

Stratagems, Combat, and “Chemical Warfare” in the Siege Mines of Dura-Europos

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Abstract

The Sasanian Persian siege that destroyed Roman-held Dura-Europos, Syria, ca. 256 C.E. left some of the best evidence ever recovered for the nature and practices of ancient warfare. Perhaps the most dramatic of the archaeological deposits, excavated in the early 1930s, were those resulting from the mining duel around Tower 19 on the city's western wall, during which at least 19 Roman soldiers and one Sasanian became entombed. Recent reanalysis of the excavation archive suggested that the mine evidence still held one unrecognized deadly secret: the Roman soldiers who perished there had not, as Robert du Mesnil du Buisson (the original excavator) believed, died by the sword or by fire but had been deliberately gassed by the Sasanian attackers. This article discusses the implications of this conclusion for our understanding of early Sasanian military capabilities and reviews the question of possible reexcavation in search of the casualties of Tower 19, whose remains were neither studied nor retained.*

INTRODUCTION

The treasures of the fortified city of Dura-Europos on the Syrian Euphrates, some 50 km downstream of its confluence with the Khabour River and 45 km upstream from the modern Iraqi border, are among the most important and remarkable finds ever made for the archaeology of the Graeco-Roman and Partho-Sasanian Middle East. Because the city met a violent death and was never substantially reoccupied, an extraordinary wealth of artifacts, artwork, architecture, inscriptions, and papyri survived for archaeologists to discover.¹ Not the least of these finds relate to the final cataclysm itself, deposited during the drastic prepara-

tions the Roman garrison made to withstand an anticipated Sasanian siege and in the ensuing struggle for the city, which, while it was lost to history, archaeology shows took place ca. 256 C.E. The dramatic remains of the siege show that this was a duel of stratagems as much as of swords; and while the outcome was a Roman defeat, it nevertheless underlined the Roman general Corbulo's maxim that the digging tool was the weapon with which to defeat the enemy (Frontin. *Str.* 4.7.2).

Research continues at the site today, building on the work of Yale University/French Academy excavations of the 1920s and 1930s.² One of the original excavators, Robert du Mesnil du Buisson (hereafter du Mesnil), himself a military officer and largely self-taught archaeologist,³ concentrated especially on the remains of the final siege, discovering much dramatic testimony of the fighting (fig. 1). This included gruesome evidence of combat and death underground in the terrifying gloom of siege mines around Tower 19 on the western wall of the city. Here, lying in a Roman countermine intended to disrupt Sasanian attempts to undermine or sap⁴ the city defenses, du Mesnil found a tightly packed tangle of up to 20 bodies he identified as Roman soldiers, still with their equipment and their last pay in their purses, and nearby another armored skeleton interpreted as one of the Sasanian attackers. These remains constitute some of the most extraordinary discoveries ever made in the archaeology of war. To anyone studying ancient soldiers, armies, and conflict, the dramatic evidence from the

*I would like to express my gratitude to Susan Matheson, Lisa Brody, Megan Doyon, and others at Yale University Art Gallery for their unstinting help and support during research visits to the Dura archive. I am also deeply appreciative of the generous support of Pierre Leriche for my fieldwork at Dura and for many discussions of the defenses and siegeworks, although I should note that he does not accept the hypothesis offered here. Thanks also go to Mathilde Gelin and to many other former and current colleagues on the Franco-Syrian Mission to Dura (MFSED). Kate Gilliver and Guy Stiebel kindly provided key references to classical texts. I am especially grateful for the assistance of my former student and now colleague Jennifer Baird, whose meticulous collection and collation of data from the Yale Dura archive greatly facilitated

the present work. Markus Gschwind also provided valuable critique of an earlier draft. Thanks also go to Garry J. Tee, Department of Mathematics, University of Auckland, for the reference to Chinese smoke generators. All translations are by the author unless otherwise noted.

¹What follows supersedes a preliminary account previously published as part of a paper on deposition of military equipment at Dura, written before development of the gassing interpretation (James 2005).

²For a colorful and fascinating overview of the fieldwork, see Hopkins 1979.

³Hopkins 1979, 119.

⁴Hence “sappers,” still a term for engineers in the British Army.



Fig. 1. Du Mesnil, as always in uniform, on top of the undermined section of city wall with the already excavated Tower 19 in the foreground, its siege damage strikingly clear. He is apparently recording the Roman countermine beneath Wall Street (courtesy Yale University Art Gallery, Dura-Europos Collection, neg. F-XIII-43).

Tower 19 countermine is of exceptional importance because testimony of this quality—permitting detailed reconstruction of human actions in war occurring on a timescale of minutes—is rarely encountered in archaeology, even at siege sites, which were far more likely to result in physically detectable traces than open-field combat of the pregunpowder age. The finds further include extremely rare, closely dated archaeological evidence for early Sasanian martial equipment. They would also appear to include the macabre holy grail of Roman military archaeology: an entire squad of Roman soldiers lying exactly where they fell in battle, still with their arms and accoutrements. While all this in itself makes the discoveries worthy of modern reappraisal, newly emergent information suggests the story of what really happened in the dark tunnels beneath Dura-Europos was only ever partially told and was even more astonishing than du Mesnil realized.

Reanalysis of the evidence suggests that du Mesnil found and faithfully recorded important clues to how the men entombed in the countermine really met their deaths, but he did not appreciate their significance. This information lay unrecognized for another life-

time, a secret thus doubly buried, first literally so and then figuratively reinterred in the excavation archive and publications. For it seems that the slaughtered soldiers may not, as du Mesnil believed, have fallen to steel weapons or to a purposely set fire intended to destroy the mine in which they were found. Rather, the evidence suggests they were already dead or dying before they came to lie where they were discovered and that they had been killed or incapacitated as a result of deliberate gassing. It is proposed that these are the first archaeologically attested victims of what we today call chemical warfare.

THE MILITARY ARCHAEOLOGY OF DURA

Many of the remains left by the siege can still be seen on the ground at Dura. Most obvious are parts of the great antisiege rampart, thrown up by the Romans in anticipation of assault, enveloping the city's Hellenistic wall circuit, especially along its most vulnerable western side, the only part of the enceinte not protected by cliffs or steep wadis (fig. 2). Toward the southern end of this line, the great bulk of the Sasanian ramp by Tower 15 intended to overcome the defenses remains in situ. At



Fig. 2. Dura-Europos: *top*, location of the site against modern (*left*) and third-century (*right*) geography; *bottom*, plan of the site under Roman rule (adapted from James 2004, fig. 3).

present, the ramp and adjacent walls are the subject of renewed, detailed excavation by Leriche, French director of the current Franco-Syrian-led expedition, who has already greatly enhanced our understanding of the history of both the defenses and the siegeworks.⁵

However, as an inevitable result of the inherently destructive nature of archaeological excavation, much of the most important information discovered during the great interwar excavation campaigns survives only in museum collections and site documentation. The latter comprises the incomplete (but continuing) series of publications and the expedition archive, now housed with many of the recovered artifacts at Yale University Art Gallery.⁶ The remarkable discoveries du Mesnil made in the Roman countermine by Tower 19 are a case in point, as the key material evidence was certainly removed or at least disturbed, and the countermine itself was (unusually for Dura) backfilled and is not now visible except in part as a shallow, grass-filled depression.

What follows, then, is an exercise in archival archaeology, a reexamination of surviving drawings, photographs, and texts to reconstruct and reinterpret the nature of the discoveries through a new account and images. This case provides a striking example of the nature of Dura's archival record—highlighting in equal measure its limitations, frustrations, and still-untapped potential.

CONTEXT OF THE SIEGE

A Macedonian military colony that always emphasized its Greek heritage, Hellenistic Europolis, known as Dura ("the stronghold") in local Semitic dialect, became in practice a multicultural city under Parthian and Roman rule, with a strong local Syro-Mesopotamian ethnocultural component, important Iranian elements, and, in its latter decades, Jewish and Christian communities. Taken briefly by Trajan, it passed permanently from Parthian to Roman rule under Lucius Verus ca. 165 C.E. It came to accommodate a major urban base for the Roman military, initially supporting aggressions against the crumbling Parthian state and subsequently serving as an advanced fortress against Sasanian Persian onslaughts.

During the 250s C.E., Dura was besieged and finally destroyed by the Persians and thereafter largely abandoned.⁷ It is now thought very likely that Dura actually fell twice to Shapur I. It seems to have been occupied, perhaps without a fight, ca. 252–254 while Shapur was sacking Antioch.⁸ Dura was certainly back in Roman hands in 254.⁹ The siege occurred well after Valerian arrived in the East with a major expeditionary force from Europe, by January 255, if not a year earlier.¹⁰ We do not know the identity of the Roman formations subsequently trapped and destroyed in the city. It is possible that the garrison comprised returned and/or different elements of the provincial army of Syria, expeditionary troops from other provinces, or a mix of these, as at Amida a century later.

After the inferred first Persian withdrawal and return of the city to Roman hands, Dura underwent a massive program to strengthen its fortifications, with the intention of holding out against anticipated renewed Sasanian attack. These changes were concentrated along the vulnerable so-called desert wall, which looked out across a flat, dry plain (steppe rather than desert, often lush in springtime). The other sides of the town were protected by wadis or river cliffs, but the western defenses lacked any protective ditch, at first sight a curious omission. The surface of the plateau on which the upper town stood comprises a meter-thick layer of limestone above much softer gypsum deposits, stratigraphy that crucially shaped the later siege-mining duel. The capping limestone is exceptionally hard; it is tough enough to break modern bulldozers,¹¹ a compelling practical reason for Durenese to bury their dead in tower tombs built on top of it or in multiple-burial chamber tombs that only required punching a single small hole through the capping to reach the softer strata. It is also why the western defenses were never given a rock-cut ditch.

In ca. 254–255, the Roman defenders massively reinforced the vulnerable western wall against rams, artillery, and undermining when they built a steep mudbrick glacis to its front and a huge rampart to its rear, preparations that shaped the subsequent mine warfare. The rampart was constructed in phases, reflecting successive changes of plan (fig. 3).

⁵Leriche et al. 1986, 1988, 1990, 2004; Leriche and Gelin 1997; see also *Syria* 63; *Syria* 65; *Syria* 69. For the siege, see Leriche 1993 (superseding Hopkins 1947).

⁶See Hopkins (1979) for a bibliography to that date. Other artifacts from the Dura excavations are in the National Museum in Damascus, with a few in the Louvre, Paris, and in the Royal Ontario Museum in Toronto.

⁷Small-scale occupation continued (Saliou and Dandrau

1997).

⁸James 1985; 2004, 22–4; Grenet 1988.

⁹*P. Dura* 32; Welles et al. 1959.

¹⁰Balty 1987; 1988, 163.

¹¹P. Leriche, pers. comm. 2008; du Mesnil du Buisson (n.d., 242) (hereafter du Mesnil). On the geology of the plateau, see Geyer 1988.

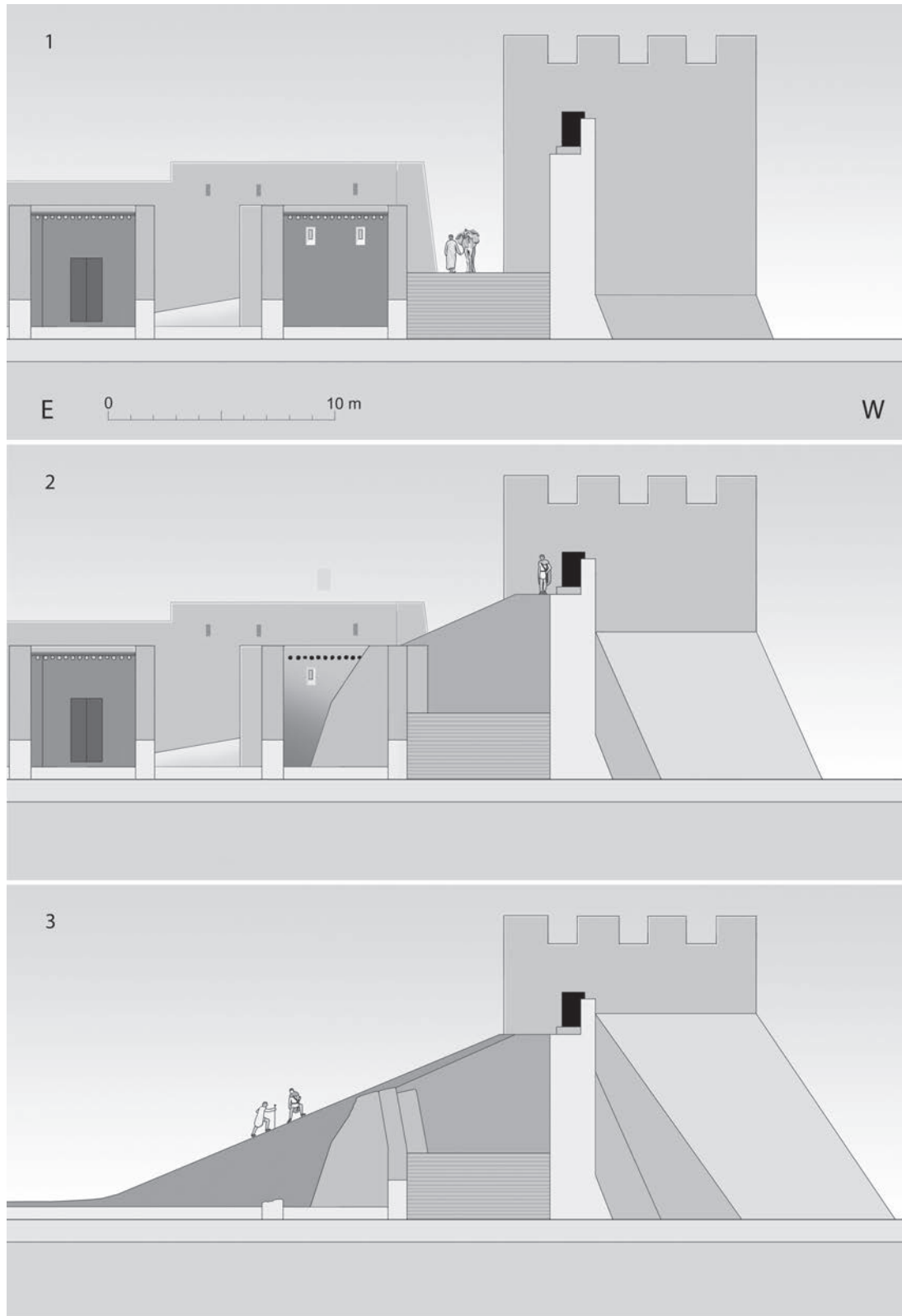


Fig. 3. Newly reconstructed sequence of events at mine site prior to siege (accurate horizontal dimensions but approximate vertical ones, as precise data not recorded at time of excavation): 1, defenses at Tower 19 before siege, showing adjacent buildings and deep rubbish/road-surface accumulation in Wall Street; 2, initial rampart, with Wall Street filled in and revetted by the curtain wall and glacis and reinforced house walls; 3, extended anti-siege rampart, with projecting house walls demolished (after James [forthcoming]).

