare humanum est (p. 90)". Donald Kyle[36] commented,

> For decades Gardiner was authoritative, and his followers continued in the same vein. Since the mid-1970s Gardiner has been challenged more and more, especially about his comparison of the so-called 'decline' of ancient athletics and the waning of the amateur ethos in modern sport (p. 28).

Figure 2 - An exceptional 'movement analysis' of the *halma*. This scene depicts an athlete during his run-up, swinging his arms backwards and forwards (three images from left to right), then swinging both arms upwards during his take-off on the *bater*. It is unclear why he looks backwards on the first two images. This looking backwards during the run-up appears also on some other vase paintings.

Source: Attic Red-Figure Cup Fragment. Wider Circle of Nikosthenes Painter (Greek (Attic), active Athens, Greece 510 - 500 B.C.). Los Angeles (Ca): J. Paul Getty Museum.

Bruno Schröder[13] stated in Der Sport im Altertum (1927) that there exists no artistic nor literary proof of a standing broad jump and that there was an upright start position. He quoted Phayllos' 55 feet jump as "Spielerei" (pure phantasy) from a "Verseschmied" (versifier).

His compatriot Franz Mezö[18], however, in his Geschichte der Olympische Spiele (1930) mentioned both standing and running jumps in which, the arms were swung backwards for steady landing and he explained the Phayllos and Chionis jumps as the sum of three jumps.

Also, the American philologist Walter Woodburne Hyde[37] was of the opinion that -taking into consideration the 8.06 m jump "[…] by the American negro (sic) Jesse Owens at the 11th Olympics, Berlin, 1936 (p. 410) "- single jumps of 50 or 52 feet are manifestly impossible and that "[...] the pentathlum jump was a multiple one (p. 410)"

The French historian Henri Irénée Marrou[38], in his Histoire de l'éducation dans l'Antiquité (1948; 1964) described the *halma* as a long jump with a short run-up.

Edgard Pouelmans[39], in his remarkable licentiate thesis on the pentathlon presented at the University of Leuven in 1948, distinguished (in the Gardiner tradition) a standing broad jump without *halteres* from a long jump with run up and *halteres* and found no evidence for a triple jump.

Bruno Saurbier[6] in his Geschichte der Leibesübungen, considered -like Mezö[18], the *halma* as three one legged jumps. Whereas Ulrich Popplow[40] in Leibesübungen und

Leibeserziehung in der griechischen Antike stated that the *halma* started with a run-up and that the take-off took place from the *bater*, a fixed threshold in the ground, "In many cases the starting device (Ablaufvorrichtung) of the run was used for this purpose (p. 153-154)".

Willy Zschietzschmann[41,42] published Wettkampf- und Übungsstätten in Griechenland in two volumes: I. Das Stadion (1960)[41] in which he mentions the end zone in the Olympic Stadion: 8 to 10.5 m between balbis and 'West End'; the end zone in Delphi: between *balbis* and *sphendone* (kind of amphitheatre). These elements will play an important role in explaining the distance covered by the long jumpers as we will see later. In volume II. *Palästra – Gymnasion*[42] he depicts a double track for training triple jumps in the *palaestra* of the Olympic *gymnasion* with an 18 m run-up zone to the *bater* and a 10 m *skamma* landing zone and 5 m extra *eskammena* (according to Carl Diem). However, we have nowhere found any archeological evidence of such an infrastructure!