First, all buildings backing onto the road running along the inside of the defenses (known as Wall Street) were commandeered, including the famous synagogue and Christian building (see fig. 2).¹² The walls of the buildings backing onto Wall Street were then buttressed internally with steeply sloping mudbrick revetments intended to form the rear of the new extended rampart. At the point where the Roman countermine would later be dug, northeast of Tower 19, there was only a relatively thin house wall, itself set back from the general street frontage. It seems that here the defenders encased it in mudbrick on both sides (fig. 4). All this reinforcement allowed Wall Street itself, its level already elevated a couple of meters by compacted accumulations of dumped material, to be filled in to roof height. The resulting first-phase extended rampart was roughly 10 m broad (see fig. 3[2]).

However, the rear mudbrick buttressing of the house walls proved too weak to withstand the lateral thrust of the Wall Street fill and began to give way, prompting further drastic action. All building walls projecting out of the rampart were demolished, and a great mass of additional material was dumped on its rear, doubling its breadth to roughly 20 m while also reducing its slope, permitting troops to run up to any point on the battlements (see fig. 3[3]). If ultimately it failed to save the city, this great embankment accidentally preserved remarkable testimony of its life for posterity, as its sloping profile threw off the winter rains of the following 17 centuries, creating a desiccated microenvironment that preserved wall paintings, artifacts, and documents engulfed during its raising. It also created the context within which the mining duel would ensue.

The anticipated Sasanian siege probably fell in 256.¹³ Several points of assault have been identified along the western defenses, and another may be assumed to have been the now-lost river gate (see fig. 2). Its duration must have been some weeks at least, since it involved completion of very substantial engineering works.¹⁴ The exact sequence cannot be established, but it seems likely that the attacks were pushed forward in parallel, to overstretch the defenders.

The current Franco-Syrian project has added significantly to our understanding of these assaults, especially

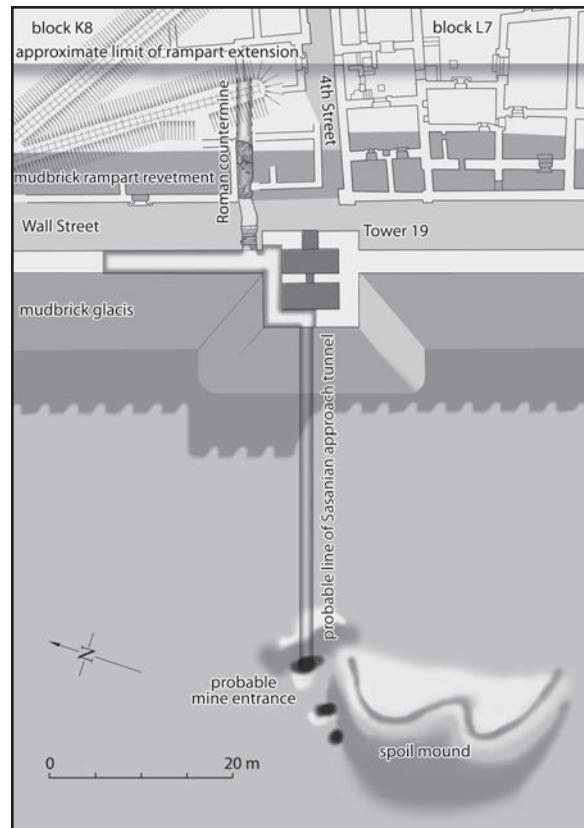


Fig. 4. Location and conformation of the mines around Tower 19, based on an unpublished inked plan in the Yale Dura-Europos Collection showing Tower 19 and buildings in its vicinity, aerial photography, and modern observation (after James [forthcoming]).

at the great Palmyrene Gate, excavations in front of which attest ferocious but apparently unsuccessful attacks.¹⁵ Two other major points of assault have been explored.¹⁶ At the southern end of the “desert wall,” a massive siege ramp was constructed, the central focus of a complex struggle that also involved sapping, tunneling to get troops into the city, and countermining.¹⁷ It is unclear whether the Persians gained entry at this point either.¹⁸ The remaining known target of attack was around Tower 19 (see fig. 4).

¹²The complex construction of the rampart is detailed only in the final report on the synagogue (Kraeling 1956, 4–5, plan IV, 3; see also Leriche 1993, 84).

¹³On the Roman numismatic and Sasanian epigraphic evidence forming the basis for this, see James 1985; see also MacDonald 1986.

¹⁴Leriche 1993.

¹⁵Gelin et al. 1997, 41–2, figs. 31, 32.

¹⁶A third was tentatively identified by du Mesnil, who noted some indications of a possible mining assault like that on Tower 19 directed at Tower 21 and a stretch of wall to its north, but this area was not excavated, and the suggestion remains unproven. Any such mine was never completed, since the city wall remains intact here (du Mesnil 1944, 6).

¹⁷Leriche 1993, 85–6.

¹⁸James 2004, 39.

DU MESNIL'S RECORDS AND ACCOUNTS OF THE FINDS

Any attempt to reinterpret the evidence from Dura must first address the problems of the archaeological record as it survives. In the case of the Tower 19 mine complex, the primary excavation archive contains only fragmentary information (not an uncommon situation for the Yale–French Academy expedition). With the apparent exceptions of several drawings and a small number of photographic negatives of the mine under excavation and of some of the finds in situ, there are no surviving primary site records as we now understand them,¹⁹ although other information can be gleaned from the finds registers compiled during the excavation. While specific associations between items mentioned or drawn in the publications and those now in the collection were largely lost, a number of artifacts now at Yale or Damascus can be ascribed to Tower 19 or the countermines with virtual certainty or a high level of confidence.²⁰

Du Mesnil's publications on the countermines discoveries were multiple and, taken together, extensive. Nevertheless, they contain frustrating omissions—notably of any large-scale overall plan of the mine finds—and some confusions and contradictions. He produced no less than seven publications, including a detailed academic treatment for which the manuscript also survives, although certain significant facts are only recorded in shorter, secondary accounts including popular magazine articles. These must all be used together to produce a composite textual account and new drawings of the mine discoveries, on which to base a revised explanation of the events that led to the digging and destruction of the tunnel and the deposition and precise disposition of the bodies and artifacts within it as they were found.

Du Mesnil's first publication was a brief note in an article on the siege for the French popular journal *l'Illustration*.²¹ Appearing in August 1933, just months after the initial discovery, it included rough sketch plans of, and a section drawing through, the tangle of bodies. Another piece, on this so-called Pompeii of the East, later appeared in the same magazine, briefly describing and illustrating the Persian body.²² He also included summary accounts of the excavations of the defenses and siegeworks around Tower 19 in his annual reports to the French Academy published in its *comptes rendus*.²³ He produced three more substantial scholarly publications treating the mine.²⁴ The most detailed description forms part of a chapter ("The Persian Mines") in the preliminary report setting out the results of the Franco-American expedition's sixth season of fieldwork.²⁵ It seems that du Mesnil regarded this account as his primary publication of the finds; there is no evidence that any further research on the siegeworks was ever planned as part of the thematic *Excavations at Dura-Europos Final Report* series.²⁶ In the preliminary report, du Mesnil simply offered an account of what was found with his interpretation of the facts; as was usual for the expedition, he did not detail the course of the excavation as such. The publication was a generally faithful and effectively literal English translation (translator unrecorded) of du Mesnil's French manuscript report, which survives in the Yale archive, undated but probably written early in 1934, most likely at Dura itself, toward the end of the seventh season.²⁷ The published translation depends heavily on its illustrations, but the photographs presented are few (again not untypical of du Mesnil's reports, although, most importantly, there are no photographs of the body tangle). The drawings are also hard to follow, as no overall plan of the countermines and its

¹⁹The probable exceptions are what appear to be four original pencil site drawings now at Yale, which had been inked over and annotated in French. These include the Persian skeleton plan on tracing paper (annotated "Rep. VI, Fig. 6," in red over a deleted annotation, probably an identifying letter). In fact, an English annotated retracing appeared as fig. 16 of *Preliminary Report VI* (du Mesnil 1936b). Two other inked drawings on gridded cards are mounted on a sheet of expedition letterhead, each annotated in French beneath, reading "Rep. VI not used" and "D." One is a simple diagram of the method of shoring the Roman mine, the other apparently a sketched section of the mine where it passed beneath the mudbrick rampart revetment, but it is rather crude and cannot be reconciled with other known drawings and information. Finally, there is another gridded card, inked over and stuck to a sheet of paper with an inked manuscript key in French added below and the crucial label "E" in top right corner. This is the original for the drawing eventually reproduced as du Mesnil 1936b, fig. 18, right. The annotations "D" and "E" confirm it

is a survivor of the set of drawings originally attached to du Mesnil's (n.d.) mine manuscript, which had temporary alphabetic identifiers.

²⁰For a reconstruction of the mine artifact group, see James 2004, 276.

²¹du Mesnil 1933a.

²²du Mesnil 1936a, 323.

²³du Mesnil 1933b, 197–99; 1934, 183.

²⁴A separate note appeared mentioning, but not detailing, a lecture he gave in Paris on the helmet found in the mine ("Séance du 20 Juin" 1934).

²⁵du Mesnil 1936b, 188–202, 204–5.

²⁶Although I included a summary account in the final report to contextualize the mine artifacts (James 2004, 32–9).

²⁷du Mesnil (n.d.). This is actually a typescript with hand annotations and corrections, plus an ink manuscript appendix on the iron objects from the mine. It is complete except for the set of accompanying drawings, only some of which survive, prepared on Dura expedition letterhead (supra n. 19).

contents is provided to show how they interrelate. Various parts of the mine are presented as separate line drawings (plans and a section through the skeleton pile), while part of the mine (that under the east side of Wall Street) was not illustrated at all. This publication shows signs of suffering from transatlantic communication problems in that pre-Internet age; it was evidently edited and laid out by others who did not entirely understand all the details of the manuscript and who, under pressure to publish, could not resolve uncertainties with the author, since they were in New Haven, while du Mesnil was in France or Syria.

Soon after penning his manuscript for the preliminary report on the sixth season (hereafter *Preliminary Report VI*),²⁸ du Mesnil wrote another, briefer treatment of the Tower 19 mines, a general French-language report on the Dura siegeworks for a specialist journal of military engineering, in which he referred to the complex as “mine no. 1” and “contremine no. 1.”²⁹ While the text adds little to *Preliminary Report VI*, the paper reproduces one of the rough sketch plans from the 1933 magazine piece, altered to include some valuable details not provided elsewhere: it identifies a crystal-pommeled sword found in the body tangle and fixes the position of the section drawing through the mass (fig. 5a).³⁰

During World War II, du Mesnil, trapped in Vichy France, published a third and final scholarly treatment of the countermines finds, again as part of an overall survey of the Dura siege, comprising a short monograph.³¹ It is effectively a verbatim republication of the 1937 piece with a few minor amendments, to which he added a long disquisition on ancient siege warfare in general. However, while a number of the drawings are versions of those in *Preliminary Report VI*, there is the useful addition of the only overall plan of the countermine and its contents du Mesnil ever published—albeit at tiny scale (see fig. 5b).³² The work also includes some photographs not otherwise published, including one of the cleaned and restored

Persian helmet. Unfortunately, in this work du Mesnil made some corrections to the drawings of the mine that actually introduced errors, halving the true extent of the stone blocking shown in the gallery under Wall Street. This compounded other confusions in his multiple and fragmentary accounts, notably misrepresentation of the extent of the earth rampart beneath which the mine was dug. This was actually twice the width indicated in his 1944 plan (see fig. 5c), which, in fact, only shows the extent of the first phase of a complex construction.³³

What follows is a new composite account of the finds based mainly on *Preliminary Report VI*, supplemented with information appearing only in other publications, plus additional data gleaned from archival sources such as photographs and drawings and my own observations.

THE DISCOVERIES AND DU MESNIL'S INTERPRETATIONS

Du Mesnil showed that, probably in parallel with assaults on the city gates and the raising of the siege ramp, the Sasanians prosecuted another, different kind of attack around Tower 19, north of the Palmyrene Gate. Their objective was to create a large breach in the city defenses by undermining about 15 m of curtain wall and (to reduce the danger from defensive “fire”) the adjacent tower, making a gap wide enough for a column of troops to charge from the Persian lines across the open plain to pour into the town (see fig. 4).³⁴ To sap the walls, the Persians first had to dig an approach tunnel from their own lines facing the city. This required competent, but not highly precise, surveying, since, so long as they came up inside the rampart/wall/glacis mass, they could quickly locate curtain and tower. More impressive, perhaps, were the sheer effort and skill required to succeed. The entrance to the tunnel has not been identified with certainty but likely started from one of the chamber tombs of the extramural necropolis. This gave the

²⁸ du Mesnil 1936b.

²⁹ du Mesnil 1937.

³⁰ du Mesnil 1937, fig. 3.

³¹ du Mesnil 1944.

³² du Mesnil 1944, fig. 4.

³³ du Mesnil's failure ever to produce any large-scale overall plan of the mine prompted someone at Yale to attempt to create one from the records—most likely mainly from the *Preliminary Report VI* publication drawings—resulting in a publication-quality composite drawing known from the Yale Dura-Europos Collection (neg. y-717a). Who executed this, when, and for what purpose all remain unknown. Unfortunately, while this composite corrects du Mesnil's confusion

over the extent of the stone blocking, it adds new errors in that it incorrectly relates the drawings of the body stack, showing the bodies much more dispersed than they actually were.

³⁴ du Mesnil 1936b, 188, 201. In some drawings, du Mesnil indicated that he thought the Persians had intended only to undermine the outer face and core of the wall, leaving the inner face intact so that when the mine was fired, the wall would tip out onto the plain. However, in others, he showed the entire thickness of the wall undermined; the two drawings in du Mesnil 1936b, fig. 14, show both possibilities. As in the event it sank without tipping, the Persians seem actually to have undermined the entire width of the wall.

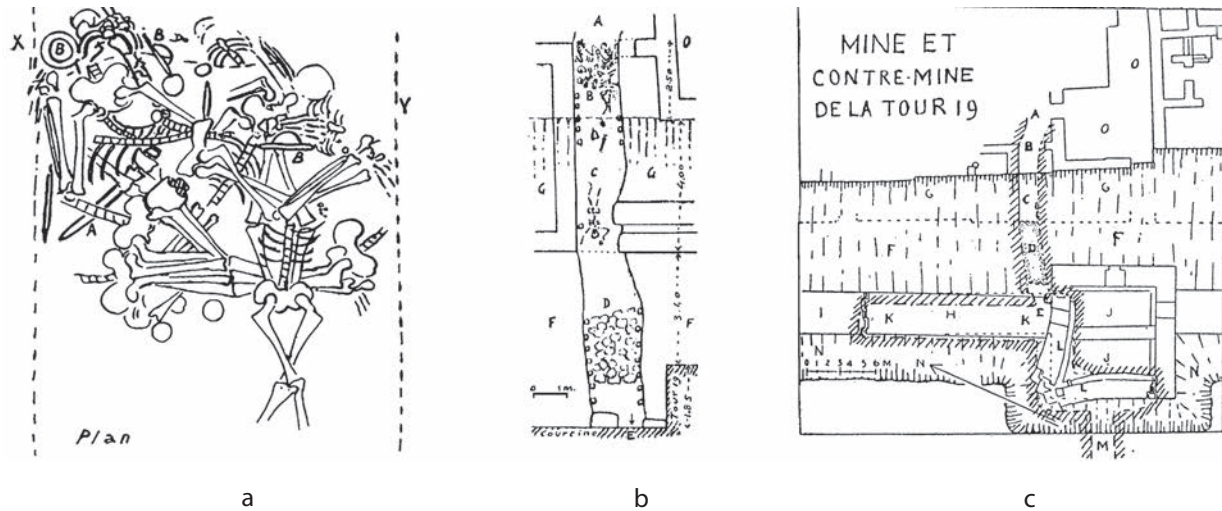


Fig. 5. Three of du Mesnil's publication drawings: *a*, the 1937 plan of part of the body stack, showing the position of the section drawing (X, Y) and locating the crystal-pommeled sword (A) (du Mesnil 1937); *b*, du Mesnil's only overall plan of the countermine and its contents (du Mesnil 1944, fig. 4); *c*, du Mesnil's 1944 plan of the mine/countermine complex (du Mesnil 1944, fig. 3).

attackers easy access to the softer strata beneath the limestone plateau capping. However, they still had to punch upward through this iron-hard stratum to get at the walls, which stood on the bedrock.

The Romans soon detected the digging of the Persian approach tunnel; the accumulating spoil could not be concealed on the dead-flat plain, and doubtless the defenders could hear the approaching miners.³⁵ Du Mesnil described a mound about 40 m out on the plain, 3.65 m high, and sprawling over an area of about 28 x 16 m, which he identified as spoil from the Persian approach mine.³⁶ He did not plan this, but it is visible on prewar aerial photographs and it is still there today (see figs. 4, 6).³⁷ An adjacent hole, probably a preexisting tomb entrance, may well mark the entrance to the Persian tunnel. This point is directly in front of Tower 19, which was therefore the likely target of the approach tunnel and the point under which the Sasanians cut their upward shaft to reach the foundations of the defenses.³⁸ Here, they began sapping the walls in earnest, reducing the ashlar to rubble small enough to manhandle along the growing timber-propped tunnel. The subsequent pattern

of subsidence provides a fairly clear guide to the conformation of the now-crushed and inaccessible Persian gallery.³⁹ Du Mesnil's drawings show the entire western wall of Tower 19 undermined, but the observed slumping clearly indicates that only the northern half of its foundations were removed; the Sasanians evidently opted to undermine just the northwestern corner of the tower, apparently judging that this would be enough to render it ineffective as a projectile-weapon platform. Apparently from here, they then tunneled on northward under the adjacent curtain. The subsequent vertical displacement of the undermined defenses was actually quite limited, sinking only about 1 m into the ground; the headroom of the sap would probably not have been very much greater than this. The survival of the upper part of the 2.33 m high socle of Tower 19,⁴⁰ still visible inside the tower pitching down into the slumped sap, also indicates a very low tunnel at this point—but one that was adequate to cause collapse of the tower floors.

The defenders mounted a standard response to the impending attack, digging a timber-shored countermine beneath their own antisiege embankment

³⁵ du Mesnil 1936b, 188.

³⁶ du Mesnil 1936b, 188.

³⁷ The unrecorded, sinuous trench dug into it—visible already in the 1922 aerial photograph and clearly visible in an aerial photograph taken in 1936 (Yale University Art Gallery, Dura-Europos Collection, neg. Y796), and discernible in another taken 14 October 1922 (Yale University Art Gallery,

Dura-Europos Collection)—was perhaps cut by looters thinking it was a tomb mound.

³⁸ As du Mesnil evidently thought but specified only in a drawing (du Mesnil 1936b, fig. 14).

³⁹ Special thanks go to Markus Gschwind for his valuable observations on this aspect.

⁴⁰ von Gerkan 1936, 14.

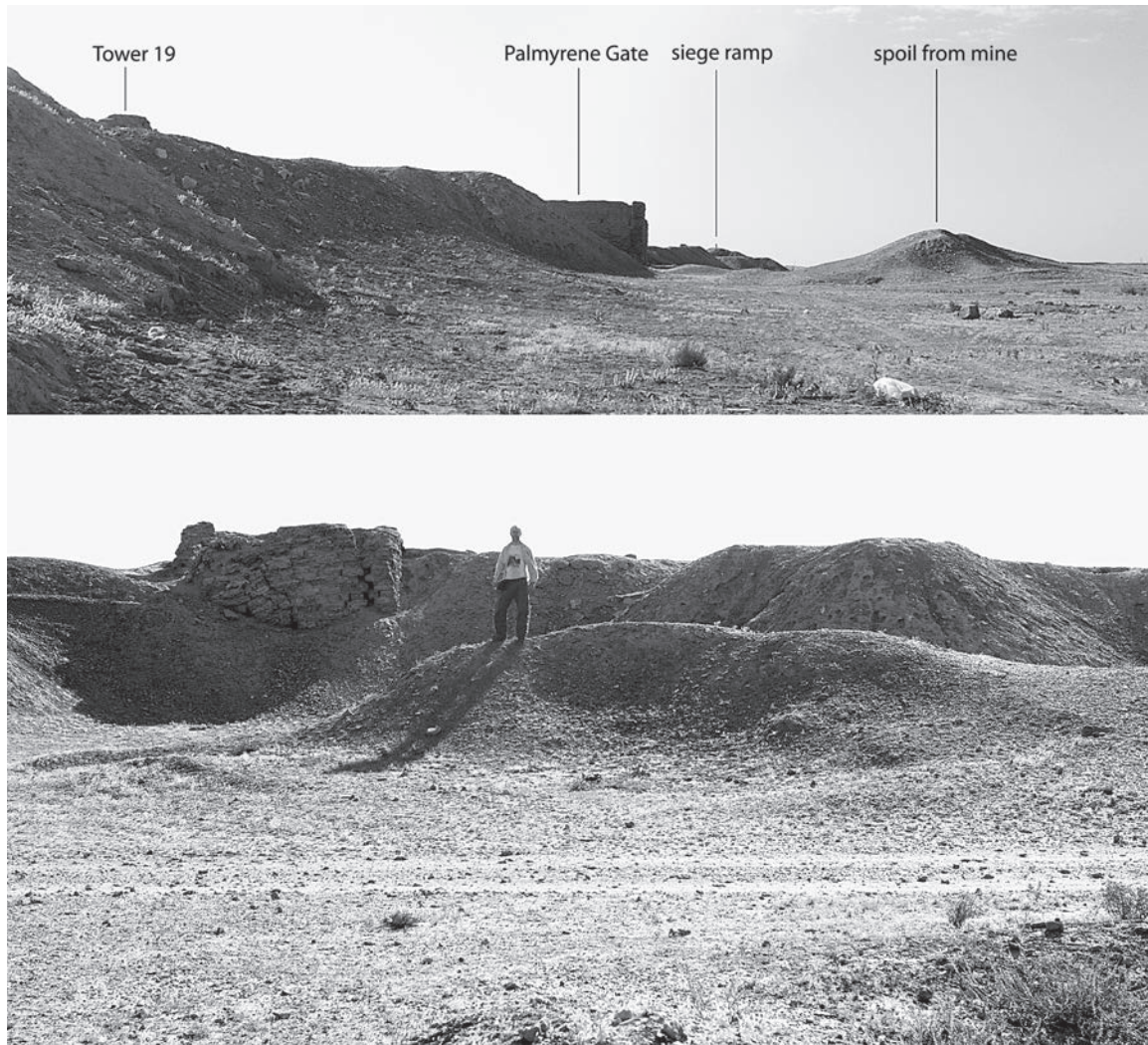


Fig. 6. The mound on the plain in front of Tower 19, identified as spoil from the Persian mine: *top*, view from the north; *bottom*, the mound, with the author standing on top, seen from the west with the ruined Tower 19 behind; the face of the city wall and the Roman antisiege glacis are largely shrouded in mounds of spoil from the Yale–French Academy excavations, especially obvious to the right.

behind the city wall, intending to break into the Persian sap and halt their operations. The Romans could see that the Sasanians were aiming for Tower 19 and may well have guessed their strategy of trying to bring it down with the adjacent stretch of wall on its north side. Since Tower 19 would threaten the unshielded right sides of attackers approaching this point, the logic would have been obvious to both sides, explaining why the Romans directed their countermine just to the north of the tower: they were not going to further undermine it themselves to get at the Persians.

The Roman countermine commenced at or near the foot of the rampart, in the southwestern corner of the city block now known as K8 (see fig. 4). Cutting through the rampart and shallow floor levels of the buildings, it ran a little above the surface of the bedrock,⁴¹ the level at which the defenders knew the Sasanian sappers would be working. We do not have data on the original relative preembankment surface levels for the K8 houses and Wall Street, but during the Parthian era, the latter had become partly filled with traffic-compacted earth and rubbish to a depth of

⁴¹ Leaving enough deposit beneath in which to set its timber posts (du Mesnil 1936b, 190).

more than 2 m.⁴² The result is that, although near the entrance the countermine's roof was in the rampart material, once it punched through the rear house wall foundations into the line of Wall Street, it was wholly within the compacted road buildup (figs. 7, 8). However, given the massive overburden of the rampart here, the Romans wisely propped the entire length closely with timber posts and lintels.

Du Mesnil does not discuss that the two approach tunnels were at different elevations, the Persian immediately below the limestone capping of the plateau, the Roman immediately above it, a difference in floor levels of perhaps 3 m. As seen below, the disparity in levels between the tunnels was also likely a crucial factor in the devastatingly effective Sasanian riposte to the Roman counterattack. The Romans doubtless worked out that the Persian undermining operation within the mass of the rampart was likely accessed from its approach tunnel via a single vertical shaft. If they could capture the Persian's subrampart gallery and command the access shaft, the attack would be thwarted, and this appears to have been the counterminers' practical objective. It is also suggested that they were concerned the Persians would fire their substantially advanced sap prematurely when the Romans broke through, and that many of the Roman party were tasked to try to extinguish any such blaze. This could in turn explain the puzzlingly limited amount of military equipment found in relation to the number of bodies present.

Unless their corpses had been extensively plundered, or du Mesnil failed to record a large mass of material (neither of which is plausible, as seen below), then only a few of the defenders who died in the tunnel appear to have been armored, and only about half had shields. It is proposed that immediately behind the armed breakthrough party were unarmed men forming the front part of a chain gang ready to pass containers of earth into the mine. This was the only known method of smothering fires started with accelerants such as the sulphur and naphtha (bitumen/crude oil) certainly available to the attackers, discussed below.⁴³ A number of short chains found in the body stack were possibly handles for leather or textile bags/buckets for the purpose.⁴⁴ This prompts a further question: were these unarmored men actually Roman soldiers at all? If not, they could have been pressed townsmen, slaves, or prisoners but perhaps most likely were military servants such as *lixae*, who underwent a



Fig. 7. Western end of the Roman countermine under Wall Street, from the city wall during excavation, with Tower 19 bottom right and the lowest courses of the mudbrick revetment to block K8 at the top. Intact timbering of the countermine is clearly visible (courtesy Yale University Art Gallery, Dura-Europos Collection, print 131).



Fig. 8. Oblique view of the excavation seen in figure 7, looking south past Tower 19 to the corner of block L7. At left, the coursed mudbrick revetment of block K8 can be seen founded on the accumulated rubbish and road surfaces of Wall Street, through which the Roman tunnel had been cut (courtesy Yale University Art Gallery, Dura-Europos Collection, neg. F-XII-18).

⁴²Kraeling 1956, 4–5.

⁴³Ammianus Marcellinus (23.4.14–15) describes unnamed military incendiary materials that cannot be extinguished by water, which only spreads the fire; they can only be smothered

with *pulver* (dust). This is consistent with naphtha (Mayor 2003, 213).

⁴⁴du Mesnil (n.d., 252).

measure of training and could be described as “valorous men” themselves.⁴⁵

Excavation proved that the Romans’ counterattack failed disastrously. Instead of capturing and holding the Persian sap, their own tunnel was taken and destroyed, allowing the Sasanian undermining to be completed without further interference. Du Mesnil described what he found in the Roman tunnel in spatial order, eastward from its junction with the Persian gallery under the city wall beside Tower 19. At this western end, the countermine gallery still had its timbering perfectly preserved, the tunnel being about 1.2 m wide between the posts, which were about 2 m long but set 250–370 mm into the floor,⁴⁶ implying headroom of about 1.65–1.75 m—barely enough to permit many adult males to stand upright (see figs. 7–10). East of this were extensive traces of a conflagration. Du Mesnil recorded that “in a zone extending [eastward from the intact end of the mine] under the old facades of the houses of Wall Street the posts, carbonized at the top, are still in place.” Despite the burning away of the ceiling planks, the tunnel, “made in well-packed earth under the ancient road,” had stayed open, apart from some minor falls of earth on its floor.⁴⁷ He records that “fragments of faggots and straw which had been used to start the fire” were found here.⁴⁸ Beyond that, “[t]he part of the mine which continued on toward the east has entirely fallen in but the center of the fire begins only about 2 m. east of the line passing under the wall of the houses on the street and ends 1.50 m. in front [i.e., beyond the limit] of the mud brick embankment. At the very end [i.e., nearest the unexcavated entrance] the gallery had fallen in but contains no trace of fire.”⁴⁹

The stretch of tunnel that did not collapse as a result of the inferno, that is, the “zone extending under [Wall] street . . . from a line under the rear wall of the houses of the former Wall Street up to about 1 m. from the curtain,” had subsequently been packed with rubble and large blocks taken from the walls and joined with “plaster” (probably the local gypsum-based mortar/plaster), a broken jarfull of which was found.⁵⁰ The way the plaster had run showed it was done from the attackers’ side (see figs. 7–10).⁵¹

On the floor of the tunnel beneath this mass of stone, close to the mine junction, du Mesnil found



Fig. 9. Du Mesnil by the junction of the Roman countermine with the city wall and the Sasanian sap (courtesy Yale University Art Gallery, Dura-Europos Collection, neg. F-X-77).