Harold Arthur Harris (1902-1974) is often considered as the successor of E. Norman Gardiner in England. He published in 1960 'An Olympic epigram: the athletic feats of Phaÿllos'. Harris[5] wrote the following "[…] possible explanation of the Greek jump [...] That it consisted of a single leap with a restricted run-up, and that this leap was measured from the start to the run-up; that there was a final take-off, the bater [...] at the end of the run-up; [...] that the dug-up pit lay beyond this final take-off; ... that the distance normally achieved was such that the pit ending 50 feet from the starting point was thought enough adequate until Phaÿllos' effort. In practice the number of steps between the starting-point and the final take-off would have become [...] as standardized as the modern hurdler's three strides between the hurdles [...] (p. 7)". Here Harris thus formulated the solution of the enigma of the *halma*, four years before Spaak[43] (1964) and forty-seven years before Lee[12] would propose a similar scenario of the *halma* as a single jump with *halteres* after a standardized restricted run-up! Harris stuck to this opinion in his 1964 publication Greek athletes and athletics, "[…] although vase paintings sometimes depict an athlete possibly about to make a standing jump, the vastly greater number showing a jumper running with his weights suggests that the Greek jump, like ours, was done with a run; the standing jump was no doubt part of the training routine. The take-off for the jump was probably the starting line of the runners

(p. 83)". However, eight years later, in his Sport in Greece and Rome[44], he drastically changed his opinion. Now he suggested a multiple, double, triple or quintuple jump and, "That the ancient technique was highly elaborate is suggested by the number of vase-paintings which depict athletes practising with them (*halteres*) (p. 36)".

The former East-German classical philologist and sport historian Joachim Ebert (1930-1999) occupies a pivotal position in the *halma* discussion. Ebert graduated in 1960 with a thesis on the ancient pentathlon and presented his 'habilitation' in 1968. However, because he refused to become a member of the Socialist Unity Party, he had to wait till 1983 before he became a full professor at the University of Halle[45]. He combined his double education as a philologist and sport scientist at the university of Halle to prove that the 'record jumps' of 55 feet by Phayllos and of 52 feet by Chionis could be equalled by a modern athlete, performing five consecutively standing broad jumps with *halteres* of 2.5 kg in each hand[46]. He showed this 'reconstruction' in a photographic movement analysis, which would later inspire several sport biomechanists to test his thesis. Ebert's[46] publication, which was extensively commented by the Dutch classical archeologist Jaap M. Hemelrijk[47], was a kind of *kampter* (turning post) in the *halma* literature because from now on the majority of authors turned to the multiple jump's thesis!

Before summarizing the diverging opinions with regard to the *halma* enigma in a chronological table (See Table 1), we would like to add one rather exceptional interpretation of the *halma*, presented in 1964 by the Dutch sports journalist Bob Spaak[43] in his book Gods in the stadion: the Olympic Games in Antiquity (in Dutch). Spaak, who cited the Phayllos jump and noticed -from vase images- that the *bater* was often marked with a pole (*kampter*) or with javelins planted in the ground, came up with the original proposal that, "It could be that the Greeks added up the run up and jump, which implies that all athletes had to start from the same spot (p. 120)". So, he already suggested the inclusion of a standardized run-up zone in the total distance of the *halma* performance, 43 years before Hugh Lee[12] would present this thesis!

The diverging opinions about the nature of the *halma* can be divided into two factions: those who are convinced that it was a running long jump on the one hand and those who claim that it was a multiple jump on the other hand. These opposite opinions are listed in Table 1: Authors in favors of the *halma* as a series of multiple jumps versus

those in favors of a running long jump. Percy Gardner[30] occupies an 'apart' position as he spoke of a "standing leap". Also indicated are the authors who claim that the *halteres* were either dropped before the landing and those who suggest that they were swung backwards but retained at the landing.

Table 1: Authors in favors of the *halma* as a series of multiple jumps versus those in favors of a running long jump.