Fig. 10. The Roman countermine, showing well-preserved timbers and an especially massive block the Persians had maneuvered into the tunnel (courtesy Yale University Art Gallery, Dura-Europos Collection, neg. F-IX-43).

⁴⁵ SHA *Max.* 2.6. On *lixae* and other military servants, see Speidel 1992; Vishnia 2002.

⁴⁶ du Mesnil 1936b, 190.

⁴⁷ du Mesnil 1936b, 190. From surviving photographs, there looks to have been at least 0.5 m of road levels above the tunnel. Two photographs probably show a naturally arched profile to the tunnel roof formed by such a collapse, where the tunnel passed under the mudbrick wall on Wall Street (see

figs. 7, 8 herein).

⁴⁸ du Mesnil 1936b, 192.

⁴⁹ du Mesnil 1936b, 192.

⁵⁰ Visible in a photograph at Yale (neg. F-XI-61). This plaster/mortar is referred to in MFSED literature under its local Arabic name of *djousse*.

⁵¹ du Mesnil 1936b, 192.

two iron weapon tips of socketed bodkin type.⁵² These may have been from short pikes designed for combat in the confines of the mine, although another interpretation is offered below.

Du Mesnil then proceeded eastward in his description, following the tunnel past the line of the mudbrick rampart revetment. Just beyond this line, which roughly corresponded with the limit of the final stone blocking in the part of the tunnel that was then still open, lay the skeleton of a man “c.1.85 m. in height” (a rough estimate, as the bones were burned away below the knee), clad in a mail shirt (fig. 11). Du Mesnil initially argued that, judging from his posture, he had been killed fighting, facing the city, falling backward.⁵³ As he died, he was apparently trying to pull up his armor, which was found raised above his abdomen.

The area just east of where the skeleton’s feet had been was heavily burned; here was the seat of the fire that brought the roof down in this midsection of the Roman tunnel.⁵⁴ On the floor lay a number of badly oxidized iron objects, including a helmet, construction of which du Mesnil compared with more recent Persian examples, and a large shattered sword sporting a pommel of jade that “appears to have come from Chinese Turkestan” (figs. 12, 13).⁵⁵ There were also fragmentary shield fittings. All these items du Mesnil attributed to the individual already described, whom he interpreted as one of the Sasanian attackers.⁵⁶ He lists other objects, fragments of beams and ceiling planks “and certain combustibles, undoubtedly intended to kindle the fire in the mine: straw, [and] pitch [*sic*].”⁵⁷ In his French manuscript, he describes the broken jar, which this substance was found within and melted over, as “torpedo-shaped.”⁵⁸ At least for British English speakers, “pitch” is an ambiguous translation of du Mesnil’s *bitume*.⁵⁹ “Pitch” describes tarry materials generated from woodland sources but can also include petrochemical equivalents, whereas *bitume* specifically connotes a crude oil-based substance, unsurprising given that the attackers came from Iraq. He also records discovery of “some yellow crystals which



Fig. 11. The solitary skeleton found a few meters to the Persian side of the body stack. Still clad in a shirt of iron mail, this is interpreted as the body of one of the Sasanian attackers, probably the individual who set the fire that brought down the roof of the Roman tunnel and who failed to make his escape (courtesy Yale University Art Gallery, Dura-Europos Collection, neg. G-908).

we believe to be sulphur,”⁶⁰ an identification subsequently confirmed by testing in Beirut.⁶¹ The incendiary properties of both sulphur and petrochemicals (naphtha) were widely known, and sulphur and bitumen are attested historically as incendiary accelerants used together in Roman-era siege fighting.⁶²

Proceeding farther eastward, “in the part of the gallery extending in front [*sic* i.e., beyond the rear edge] of the mud brick embankment to the east [but still beneath the broad dumped-earth rampart extension] the

⁵² “[T]wo arrow points of the sleeve type common at Dura . . . Found in the west part of the counter-mine” (du Mesnil 1936b, 192). These are the items labeled “D” and identified as “quarrel heads” in du Mesnil 1936b, fig. 15. In a detail of his manuscript edited from the published translation, du Mesnil (n.d., 247) specified that these were found under the stone filling, on the floor of the mine.

⁵³ du Mesnil 1936b, 192.

⁵⁴ du Mesnil 1936b, 194.

⁵⁵ du Mesnil 1936b, 194.

⁵⁶ du Mesnil (n.d., 249). The mail shirt (James 2004, no. 379) bears a trident-shaped “heraldic” device picked out in copper alloy rings on the chest, which certainly fits with Sasa-

nian iconography. However, du Mesnil was probably wrong about the shield, which appears to have been of Roman design like a number of others in the mine and had likely been used as kindling for the countermine fire.

⁵⁷ du Mesnil 1936b, 194.

⁵⁸ “[E]n forme de torpille” (du Mesnil [n.d., 249]).

⁵⁹ du Mesnil (n.d., 249).

⁶⁰ du Mesnil 1936b, 194.

⁶¹ du Mesnil 1937, 13 n. 1.

⁶² Joseph *Bj* 3.228. Thanks go to Guy Stiebel for this reference. On use of Near Eastern petrochemical materials for military incendiary purposes in classical times, see Mayor 2003, 228–35.



Fig. 12. The iron helmet in situ on the floor of the mine between the stack of Roman bodies and the Persian to whom it probably belonged (courtesy Yale University Art Gallery, Dura-Europos Collection, neg. G-788).

bodies of sixteen to eighteen soldiers were found with the remains of their armour and clothing, the whole constituting a mass about 40 cm. in width [*sic*: actually vertical depth] and 2 m. in length.⁶³ My count based on du Mesnil's drawings suggests at least 19 bodies.

Du Mesnil noted three zones within this tangle of corpses (explored in detail below).⁶⁴ The western part nearest the city wall was heavily burned. In the middle, the bones were white, and it was possible to distinguish bodies. The easternmost skeletons "lay in contracted positions," which du Mesnil describes, noting that the bodies here still reeked, one skull still containing

a desiccated brain. The dispositions of bones and artifacts were presented in "accompanying sketches" in *Preliminary Report VI* (fig. 14).⁶⁵ The relationships of these drawings to one another and to the zone with the Persian skeleton (fig. 15[3]), let alone the section connecting with the Persian sap (see fig. 15[4]), were not evident, especially in the absence of an overall plan of the tunnel deposits.

Du Mesnil provided considerable detail on the artifacts recovered from the mine.⁶⁶ He noted the poor state of the ironwork found among the human remains but tentatively identified "parts of swords, perhaps also of a javelin, and portions of thin, curved plaques from leg guards(?) and bosses rather than helmets," plus "a large sword . . . together with its pommel of rock crystal."⁶⁷ All the ironwork from the mine was reviewed again in an appendix, where du Mesnil briefly discusses, but does not quantify, the fragments of iron mail (so-called chain mail) in the body tangle, "readily recognisable especially in the section where the bodies had been carbonized," pieces of swords (again mentioning the crystal and jade pommels), a "javelin" head, fragments of "four or five" iron shield bosses, a chisel, shield mountings, large nails from the mine timbering, and "two arrow points of the sleeve type common at Dura . . . [f]ound in the west part of the counter-mine."⁶⁸ Du Mesnil also noted the bronze objects, including "a shield boss [*sic*: several appear in the drawings], rings of several sizes, small chains . . . and pierced ornamental plaques." There were also fragments of wooden shields, plus "a few fragments of leather and cloth."⁶⁹ The French manuscript specifies fragments of *brodequins de cuir* (leather boots).⁷⁰ Du Mesnil's 1944 treatment refers to pieces of "linen" (*linge*) and hair among the incompletely decomposed bodies.⁷¹ He also recorded three different groups of coins, which in one case could be seen to have been under a mail shirt, "near the thigh bone, probably in the belt," and he thinks the same was true in the other two cases, stating, "They undoubtedly represent the last pay of the soldiers and indicate clearly that their owners were Romans."⁷² More burnt wood was found over and within the tangle, representing the collapsed shoring of the tunnel.

⁶³ du Mesnil 1936b, 194. The illustration reference is to the cross-section through the gruesome deposit, which reveals a translation error here of "width" for "depth" or "thickness" ("40 cm. environ d'épaisseur" [du Mesnil (n.d., 250)]). Elsewhere, du Mesnil (1933a) estimated there were 15–20 bodies.

⁶⁴ du Mesnil 1936b, 195.

⁶⁵ du Mesnil 1936b, 195, fig. 18.

⁶⁶ On reconstructing the original assemblage of military

equipment, see James 2004, 276.

⁶⁷ du Mesnil 1936b, 195–96.

⁶⁸ du Mesnil 1936b, 204–5.

⁶⁹ du Mesnil 1936b, 196.

⁷⁰ du Mesnil (n.d., 252).

⁷¹ du Mesnil 1944, 18.

⁷² du Mesnil 1936b, 197. The coins included issues of Valerian (Bellinger 1936, 470–75).

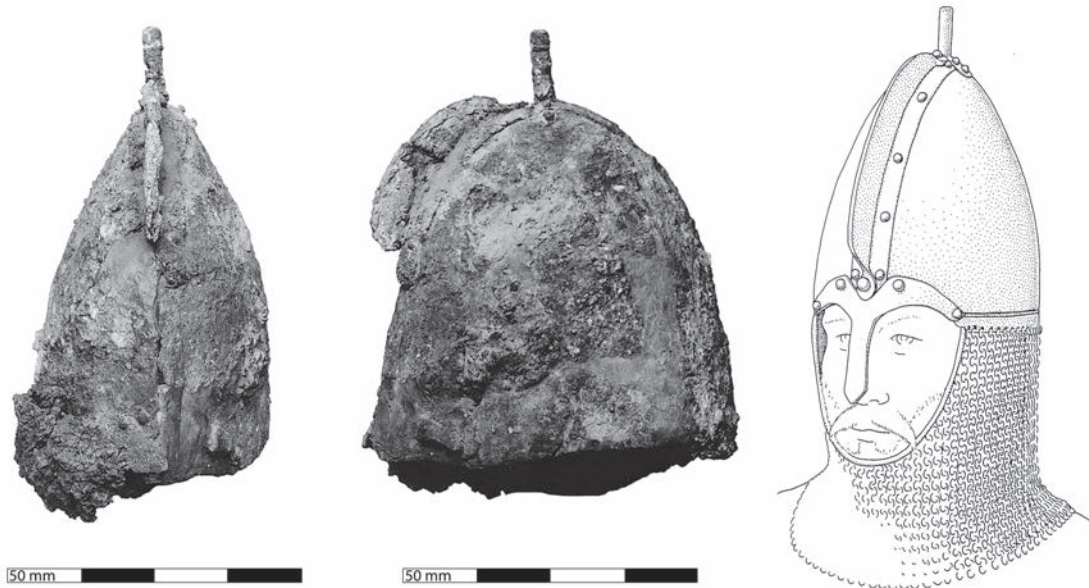


Fig. 13. Two views of the restored helmet, now in Yale University Art Gallery, and a reconstruction drawing of its original appearance. The exact form of the pendant mail defense is uncertain, but it covered at least cheeks, ears, and neck, if not the chin area (adapted from James 2004, figs. 47, 48).

He noted that “the entrance to the gallery has not been discovered but it could not have been far distant, since at this point all trace of wooden supports disappears.”⁷³ His logic here is not entirely clear, but the absence of traces of posts east of the body tangle may have been because they had rotted away, since the protecting rampart tailed off beyond this point, perhaps marking the limit of the dry microenvironment protected from seeping winter rainfall. He opined that “the entrance to the counter-mine . . . doubtless comprised steps (*un escalier*).”⁷⁴

Du Mesnil set out his reconstruction of the events leading to deposition of these remarkable remains as a series of numbered points:⁷⁵

1. The Persian sap is dug.
2. The Roman countermine is dug with intent to stop the sapping, “from the city as far as the foot [*sic*: bad translation, actually to beneath the apex] of the embankment.” Du Mesnil notes the Romans could guess the Persian’s objective by the location of the growing mound of spoil and the noise of digging.
3. When the mines meet, combat ensues and the Romans are driven back into their own gallery with the Persians in pursuit, and “[i]n this combat, a

Persian soldier is killed.”⁷⁶

4. The Romans inside the town, seeing that their men “were retreating in disorder and fearing that the Persians would emerge into the city, hastily block up the entrance into the counter-mine shutting up those who were wounded or lagging behind. At the same time the Persians, who were undoubtedly too few to enter the city, and who had already attained their objective, set fire to the counter-mine and rapidly withdrew.”
5. The eastern part of the countermine is burned and it collapses, causing more limited damage to the western part. In his 1937 paper, du Mesnil judged, from the positions of the bodies in the tangle, that some men were killed in combat or asphyxiated by the fire before the roof collapsed, others perished in the flames, and others were still alive when the roof came down.⁷⁷
6. Subsequently, the Persians block the remainder of the Roman gallery with rubble prized from the city wall as the undermining resumes.
7. The Persians finish and fire their mine.
8. Wall and tower slump into the Persian mine and are severely damaged but kept upright by mud-brick glacis and rampart (fig. 16).

⁷³ du Mesnil 1936b, 196.

⁷⁴ du Mesnil (n.d., 254–55).

⁷⁵ Quotes are from du Mesnil (1936b, 198), except where

stated otherwise.

⁷⁶ du Mesnil (n.d., 254–55).

⁷⁷ du Mesnil 1937, 16.