MULTIPLE JUMPS	RUNNING LONG JUMP
Gardner[30]: standing leap	Bintz[28]
Wassmannsdorf[†]: triple jump	Gardiner[9,33,34]
Jüthner[21]: triple js	Schröder[13]: No st br j
halteres swung back	
Mezö[18]: triple js-standing & running js	Marrou[38]
Hyde[37]: multiple jump-standing l j without *halteres*	Pouelmans[39]
Saurbier[6]: run & 3 1 leg js	Popplow[40]
Zschietzschmann[41-42]: multiple js	Harris[5,48]
Ebert[46]: 5 standing br js	Spaak[43]: run + j = *halma*
Harris[44]: multiple/double/triple or quintuple js	Patrucco[49]
Finley; Pleket[35]: 5 separate or contin. Js -*halteres* dropped	Paleologos[50]: short run up
Brein[50]: quintuple jump	Sweet[7]: no multiple js
Swaddling[17]: multiple j	Hupperts[25]: short run 1 ft
halteres swung back--pictures of sbjs	
Derksen[52]: multiple sbjs	Grodde[11]
halteres dropped- take-off	
Lenoir[53-55]: 5 standing br js	Young[56]
Van Hove[3-19]: 5 standing br js	Miller[23]
Schmid[57]: triple jump	Kyle[58]
Sinn[59,60]: 5 standing br js	Lee[12]: from end stadion
halteres swung backwards	
halteres swung back and dropped	
Decker[61]: 5 standing js	Jajcevic[62]
Bäumel[63]: 5 standing br js	
halteres dropped	
Manas; Rodríguez-López[64]: standing triple jump	

[†] Wassmannsdorf Karl, 1885, Monatsschrift für das Turnwesen 4: 270-275. p. 270.

The table 1 shows the major impact which Ebert's publication[46] had on the different authors cited. We are not able to comment each of these publications but would like to make three exceptions: Brein's publication[50] of 1978, Harald Schmid's[57] doctoral thesis of 1997 and Lee's publication of 2007.

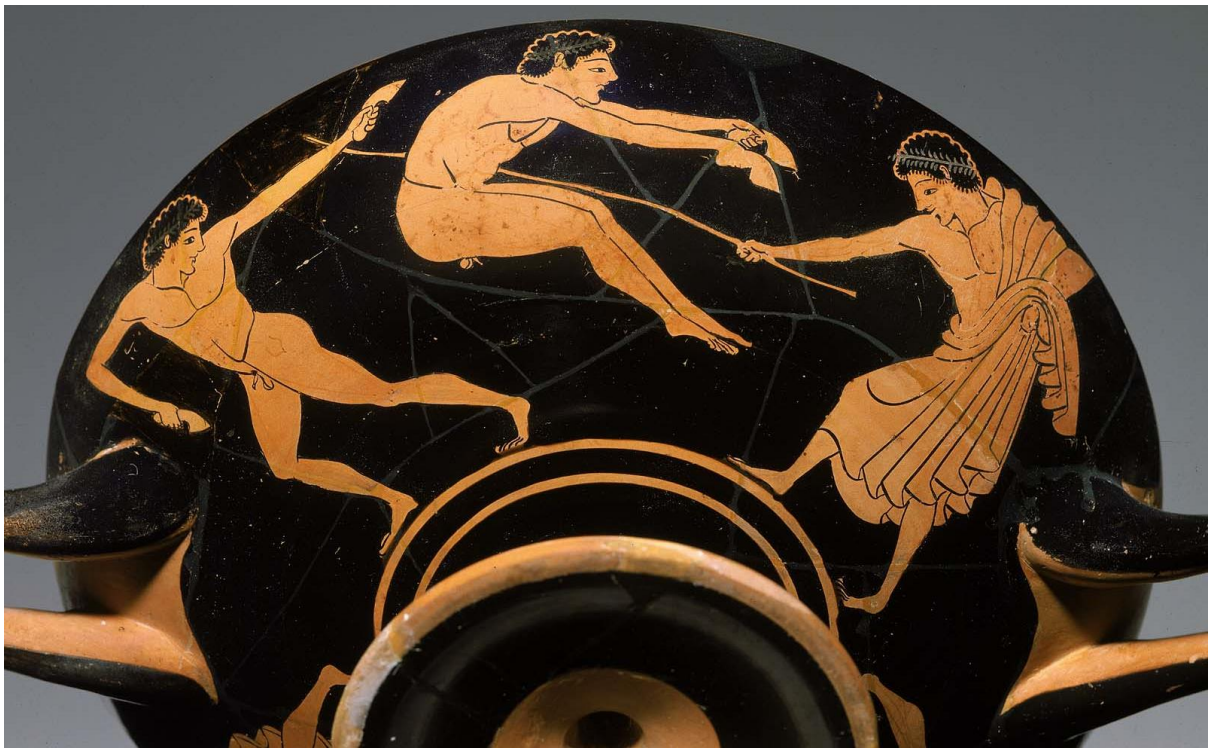
Friedrich Brein[51], who has edited Jüthner's magnum opus[14,29]), suggests that the skamma was 50 feet long dug up, which started at the balbis (starting blocks) in the direction of the stadion run (p. 93). Brein[51] opts -in line with Ebert[46] for a quintuple long jump with *halteres* and accompanied by the sound of the aulos, whereby the athlete took off with one foot from the *balbis* and continued with standing broad jumps in the dug up *skamma*.