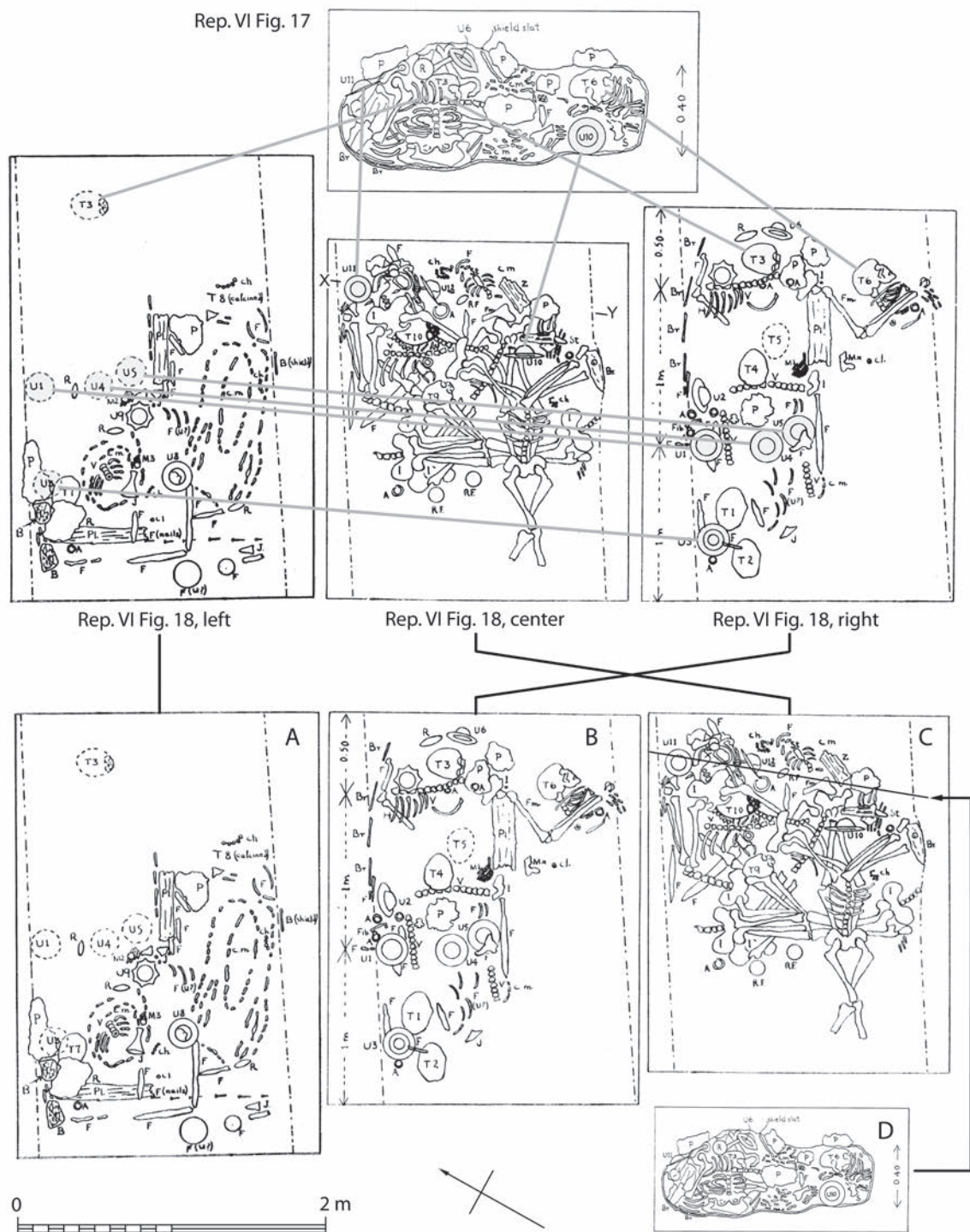


Fig. 14. *Top*, the drawings of the pile of Roman bodies and equipment from the Tower 19 countermine, as they were published and annotated in du Mesnil 1936b. Items appearing in more than one of the drawings are linked. Added to the central plan is the section location (X, Y) indicated on the other version of this drawing (du Mesnil 1937, fig. 5.1). *Bottom*, A–C, the suggested original relationship between the three overlapping “plans,” with a common upper (eastern) margin and the profile (D) at the same scale, with its location.



Fig. 16. Tower 19 and the adjacent sapped section of curtain wall, seen from the city interior in 2008, looking south along Wall Street. The damage to the tower, and slumping of the wall into the Sasanian gallery (*right*), are clearly seen. The curtain was entirely encased in an earthen rampart at the time of the siege, which prevented it from toppling.

Du Mesnil demonstrated convincingly that, despite failure of their countermine with the loss of some 20 Roman lives, the struggle around Tower 19 ended in tactical success for the defenders, for their previous vast toil in buttressing the walls against just this kind of attack paid off. When the Persians fired their sap, no practicable breach resulted; although shaken and battered, the defensive circuit held. This has the ironic implication that, in whatever way they died, the Romans entombed in the countermine perished in vain, on two counts. First, the Persian mine at Tower 19 failed anyway, as their precautionary rampart strengthening proved up to the task of thwarting Sasanian sapping. And second, while the defenses held here, they were somehow overcome elsewhere, and the city fell despite the best efforts of the defenders.

EXCAVATION AND SITE RECORDING

The foregoing is a compelling interpretation of dramatic finds even if, by modern standards, du Mesnil's published accounts, and yet more his primary site recording, leave much to be desired. The photographic record is notably incomplete—not a single picture of the body pile is known to exist. Was it deemed too gruesome to photograph? This seems unlikely, as several pictures were taken of the isolated Persian body nearby. Perhaps negatives were exposed but were lost

or went wrong in development. However, this is far from the only major gap in the surviving photographic coverage of the expedition. Certainly, no attempt was made to arrange scientific examination of the human remains, which would today be a fundamental aspect of study of such a find.

However, by the standards of his time, and especially those of contemporary archaeological projects in the Middle East, du Mesnil's excavation and recording rate well, and his results were published in detail and with commendable speed. Dura was, as normal in the region, excavated by large teams of locally recruited workmen of varying levels of skill and experience, supervised by a small group of western archaeologists who also concentrated on recording and interpretation; in several photographs, du Mesnil, habitually immaculate in uniform, appears in an aloof, commanding role, doubtless reinforced by his military officer's training and experience and his aristocratic upbringing (he was Monsieur le Comte du Mesnil du Buisson) (see figs. 1, 9).⁷⁸ An able scholar who could read Hebrew and Aramaic, he was nevertheless a self-taught fieldworker with an idiosyncratic and fiercely independent approach; for example, publication of his account of the Dura synagogue paintings came as a surprise to his Yale coworkers.⁷⁹ Du Mesnil also rather followed his own path in recording his excava-

⁷⁸ On social relations and attitudes within the Yale–French Academy project, see Baird (forthcoming).

⁷⁹ du Mesnil 1939; Hopkins 1979, 119, 211.

tions and probably considered that the manuscript for *Preliminary Report VI*⁸⁰—apparently incorporating original site drawings finished in ink and accompanied by a text composed on-site no more than weeks after completion of the discoveries and sent directly to Yale—was the primary excavation record of the countermine. And, to be sure, in this text, du Mesnil recounted what he discovered in enough detail to permit his interpretations to be critically reassessed. As a whole, recording of these siegeworks compares favorably with that of other aspects of the Yale–French Academy excavations, conducted under great pressure to keep producing spectacular finds to justify continued funding.

Yet puzzles remain, such as the absence of any overall detailed plan of the countermine and du Mesnil's failure to plan a stretch of tunnel that he did excavate, that beneath the eastern side of Wall Street. And having put great effort into digging the Roman tunnel, why did he not complete it by excavating its entrance? Why does he seem to have become confused about the extent of the overlying rampart (crucial for understanding the conformation of the countermine) and also the extent of the final Persian stone blocking of the Roman tunnel? And why, since the countermine and its contents lay entirely in block K8, do so many of the records confusingly and erroneously ascribe them to block L7, hampering their identification in the Yale archive and collection?⁸¹ These issues become comprehensible if we reconstruct the course and context of the actual excavation, something on which du Mesnil is silent in his main accounts.⁸² The Roman countermine was revealed beside Tower 19 during removal of the overlying earthen rampart, beneath which it had been dug. It was then excavated as an open trench.

But not apparent from du Mesnil's detailed accounts is the reality that it was dug piecemeal in several sections, out of spatial order and over two seasons, the sixth and seventh, a significant point actively obscured by the fact that he published a seamless synthesis of all the discoveries in the preliminary report on the first of these two seasons.⁸³

The complex course of the tunnel excavation was contingent on external factors. If du Mesnil could already see from gross surface indications that Tower 19 and the adjacent curtain had been subjected to undermining, the immediate reason that in late November 1932 he moved his excavation team to commence a new *chantier* in this area was the identification of the synagogue and its famous paintings, in block L7 just to the south.⁸⁴ While clearance of block L7 progressed, du Mesnil also examined the defenses.

The western, Wall Street half of the mine was probably dug during December 1932. The body tangle in the eastern part was excavated in the early days of 1933.⁸⁵ All this was achieved under difficult conditions, during “almost uninterrupted freezing weather from Thanksgiving until the end of January.”⁸⁶ While it has always been clear that the part of the mine under Wall Street and the tangle of skeletons were excavated in the sixth season, it is only du Mesnil's brief annual reports to the French Academy that confirm that the remaining middle portion, wherein lay the Persian, was dug in the seventh season (1933–1934).⁸⁷ It is possible to reconstruct why du Mesnil dug the mine in this piecemeal manner. The western part of the countermine was found first, when the stretch of Wall Street behind block K8 was being cleared in late 1932. This operation involved using mining trucks on light rails to move spoil northward along Wall Street and through

⁸⁰ du Mesnil 1936b.

⁸¹ The Roman tunnel was, according to the site recording system in use (James 2004, 26–9), entirely in the zone of city block K8 north of 4th Street and, being under the rampart, should have been described as lying in K8-W (i.e., a wall area). The part running through the buildings at the southwestern corner of K8 backing onto Wall Street should have been recorded according to numbers assigned to the specific rooms concerned. While the countermine is, indeed, in places correctly described as being in K8-W (e.g., in the caption of du Mesnil 1936b, pl. 28.1), in the site records, objects from the mine are misleadingly given L7-W numbers, as though they came from the adjacent block containing the synagogue, across 4th Street to the south.

⁸² This was in line with the *Preliminary Reports* as a whole, which generally recounted results with minimal discussion of method or circumstances of excavation, beyond brief introductory comments in each volume.

⁸³ du Mesnil 1936b. Hopkins (1979, 139, 187) does discuss

the countermine finds under both the sixth and seventh campaigns but rather garbles and confuses what was found when, the text in the seventh-season chapter discussing material already described under the sixth season, and apparently being retrospective.

⁸⁴ Hopkins 1936.

⁸⁵ du Mesnil's surviving sketch of part of the skeleton pile, apparently one of his actual site drawings inked in and incorporated into the manuscript for *Preliminary Report VI* (du Mesnil 1936b), is dated 19 January 1933.

⁸⁶ Hopkins 1936, 2.

⁸⁷ du Mesnil 1934, 183. The detailed chronology of the mine excavation within the 1933–1934 season cannot be determined, as the key finds—the Persian's helmet and mail shirt—are not listed in the season's finds register. Du Mesnil was clearing the embankment behind the synagogue—i.e., in L7-W—and areas to the north in the seventh season, which ran for five months from late October 1933. He continued this work in the eighth season (Hopkins 1939, 1–2).

a gap made in the wall between Towers 19 and 20 to dumps outside the city. Wall Street was cleared southward from this gap, first the stretch flanking K8, then onward past L7. It was near the road junction between the two blocks that du Mesnil spotted the countermine crossing under the street. We can infer that only part of the L7 stretch of Wall Street had been cleared when work was halted for the season and the rail track removed so that the mine could be dug.

The stretch of the countermine on the east side of Wall Street, revealed apparently as a trench full of rubble, was excavated first (see figs. 7–10, 15[4]).⁸⁸ The relative featurelessness of this stretch, and the fact that it was first to be dug, before du Mesnil realized the complexity of the human and artifact remains in the tunnel, helps explain the absence of any detailed drawing. The still-timbered section by the city wall was then carefully excavated, as far as possible removing the stone fill while leaving the shoring in position. The excavators encountered one especially enormous block that had been maneuvered into the tunnel, the eastern face of which seems to correspond to the apparent (but spurious) end of the rubble infill seen in figure 15[4]. The “straight joint” within the rubble mass in the new composite plan is an artifact of digging and recording, not an indication of two distinct phases of stone blocking.⁸⁹

The western, Wall Street part of the tunnel was excavated and recorded during the sixth season and soon backfilled to reinstate the railbed, permitting completion of southward clearance of Wall Street to and beyond Tower 18 during the seventh season. However, it is apparent that only part of the rest of the countermine was located and excavated before the sixth campaign ended in March 1933. This, it seems, was because the rampart overlying it had not been completely excavated. East of the line of Wall Street, only the upper, dumped material had been removed. During this process, completed by early January 1933, du Mesnil evidently again picked up the outline of the mine emerging from beneath the still in situ mudbrick revetment of the western house walls of K8, which still stood about 3 m high (see fig. 4). Part of the tunnel remained buried beneath this, while the countermine entrance, around the tail of the dump rampart, was

not accessible either; it can be shown, by plotting the mine’s course against features visible in aerial photographs and on the ground today, that the new stretch of tunnel du Mesnil revealed extending beyond the mudbrick revetment disappeared again beneath the embankment of a rail track being used for removing spoil from block L7 (see fig. 4). Du Mesnil evidently decided immediately to excavate the new, isolated stretch of mine he could see. His workers, apparently cutting back a little into the revetment (which here had slumped into the tunnel),⁹⁰ soon came down on the stack of bodies.

This grim but startling discovery made him determined to continue excavation of the mine by removing the overlying stretch of mudbrick revetment to link the two sections of tunnel already dug.⁹¹ Unknown reasons—probably the overriding need to deal with the sensational newly found synagogue paintings—prevented him from completing this during the sixth season. He therefore returned to the task in the seventh, revealing the Persian skeleton, helmet, and jade pommel; the seat of the fire that destroyed the mine; and the incendiary materials used to start the blaze. He never did complete excavation of the tunnel by revealing its entrance, because the rail line was still in use or other priorities supervened. Du Mesnil therefore probably dug only two-thirds of the length of the gallery, although little is likely to have been deposited or to have survived in the shallower, unexplored entrance area that still remains buried under the rail embankment.

Reconstructing the course and context of the countermine excavation helps explain a number of puzzling features of the record, especially the lack of any overall plan of the mine and its finds until the 1944 publication, presumably a composite du Mesnil assembled at that time. The tunnel was dug and drawn in three sections, never all visible at the same time, over two years.⁹² It also partly explains why there are better records of the Persian skeleton zone (including photographs) than of the body stack. They were dug in different seasons, the Persian skeleton being found after the surprise of the body stack, by which time du Mesnil was better prepared.

It also suggests why so many of the records erroneously and confusingly ascribe the mine and its finds

⁸⁸ These earliest surviving photographs of the mine show the in situ timbering of the westernmost part of the Wall Street section and the eastern part already cleared of its rubble fill.