Harald Schmid[57], former European champion both in the 400 m hurdles and 4 x 100 m relay and Olympic bronze medalist in the 4 x 100 m relay in Montreal in 1976 and in the 400 m hurdles in Los Angeles in 1984, published his doctoral thesis in 1997 entitled Zur technik des Weitsprungs in der griechischen Antike (two volumes). This sport scientist presents an excellent review of literature, an extensive iconography of the *halma* and makes interesting references to contemporary traditional long jumps in Greece and Cyprus (without *halteres*) and modern hop-step jumps. But, after all these academic endeavors, he comes to the following stunning conclusions that there is no indication of a *bater* nor *skamma* nor clear landing marks, nor in literature nor in iconography. Referring to his study of folkloristic triple jumps, still practiced in Greece and Cyprus, he concludes that such a triple jump without *halteres* is the only solution to solve the question of the ancient long jump and that, "The vase images don't depict athletic jump contests but jump training with halters (p. 162)". No further comments …

In his much-cited publication 'The *Halma*: a running or standing jump?' Hugh M Lee[12], professor of Classics at the University of Maryland (US), first confronts the 'Running long jump school' with the 'Standing broad jump school'. He points to the publication by Olaf Grodde[11] on Sport bei Quintilian from which he cites, "The competitors seek a longer attempt and bring themselves in a run to the jumping pit (p. 156)". He further illustrates this explicit mention of the run-up with the visual evidence of two jumpers on a red figure kylix by the Telephos painter, preserved in the Boston Museum of Fine Arts (See figure 3).

One of these 'iconic' images had already appeared in a chapter by the Belgian archaeologist Doris Van Hove in her exhibition catalogues in Dutch and French Sport in Hellas / Le sport dans la Grèce antique[19,65] (p. 107) (See figure 3). Although Van Hove identifies the vase painting as athlete hits the *bater* with a bang, she remains persuaded that the *halma* was a combination of five standing broad jumps, based on the laboratory experiments by Lenoir[53]. Thus Lee[12] 'reformulates' the thesis, already put forward by Harris[5] in 1960 (but who later changed his opinion) and by Spaak[43] in 1964, that the *halma* combined a run-up from the border of the stadium [ca 10.5 m] with a take-off at the *balbis*, marked by a *kampter*, to a landing in the *skamma*.

Figure 3: Pentathlon scene with *akontist* (javelin thrower) and jumper with *halteres* during take-off on the *bater*, watched by an official or a trainer. Here the *bater* is the *balbis*, marked by a *kampter* (turning post).



Source: Attic red figure kylix attributed to Telephos painter ca 470-460 BC. Boston: Museum of Fine Arts.

Biologized by the *halma*: the biomechanists

Two of the major pioneers of human movement analysis, Eadweard Muybridge (1830-1904) and Georges Demenÿ (1850-1917) photographed the sequences of the long jump. Muybridge[66] developed the high-speed photography with different cameras. Demenÿ[67], who was the assistant of Etienne-Jules Marey (1830-1904), considered the father of chronophotograph, analyzed both the running long jump as well as the standing long jump. In his 1904 publication Mécanisme et éducation des mouvements (reprinted in 1924) Demenÿ[67] showed an illustration of a circus acrobat, who jumped over a horse-drawn carriage, throwing away the *halteres* he held in his hands at the take-off, which "[…] increased the horizontal speed of his body. Like in the explosion of a bomb, the parts projected forwards, will touch the ground at a further point (fig. 427 p. 333)". The circus artist in question was the Englishman John Higgins (1872-?), who made jumps with *halteres* his specialty[68]. However, no reference was made to the ancient Greek pentathletes, although Guillaume Depping[69] in his Merveilles de la force et de l'adresse (1886) had already pointed out the role of the *halteres*, "[…] which provided a greater momentum and energy to the jumper and acted as counterweights when he landed on the ground. (p. 143)".