⁸⁹ Du Mesnil accurately planned individual tunnel timbers but not the individual stones of the rubble blocking.

⁹⁰ The unpublished section drawing roughly sketches this collapse (supra n. 19).

⁹¹ In K8, most of the mudbrick revetment was never re-

moved and remains in situ.

⁹² The excavation history also explains the odd excavation line shown around the body stack found in January 1933, published in *l'Illustration* (du Mesnil 1933a). Du Mesnil did indeed dig this part of the mine as a separate “pit,” only reconstructing the line of the tunnel’s walls after the following year’s work.

to “L7–W” (W = wall zone) rather than the correct K8–W. Only the southwestern corner of block K8 was ever excavated, apparently solely to reveal the mine. It was in effect a kind of minor addendum to the far greater effort to clear the synagogue and the whole of L7, and during recording it was carelessly and confusingly treated as part of the latter.⁹³

The two-season excavation also helps explain du Mesnil’s puzzling forgetting of the real extent of the rampart overlying the countermines in his publications. The line shown in his drawings, and in the Yale versions derived from them, represents the extent of the inner, mudbrick rampart only, which he was dealing with in the seventh season, not the overlying and much more extensive dumped-earth extension to the rampart, which he had removed the previous year without, it seems, planning it (see fig. 4). Over the following years, du Mesnil forgot the distinction, just as later his own apparently contradictory drawings would confuse his memory of the extent of the stone blocking inside the tunnel.

GENERATING A NEW PLAN OF THE MINE AND ITS CONTENTS

Alongside critique of the textual records, a vital starting point for reinterpreting the mine discoveries is creating an overall plan, one that is as detailed and accurate as possible, of the gallery and its contents. An immediate problem in creating one is the lack of clarity in the relationships among du Mesnil’s published drawings. As we saw, those in *Preliminary Report VI* cannot be clearly interrelated. The plan of the stone-blocked zone under Wall Street (see fig. 15[4])⁹⁴ has no point of contact with that of the middle of the excavated area around the Persian skeleton (see fig. 15[3]); these drawings also seem to show the end of the stone blocking on two completely different lines. In turn, it is not apparent how the Persian skeleton plan relates to the three drawings detailing the tangle of Roman bodies (see fig. 14, top).⁹⁵ Yet more exasperatingly, the relationships among these three drawings are far from obvious; while some items appear in the left and right drawings, neither shares any clear common detail with the center drawing. And finally, the section or profile drawing through this deposit was

not precisely located, either.⁹⁶ It is possible to resolve these problems partly through internal evidence. For example, the profile does contain details that relate it to all three of the skeleton-pile plans (see fig. 14, top). Information only appearing in du Mesnil’s other publications also helps.

Du Mesnil’s 1944 work presents a tiny overall plan of the Tower 19 mine galleries, except for the Sasanian approach tunnel (see fig. 15[1]),⁹⁷ alongside an equally tiny but fairly detailed plan of the entire countermines complex, including the position and extent of the skeletal deposits (see fig. 15[2]).⁹⁸ This confirms that the tangle of Roman corpses was indeed crammed into a zone little more than 2 m long, endorsing the proposal that the three plans in *Preliminary Report VI* represent different layers of the same area. But how exactly are they to be superimposed? They were published with their lower (western) edges aligned (see fig. 14, top), but the items common to both left and right drawings suggest a different disposition; for these shared details to correspond, it is the top (eastern) edges that should align. If it is assumed that all three plans should be aligned at the top rather than the bottom, they make more sense, especially if two of them are swapped around (see fig. 14[A–C]); instead of being three horizontal plans, these probably represent three stages of recording and clearance of artifacts along the mine gallery from west to east, as du Mesnil followed the deposit. This interpretation is confirmed by the caption to another version of the drawing (see fig. 14[C]) reproduced in du Mesnil’s 1944 paper, which describes it as “des couches profondes de la partie est.”⁹⁹ Figure 17 (bottom) shows a schematic representation of what the so-called plans probably show. When rearranged in the manner suggested, the drawings are also reconcilable with the profile (see fig. 14[D]), which is clearly not a single plane but a composite elevation of the eastern part of the deposit. Its position is confirmed by a drawing in du Mesnil’s 1937 publication (see fig. 5a). The three skeleton plans can now be superimposed to produce a new composite image of the pile of bodies (see fig. 17, far right). This corresponds well with du Mesnil’s tiny overall plan (see fig. 15[2]).

Next to be resolved is the relationship of the plans of the city end of the excavated mine to those of the

⁹³ In part, this was probably because finds from K8 and the mine were arriving at the dig house for registration along with those from L7, all being dug as part of the same *chantier*. However, the confusion extended to other records. The apparently sole surviving original site drawing of the mine excavation (supra n. 19) specifically labels the mine body tangle it depicts, which lay squarely inside block K8, as being in L7-W25, bizarre and demonstrably wrong, as that was a room in another build-

ing across the street. This instance defies explanation.

⁹⁴ du Mesnil 1936b, figs. 15, 16.

⁹⁵ du Mesnil 1936b, fig. 18.

⁹⁶ du Mesnil 1936b, fig. 17.

⁹⁷ du Mesnil 1936b, fig. 14, right.

⁹⁸ du Mesnil 1944, fig. 3; see esp. fig. 4.

⁹⁹ du Mesnil 1944, fig. 6.

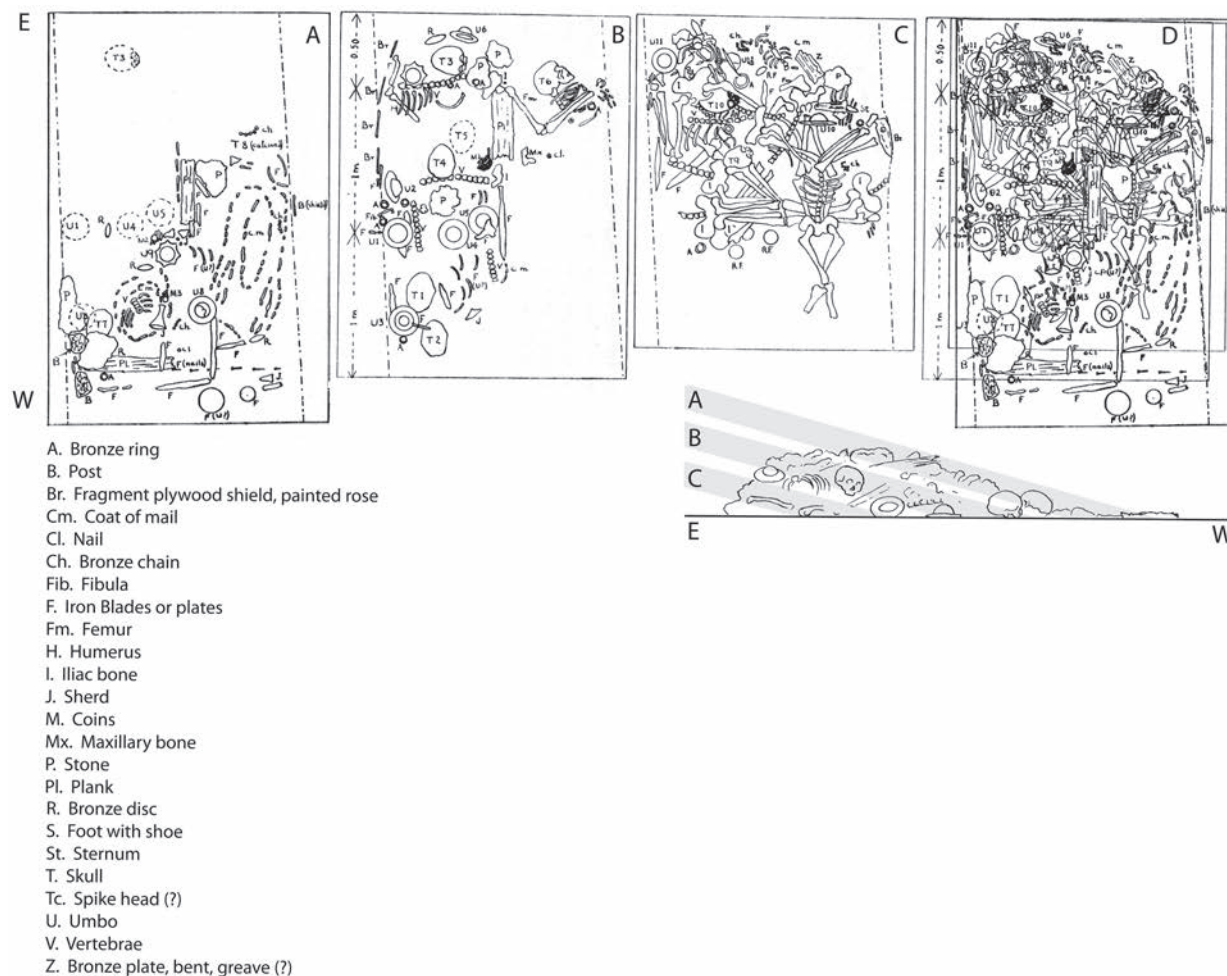


Fig. 17. A–C, Du Mesnil's three drawings of stages of excavation of the body stack, correctly aligned and arranged in the order they were executed, as he excavated the deposit from the shallower, heavily burned western side toward the deeper, better preserved eastern end; D, composite showing the original arrangement of the entire body stack (see also fig. 14).

adjacent stretch of the gallery containing the single Persian skeleton and the main seat of the fire. The *Preliminary Report VI* plan of this area (see fig. 15[3])¹⁰⁰ and du Mesnil's 1944 version¹⁰¹ are effectively identical except with regard to what happens at the western end of the drawing, to which we return below. Du Mesnil's tiny overall plan (see fig. 15[2]) shows two scales beside these sections of the mine, one measuring out 2.5 m for the Roman bodies and a contiguous 4 m scale for the center part of the mine. Equivalent scales are found on one of the plans of the Roman bodies (see fig. 14) and on both versions of the Persian skeleton plan. The clear implication is that these scales should simply be placed end-to-end to align the drawings. However, if the scales are presumed to form a straight

line, the result is an apparent kink in the northern wall of the mine gallery, which should be straight, as it followed a straight house wall (see fig. 15[2]). The Persian skeleton plan has to be rotated slightly counterclockwise to correct this. The drawings can then be shown in their correct relationship, against the background of a scaled-up version of du Mesnil's overall plan (see fig. 15[5]). This reveals some spatial overlap in the drawings, but no artifacts are shown in common except a single mine prop.

Finally, it remains to establish the relationship between the drawings of the eastern half of the mine excavations and the plan of its western junction with the city wall and the Persian sap. This shows the blocking wall made by the Persians to inhibit any renewed Ro-

¹⁰⁰ du Mesnil 1936b, fig. 16.

¹⁰¹ du Mesnil 1944, fig. 8.

man attack on their mine (see fig. 15[4]). In figure 15[3], superficially, the relationship looks simple: the limit of the stone blocking is also drawn straight across the Roman gallery at the lower edge of the Persian skeleton plan, inches from the body's fingers, in line with the buried house walls lining the former Wall Street. However, when the Persian skeleton and stone-blocked zone plans are superimposed on an overall plan of the Wall Street area (see fig. 15[5]), it is immediately apparent that there is a gap of about 2 m between them for which no detailed drawing exists, and that the stone blocking appears to end on two different lines. In his 1944 treatment, du Mesnil resolved this apparent contradiction by deleting the stone blocking from the Persian skeleton plan, evidently deciding this was a mistake. However, his original manuscript drawing and photographic evidence at Yale show it was real and that the edge in figure 15[4] is spurious.¹⁰²

The composite arrangement of images resulting from all this suggests an apparent kink in the line of the tunnel around the unplanned section of Wall Street (see fig. 15[5]). Surviving photographs of this area (see figs. 7, 8) may suggest that this is the consequence of a small surveying error, as the sections of mine were never simultaneously intervisible, but only reexcavation could resolve this minor point.

Together, these observations permit compilation of a new detailed plan of the whole countermining complex, using as far as possible du Mesnil's original pen strokes or Yale's tracings (fig. 18). Creating this new composite image facilitates a review of du Mesnil's interpretation of the events leading to deposition of the finds and provides the basis for new scale reconstruction elevations of the course of both rampart construction and mining duel.

REINTERPRETING THE SEQUENCE OF EVENTS

While du Mesnil's overall interpretation of the sequence (Persian sap, Roman countermining, destruction of the latter, completion but failure of the former) seems beyond dispute, what of his detailed explanation for the sequence of events leading to deposition of the bodies and associated artifacts in the countermining? He believed that the tangle of bodies represented Romans who, recoiling from combat with the Sasanians in the tunnels but being too slow or hampered by wounds, failed to make their escape from the mine before their officers outside panicked at the prospect of the Persians breaking into the town

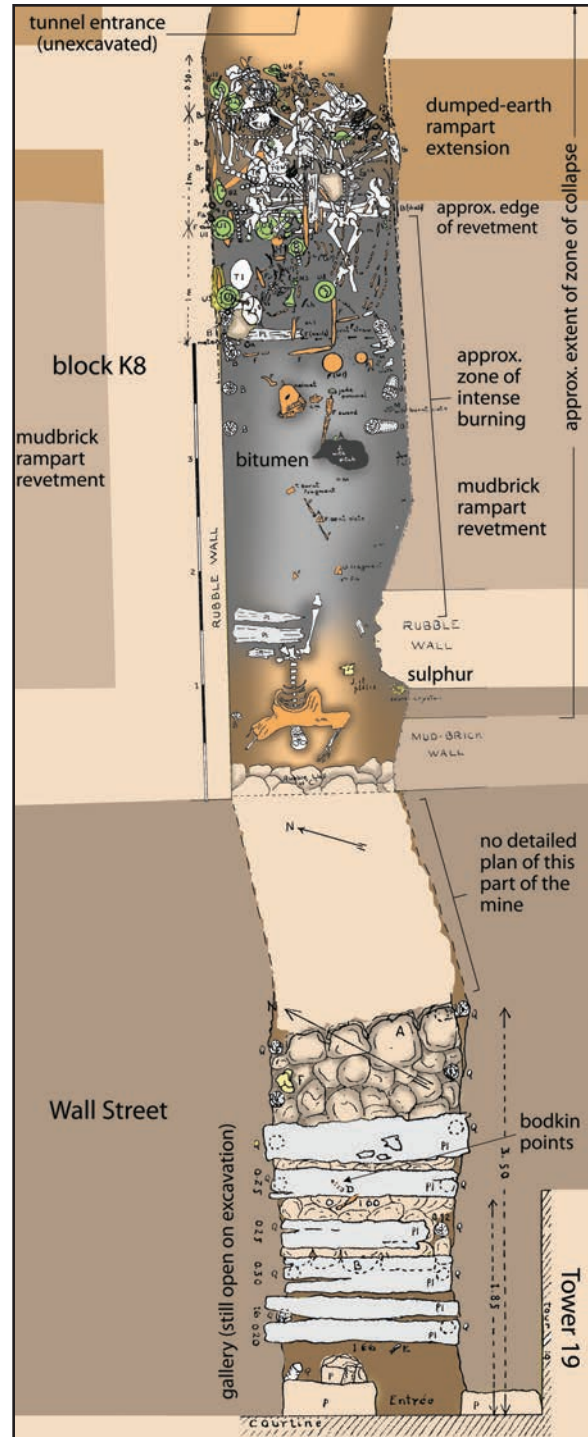


Fig. 18. Complete composite plan of the Roman countermining and the archaeological deposits found within it (after James [forthcoming]; adapted from various drawings by du Mesnil).

¹⁰² Du Mesnil's own ink-over-pencil drawing from his manuscript report, probably his actual site drawing made at the time of discovery, proves this (*supra* n. 19). The edge of the stone packing also seems visible in photographs G-909 and G-910 (Yale Dura-Europos Collection), while much of the blocking is certainly still to be seen in situ under the line of the house wall and brick revetment in fig. 7 herein. In a previous publication, I followed du Mesnil's error here (James 2005).

directly through the Roman gallery and deliberately collapsed the entrance.¹⁰³ These men, huddled together, seated, crouching, or standing by the fallen entrance, were slaughtered where they were trapped or subsequently perished when the Persians fired their gallery. Initially, du Mesnil also argued that the lone Persian was simply another casualty of the fighting.¹⁰⁴ However, these explanations seem implausible.

First, could the Romans have suddenly sealed their mine? Perhaps they had already prepared its entrance for deliberate collapse in case of need (e.g., via ropes attached to pitprops). But what, actually, was the danger? There would have been large numbers of defenders near the entrance who, forewarned, could make short work of any Persians emerging from the narrow gallery, no more than one at a time. Further, would—could—up to 20 living Roman soldiers, many encumbered with large shields, physically cram, standing and sitting, into the tiny space in the gallery where they were found? And would they really have waited there passively to be burned alive, eventually collapsing where they stood? Finally, is it likely that the Persians would not have bothered to recover their own combat casualty, whom they must have stumbled over to set fire to the gallery?

The key to an alternative explanation of the deposits lies in du Mesnil's plans of the Roman bodies. If in some ways obscure, perhaps selective in what they recorded, and maybe also partly garbled in retracing for publication, they nonetheless contain much important detail. To a considerable degree, it is possible to trace individual corpses in the tangle and so to reconstruct how they were deposited (fig. 19). For the most part, skulls are of little use here, as they tend to roll away from their original positions after decay, and in any case, postcranial remains clearly show far more bodies than the 10 identified whole skulls. Many sets of articulated vertebrae and/or pelvises and legs can be traced on the plans, especially for the lowest level (see fig. 19[C]). Reanalysis of these drawings suggests at least 19 bodies in the pile. Du Mesnil believed that the Romans had been sitting or standing when they died.¹⁰⁵ However, it seems clear from his own drawings that a number of the lowest bodies sat up against the sides of the gallery, with their legs outstretched across it—not defensively contracted as we would expect if other, hobnailed comrades were standing over them (see fig. 19[6, 7, 10–12]). Other bodies lay on top of these, mostly stretched across the mine on top of others (see fig. 19[4, 8, 9, 13, 14]). How could these have

ended up in such a posture, if crammed among comrades collapsing together from a standing position?

Yet more bodies had come to rest sitting or lying against the existing pile—on the Persian side. Of this last group, being most exposed to the subsequent fire, except for Skeleton 5, the bodies are highly fragmentary, comprising spinal columns (see fig. 19[15, 16]) or individuals detectable only from patterns left by fragments of the mail they were still wearing when burned (see fig. 19[17–19]).

The disposition of the remains so carefully recorded by du Mesnil is not explicable in terms of men expiring where they were standing or sitting just before the mine was burned. Rather, these bodies had been deliberately piled: carried or dragged to this point from elsewhere and stacked. First, some had been laid slumped up against the walls of the tunnel, their legs stretching across it. Others had then been dumped lying right across the gallery. More were added to the growing pile, and the last were laid against it, these final bodies proving that all this was conducted from the Persian side. Heaped at least three or four high, with about a dozen shields then thrown on top (their bosses ending up in two concentrations on the front and back of the pile), the bodies composed a wall, effectively blocking the low tunnel.

It is suggested that when the Romans retreated from the mine, their officers outside did not collapse the entrance because they could not or because they contemplated a renewed assault; equally, the victorious Sasanians did not venture out of the mine but concentrated on its urgent destruction. Evidently, the Persians found about 20 dead, dying, or incapacitated Romans, many with broad shields, encumbering most of the floor area of the Roman tunnel and spilling into the Persian sap. With brutal practicality, the Sasanians turned these obstacles to advantage by carrying the bodies and shields toward the countermine entrance, where they piled them into a barrier, hindering any further Roman attack while simultaneously clearing the floor to facilitate preparation of a destructive fire (fig. 20[3]).

The wall of bodies and shields may have had an additional purpose. One recorded mine-combat technique was to shoot light artillery projectiles—bolts and stones—along enemy galleries; du Mesnil believed this could explain the presence of stone balls in one of the tunnels near the siege ramp and also noted the two iron heads on the floor of the Tower 19 countermine (see figs. 15[4], 18).¹⁰⁶ These might have been from

¹⁰³ du Mesnil 1944, 16, 20.

¹⁰⁴ du Mesnil 1936b, 192.

¹⁰⁵ du Mesnil 1936b, 195; 1944, 20.

¹⁰⁶ Supra n. 52. Du Mesnil (1944, 34) reported Philon of

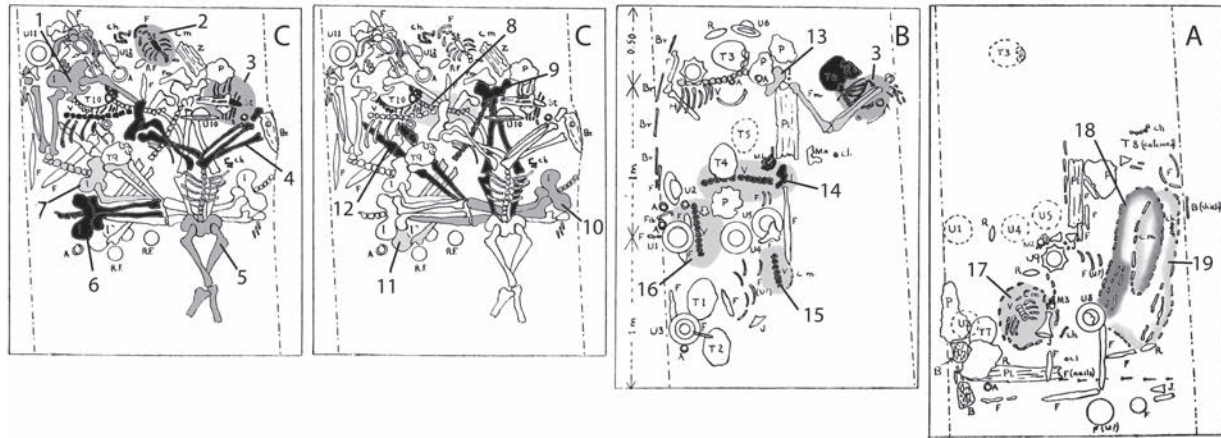


Fig. 19. Du Mesnil's drawings of the composition of the body stack, shown in reverse order approximating the sequence of deposition of the bodies, beginning with the lowermost (C), shown twice to facilitate picking out of the many skeletons traceable in this single image. At least 19 bodies are traceable in the pile from partially articulated skeletons and/or outlines of armor of otherwise incinerated corpses (see also fig. 14).

improvised mine-fighting weapons, but an immediate Roman response to loss of their tunnel may well have been to bring up a light catapult and to start shooting bolts into the smoky darkness. Although the exact conformation of the entrance of the Roman gallery is unknown, scale reconstruction (see fig. 20[3]) suggests it was probably feasible to shoot along it. This would have given urgent added incentive to the attackers to use the Roman casualties as "organic sandbags."¹⁰⁷

Building the body wall probably occupied just a few minutes. Imminent lethal danger meant that there was no time to plunder the corpses thoroughly, if at all; several still had their purses on them when they were deposited, and a sword with a rock-crystal pommel was dumped in the stack. The Sasanians then brought in straw, bundles of wood, pitch, a jar of bitumen, and sulphur crystals, apparently supplemented with Roman cloaks and a shield, to start the blaze that would collapse the countermining roof.

What of the Persian corpse? If the new interpretation of the stack of bodies is accepted, it is incredible that, as du Mesnil originally assumed,¹⁰⁸ the Sasanians carrying the Roman dead should have stepped over the lone Persian casualty of the fighting, leaving him, his helmet, and his sword in situ when they fired the mine and withdrew. A more plausible explanation is

that the body was deposited after the construction of the body wall and the preparation of the fire; it is that of someone who failed to escape quickly enough when it was ignited, as du Mesnil evidently subsequently concluded.¹⁰⁹ It is suggested that this is the Sasanian who actually started the blaze. He may have been in command of the party preparing the incendiary material and took personal responsibility for igniting it and ensuring it was burning properly before withdrawing. Putting down his helmet (too tall anyway for the gallery) and his encumbering sword, he knelt to set the fire but perhaps lingered too long to ensure it had caught; the combustibles, including bitumen and sulphur (see fig. 18),¹¹⁰ would have quickly given off a cocktail of noxious fumes that in the confined space could swiftly incapacitate him. Choking, he collapsed backward and tried to pull his heavy mail shirt off before he sank into unconsciousness (see fig. 20[4]). Alternatively, perhaps he was already badly wounded.¹¹¹ The fire then partly consumed his body before the roof fell in on him and the Roman dead (see fig. 20[5]).

This new reading of the events leading to the disposition of bodies and artifacts found in the mine is significantly different from the scenario presented by du Mesnil and better explains the evidence, especially

Byzantium's advocacy of use of arrow shooters and small stone throwers in mines.

¹⁰⁷ To adapt apposite modern British Army gallows-humor slang for close-protection bodyguards.

¹⁰⁸ du Mesnil 1936b, 192.

¹⁰⁹ du Mesnil 1937, 16; 1944, 20.

¹¹⁰ du Mesnil 1936b, 194.

¹¹¹ As du Mesnil (1937, 16; 1944, 20) speculated in his later publications: had he been struck by a bolt shot into the mine, before the body wall was built?

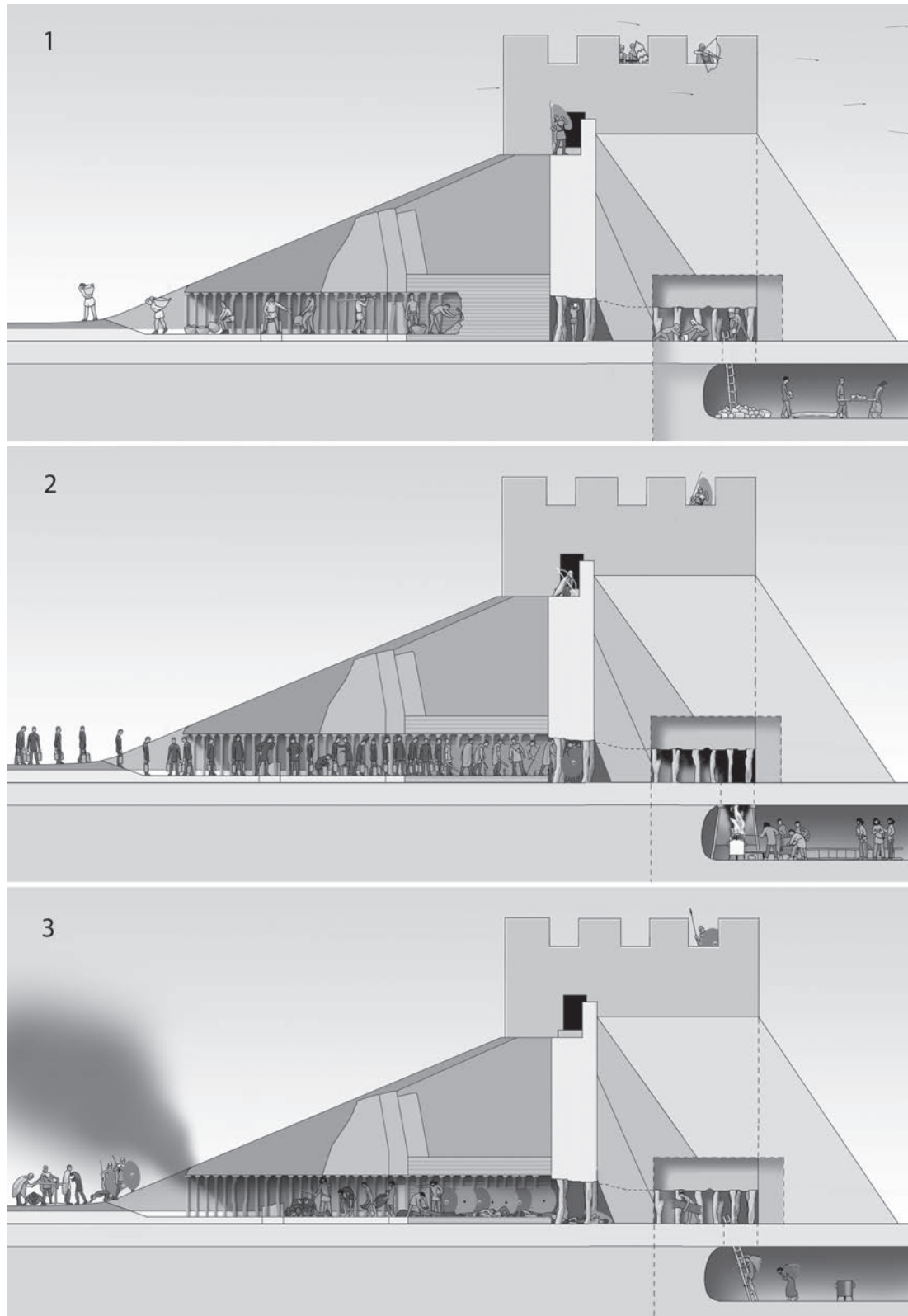


Fig. 20. Newly reconstructed sequence of events in the mines: 1, Sasanian sappers undermine Tower 19 and tunnel along curtain wall, Romans dig countermine to intercept; 2, Romans break through, forewarned Sasanians feed naphtha and sulphur onto their smoke generator; 3, most Romans overcome before they can escape, as smoke clears, Sasanians enter tunnel and pile Roman casualties into a wall (*left*) while they assemble incendiary materials and inflammables (*right*) to destroy the countermine (after James [forthcoming]).