The impact of Ebert's biomechanical thesis of a series of five consecutive standing broad jumps with *halteres* has already been stressed[46]. He not only convinced a whole generation of sport historians but also inspired sport biomechanists to test his standpoint.

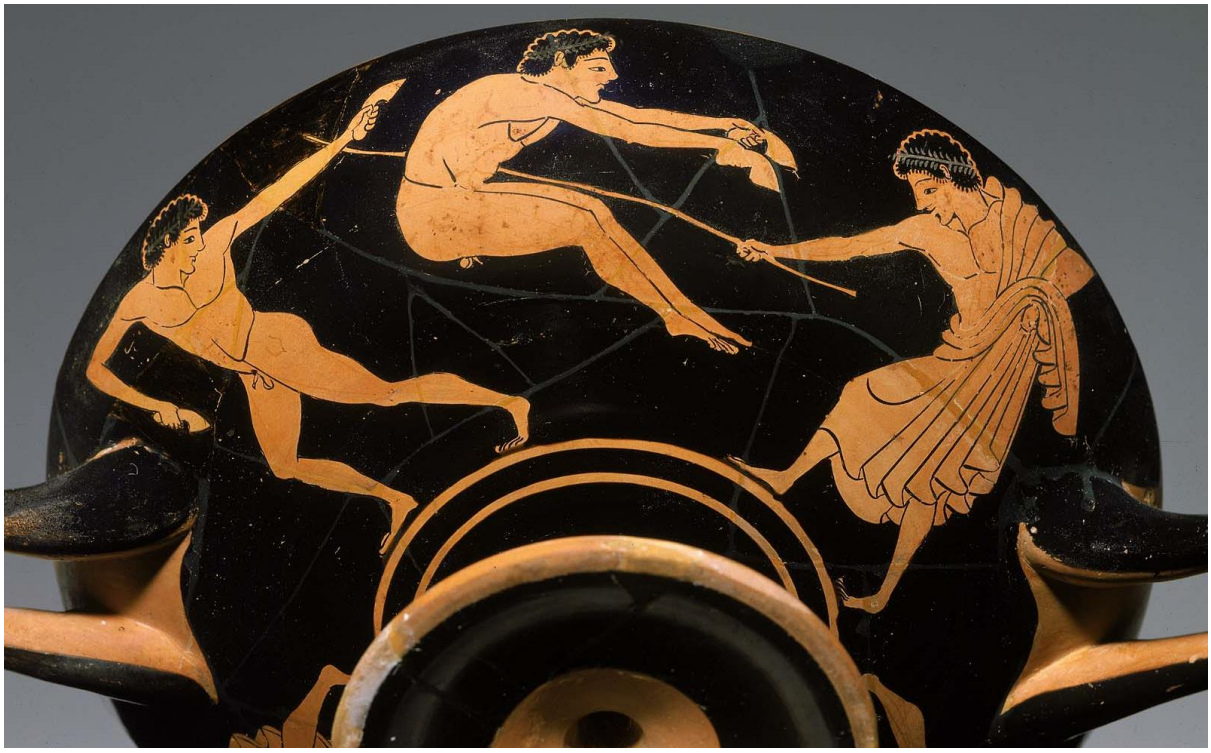
The article by Minetti and Ardigo[70] is probably the most cited biomechanical explanation of the ancient Greek long jump, probably because it was published in Nature. Inspired by Ebert[46], they tested whether *halteres* could extend a standing broad jump. However, they used a software model of a jumper with weights varying from 0 to 20 kg but in a vertical jump. Moreover, four subjects were asked to perform maximal vertical jumps on a force platform with a pair of *halteres*, which ranged between zero to 17 kg. They concluded that a greater distance of at least 0.17 m in a 3-m jump can be achieved during a loaded horizontal jump (which they did not test…) and,

> That the mass range of the halteres that enables all these effects to be optimized (about 2-9 kg) corresponds closely to the actual size range of archaeological halteres specimens […] suggesting that athletes in ancient times had worked this out for themselves (p. 142).

Butcher and Bertram[71] conducted a simple lab exercise to investigate the effect of carrying pairs of handheld weights of 1.4, 2.3 and 3.6 kg in a standing long jump. Only two subjects, a male of 90.9 kg and a female of 57.3 kg, were tested. The effect on each of the jumpers was very similar, but the larger individual had a greater advantage by using heavier weights.

The article by Lenoir, De Clercq and Laporte[54] on 'The "how' and 'why' of the ancient Greek long jump with weights: a five-fold symmetric jump in a row?' is of a very different level than the two foregoing ones. The authors refer to Ebert[46] and Minetti and Ardigo[70] and combine an in depth-review of literature and pictorial sources with a filmed biomechanical analysis of five consecutive standing broad jumps performed by four trained athletes with and without weights. All four jumped further with weights of 2.3 kg each than without weights. The only problem is that Lenoir and his colleagues[54] are so 'impressed' by the performances of Phayllos of Kroton and Chionis of Sparta, who jumped respectively 50 Delphic and 52 Olympic feet, that they seek the solution of the enigma in Ebert's thesis of five standing broad jumps and thus decline all other visual evidence offered by vase paintings. "[…] presenting the athletes with the legs spread apart is very likely the result of artistic considerations rather than a reliable reproduction of jumping technique (p. 1036)" or "The second objection against interpreting pictorial remains as evidence for a running jump is that *halteres* were also used for training exercises (p. 1037)". They claim that "This technique is also compatible with the written and pictorial remains of that era (p. 1042)". Nevertheless, these University of Ghent colleagues remain their academic 'cool' when they conclude that "The ancient Greek pentathlon jump could have been a five-fold standing broad jump […] the dynamical version of the five-fold jump remains a plausible explanation of the 55 jumps of Phayllos (p. 1042)". A Dutch version of this article appeared in *Sportimonium*[55].

Figure 4: Jumper in mid-flight during *halma* practice in the *palaestra* with trainer and another jumper.



Source: Attic red figure kylix ca 500-490 BC attributed to Onesimos painter; Boston: Museum of Fine Arts.

Decatoire, Monnet and Junqua[72] studied the effect of releasing the weights during a long jump performed by one of them, which resulted in a gain of 21 cm. Results from a master thesis in engineering at Grand Valley State University showed that performance in a standing broad jump improved with weights by an average of 9 cm. Further it was proven that releasing the weights before landing added an additional 3-7 cm on average[73]. Although several authors have suggested this technique of dropping the *halteres*[23,50,52,58,62], there exists -to our knowledge- not one single image of it in ancient Greek iconography, but it has been spread through a 'visual reconstruction' by K. Iliakis, which appeared in the chapter on 'Jumping' by Klianthis Palaeologos[50] (p. 178-179) in The Olympic Games in ancient Greece, edited by Nicolaos Yalouris. This is an example how modern iconography can 'infect' ancient images.

A synthetic overview of publications and congress reports on the effect of using *halteres* in standing long jumps has been given by McKenzie, Chloe, Matt, Gamble,

Chris[74] from Auckland University, New Zealand. However, as not one single image of such a standing long jump with *halteres* could be traced in our extensive iconographic analysis, we will not go into further detail on this matter. Nevertheless, the 'Ebert standing broad jumps thesis of the *halma*' has inspired many school teachers, university professors and sport fans to try out jumping with handheld dumbbell weights. Such an example was, for instance, the collaboration between the School of Art and the Athletics Department of the Texas Tech University at Lubbock. Four participants tested a standing broad jump with 'homemade' bronze *halteres* of the phone receiver type. They jumped three times with no weights and three times with weights of 3, 2 and 1 kg. Remarkably enough, three of the four participants jumped farthest on average with no weights while one jumped farthest on average with 3 kg weights[75]. All in all, this experiment was more a successful collaboration experiment between a Classics department and an Athletics department than an elaborate biomechanical experiment.

Jumping to conclusions with the help of iconography

Presenting an article on the technique of the ancient Greek long jump without referring to the extensive iconography related to the topic, is almost like participating in the *halma* without *halteres*. During the Sarton Medal Lecture[2], we have extensively referred to -and shown- the multifaceted iconography on the topic, which stands in strong contrast to the scarce written sources. These images, which say more than a thousand words, are rather abundant but need critical interpretation. Jüthner and Brein[14] pointed out that the literary sources of how the long jump training took place are very sparse and that we are almost exclusively dependent on pictorial sources, "The question is whether the research based on these literary sources of the pentathlon jump is confirmed by the visual images [...] The challenge is thus to interpret the entire material integratively ("zusammenfassend") (p. 213)". Others are more than sceptical about iconography. Howland[76], for instance, has stressed that,

> […] vase paintings are our main source of information, but Harris (1964) rightly emphasizes that this kind of evidence is unreliable. Artists are not photographers and are not always well versed in

> athletics. Runners, for instance, are frequently depicted in an impossible attitude [...] (p. 381).

Taking into account these 'anti-iconographic' warnings, one cannot deny the overwhelming visual evidence that the pentathletes competing in the *halma*, started from a spread position with the *halteres* in their hands. Then followed a run-up with the *halteres* swung rhythmically, assisted by the sound of the auletes, followed by a take-off on the *bater* with the arms swung up high. During the flight phase the arms are first swung forwards (see figure 4) and just before landing backwards and forwards again to secure a stable landing with clear footmarks (see figure 5). David Young[56] commented, "[...] Many scholars have accepted the hypothesis of the eminent German scholar, Joachim Ebert (1963), namely that the ancient jump consisted of a series of five standing broad jumps. But the evidence from art excludes any possibility of a standing jump (p. 35)". We thus share Harris's[5,48] original vision on the long jump, explicitly formulated by Spaak[43] and by Lee[12], that the *halma* included a run-up of ca 10.5 m from the border of the *stadion* (often a semicircular *sphendone* as seen in the pictures by Sturzebecker[77] to the stone *balbis*, which served as starting line of the *stadion* run but also as the *bater* or take-off point for the jump. The *bater* is also the beginning of the *skamma* or dug up area and pickaxes are often depicted, which were used for that purpose. The *skamma* in which the jumper had to land with clear footmarks, was about 5 to 6 m long, which explains why Phayllos of Kroton gained such fame when he landed outside the dug-up zone with his 16.31 m jump.

Let us end this enigmatic history with the picture of a jumper who has just landed in the *skamma* in a stable position with the *halteres* in his hands, depicted on a kylix from the 5th century BC. We hope that our conclusion is as stable as this landing!

Figure 5: Pentathlete finishing his *halma*-jump in the skamma with the *halteres* in his hands and a pickaxe (*skapheion*) in the background.

Source: Red figure kylix 5th Century BC, with inscription 'kalos' (beautiful), attributed to the Louvre Group. Lecce (Italy): Museo Provinciale Sigmondo Castromediano.

The answer to the original question: "How could ancient Greek athletes jump 16 meters and why modern athletes not?"

The *halma*, which the ancient Greek pentathletes performed, included a standardized 10,5-meter run-up, which means that they still had to jump at least 5,5 meters with *halteres* in their hands in order to reach a record length of more than 16 meters. So, the question is whether our modern record holders of the long jump are able to jump such a distance with *halteres* in their hands? They are probably capable to do so, but -as the English saying states that 'The proof of the pudding is in the eating' - the proof of the jumping with *halteres* is in the testing! Which faculty or department of physical education or kinesiology will prove that such a jump is feasible?

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