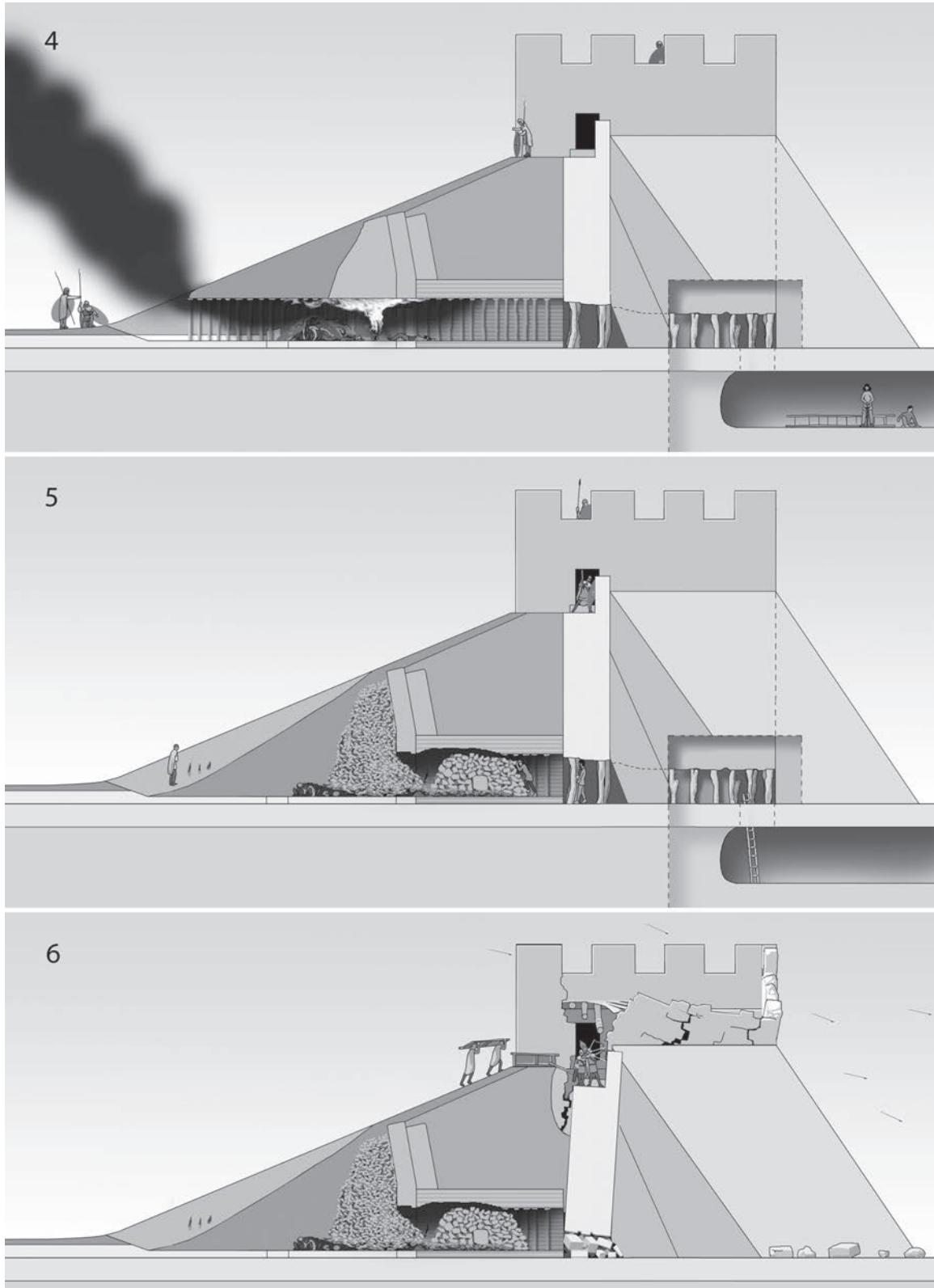


Fig. 20 (continued). 4, the Sasanian who set the fire failed to escape ensuing inferno; 5, western half of countermine collapses, Persians resume undermining curtain using the still-intact portion of the Roman mine as a convenient stone dump; 6, Sasanians complete and fire their sap but enshrining rampart successfully prevents tower and wall from toppling as intended, no practicable breach results and Romans able to reoccupy their ramparts (after James [forthcoming]).

the body stack. Above all, if the Roman casualties did not perish where they were found, as the excavator surmised, but had been carried there from elsewhere by the Persians and dumped, two new questions arise: where, then, did they actually die—and how?

HOW DID THE ROMANS REALLY DIE?

That so many of the city's defenders perished in the narrow confines of the mine is itself remarkable. The tunnel was barely tall enough to stand upright in, and it was narrow enough to touch both walls at once. It seems utterly implausible that they could all have fallen in hand-to-hand combat in such a space, as this implies superhuman strength and skill on the part of the victorious Sasanians. However, du Mesnil's hypothesis that they had been trapped by their own side and stood at bay while the Sasanians encompassed their deaths by fire is equally implausible and not compatible with the detailed disposition of the bodies.

In seeking an alternative explanation for this mass death, my first hypothesis was that there was a terrible accident rather than enemy action. In the hot, dark tunnel, lit only by oil lamps, once the mines met and fighting broke out, Romans at the back pushed forward, while those at the front, meeting ferocious resistance, tried to recoil. In the confined space, crowd crush could soon incapacitate or kill many by asphyxiation and perhaps trampling, as modern accidents at football stadia and religious gatherings have shown. However, at an informal presentation of this hypothesis, an ancient historian, Kate Gilliver, suggested that smoke rather than crushing could have been the cause. Surviving historical texts record that the Hellenistic Greeks had developed simple fume generators to literally smoke out enemy siege miners. At Ambracia in 189 B.C.E., Greeks drove Roman sappers from their tunnel using a cask full of burning feathers, from which the choking fumes were pumped using blacksmith's bellows.¹¹² This historical information provided the final piece of the archaeological jigsaw puzzle.¹¹³ Use of smoke generators in mine warfare was a technique listed as a stratagem in Imperial-era Graeco-Roman military treatises (e.g., Polyaeus *Strat.* 56.7). The Romans caught in the tunnel by Tower 19 had been gassed. And we can even identify the chemical agents used.

The proposed sequence of events is as follows. Just as the Romans detected the Sasanian mining operation, so the Persian sappers heard the approaching

counterminers (see fig. 20[1]) and had enough time to plan a riposte. They prepared a very nasty surprise for the Romans, and it worked perfectly, perhaps proving even more devastatingly effective than they had expected. Probably in their own approach tunnel, close beneath the shaft leading up to the level of their undermining gallery and the approaching Roman countermine several meters above, they set up a brazier of hot charcoal (see fig. 20[2]). As the Romans started to break through into the prop-filled void being created under the city wall, the Persians retreated into their approach tunnel behind their brazier and threw onto it some of the bitumen and sulphur crystals we know they had because they were using them, probably just minutes later, to set fire to the Roman tunnel.

These materials would have produced dense clouds of hot fumes, a deadly cocktail of oily hydrocarbon smoke incorporating carbon dioxide, lethal carbon monoxide, and—even nastier—sulphur dioxide gas. When inhaled, sulphur dioxide combines with water on the surface of the eyes and in the mucus of nose, throat, and lungs to create sulphurous acid (H_2SO_3). The Sasanian engineers probably actively pumped these fumes up into the propped sap and the Roman tunnel with bellows—the documented technique—although once the deeper Persian tunnel was connected to the higher Roman gallery, a natural chimney effect would have drawn the hot gasses upward, an air current perhaps magnified by the prevailing westerly winds that on many days buffet the city. Either way, the foremost members of the Roman assault party would have found themselves engulfed in total blackness and in seconds were choking to death. Men would have been collapsing into unconsciousness at the front of the party before the smoke reached those farther back. Only the hindmost were able to turn and stagger, fighting for breath, out of the tunnel, pursued, it must have seemed, by the sulphurous clouds of Hell billowing out of the entrance. Whether or not they understood what was happening (and they probably did), it is no wonder the Romans hesitated to reenter the tunnel, even when the smoke cleared (see fig. 20[3]).

Down in their own approach tunnel, the Persians simply had to keep the smoke going until the noises in the gallery above stopped. Capping or dousing their brazier, they waited briefly for the worst of the fumes to blow on through the connected mines and out into the city and then entered the Roman tunnel,

¹¹² Livy 38.7; Polyb. 21.28. Thanks go to Kate Gilliver for bringing this incident to my attention.

¹¹³ At the time I had not yet read Mayor's (2003) extensive recent treatment of ancient biochemical warfare.

its floor now carpeted with dead or incapacitated men (see fig. 20[3]). Unable to defend themselves, they would have fallen easy prey to a coup de grâce from the Persians, who began systematically dragging them toward the entrance and piling them, some perhaps still alive, into a blocking wall. As the gallery floor was thus cleared, the attackers prepared and started the fire that would collapse the middle section of the Roman gallery, using more bitumen and sulphur, this time as accelerants to make the flames flare rapidly into an unquenchable inferno (see fig. 20[4]).

This new reconstruction of the dramatic struggle in the dark beneath Tower 19, if correct—and it seems to explain all the available evidence satisfactorily, not least the startling number of casualties in so confined a space—constitutes the oldest known archaeological evidence for what we today call chemical warfare, that is, deliberate use of chemical agents, usually in the form of gas or vapor, to incapacitate or kill enemy personnel.

GAS WARFARE AND SIEGE TECHNIQUES AT DURA AND BEYOND

As we have seen above, there is clear classical literary evidence that use of smoke in siege mines was a widely known, if perhaps rarely used, stratagem in Hellenistic and Roman siege warfare. The evidence for this, and for wider employment of biochemical stratagems, methods, and weapons in ancient warfare, in China as well as in the West, has recently been synthesized by Mayor.¹¹⁴ The principle of directing choking smoke into mine galleries was established at least as early as the fourth century B.C.E., when Aeneas Tacticus advocated its use to force enemy miners out of their tunnels—in modern jargon, it was an “area denial” technique that could also kill.¹¹⁵ Area denial would have been the primary objective of the postulated Sasanian smoke generator at Tower 19, namely, a stratagem to clear the Roman tunnel and allow it to be seized long enough to destroy it, whether by driving out the Roman assault troops or by asphyxiating them. The Sasanians were spectacularly successful but are unlikely to have anticipated inflicting so many casualties—although their choice of smoke-generat-

ing agents, the noxiousness and potential lethality of which cannot have been unknown to them, suggests their intent to achieve their objective by killing if required. This, in my view, justifies applying the modern terms “gas warfare” or “chemical warfare” to this stratagem. Poison-smoke generators of the type hypothesized here would be classified as chemical weapons under Article II of the modern international Chemical Weapons Convention, which provides the following definitions:

1. “*Chemical Weapons*” means the following, together or separately:

(a) *Toxic chemicals* and their precursors, except where intended for purposes not prohibited under this Convention, as long as the types and quantities are consistent with such purposes;

(b) Munitions and devices, specifically designed to cause death or other harm through the toxic properties of those toxic chemicals specified in subparagraph (a), which would be released as a result of the employment of such munitions and devices;

(c) Any equipment specifically designed for use directly in connection with the employment of munitions and devices specified in subparagraph (b).

2. “*Toxic Chemical*” means:

Any chemical which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals. This includes all such chemicals, regardless of their origin or of their method of production, and regardless of whether they are produced in facilities, in munitions or elsewhere.¹¹⁶

It is, of course, of considerable interest to find at least good circumstantial archaeological evidence for employment of such a tactic in the siege of Dura. It is of even greater interest to find it apparently being used by the Sasanian Persians, whose military structures and capabilities are much less well attested than those of their Roman foes. Parthian and Sasanian armies were generally represented in the Graeco-Roman sources, through which western scholarship has mostly perceived them, as quasifeudal cavalry forces of lancers and horse archers, with the Parthians especially exhibiting little capacity for siege warfare; Seleucid skills in artillery and siege warfare were generally allowed to wither away under the Arsacids—or so it would seem. However, the archaeological testimony of the siege

¹¹⁴ See Mayor (2003, 222–26) for poison smoke in classical warfare. There is also literary evidence that the Chinese independently developed smoke generators for use in siege mine warfare, perhaps even earlier than the Greeks. A text of the fourth century B.C.E. describes how toxic smoke from burning plant material (e.g., mustard) could be directed by double-acting bellows into enemy saps (Needham 1965, 137–38). Thanks go to Garry J. Tee for this reference.

¹¹⁵ Aen. Tact. 37.1–3; Whitehead 2002, 93; Mayor 2003, 222.

¹¹⁶ Organisation for the Prohibition of Chemical Weapons (n.d.) (emphasis added). The smoke generator in the mine burning sulphur crystals and heavy hydrocarbons hypothesized here would certainly be judged a device constituting a chemical weapon system under these definitions and its use as chemical warfare.

of Dura shows that, within a generation of establishment of the Sasanid dynasty, the Persian army was fully capable of state-of-the-art Graeco-Roman-style siege warfare, including construction of assault ramps, siege machines (albeit of uncertain form), sapping, and assault mining. In such a context, that the Sasanians should also know how to employ smoke generators in mine warfare is actually unsurprising.

We know how the Romans acquired their expertise in poliorcetics; as the etymology of this technical name for the science of siege warfare shows, they copied it from the Greeks, who, during the Hellenistic era, had developed it to a level unprecedented in the western world. As talented engineers themselves, the Romans refined the science incrementally. We may ask where the Sasanians acquired the expertise they demonstrated so devastatingly at Dura. Pretty clearly, like the Romans, they learned from the Greek military tradition, and they also learned from the Romans themselves. Perhaps the Greek community in Seleucia-on-the-Tigris, close to the Sasanian capital of Ctesiphon (both near modern Baghdad), provided a conduit for transmission of this knowledge. The populations of both these cities, and the peoples of the former Parthian empire more generally, had had bitter direct experience of Roman siege warfare during the imperial military aggressions of the preceding 150 years. This included the Mesopotamian city of Hatra on the periphery of Parthian rule, which, after remarkably defying several Roman sieges, fell to the Sasanians through unknown means ca. 240 C.E., perhaps bequeathing to the new power its formidable expertise in artillery and siege fighting—which included offensive use of naphtha.¹¹⁷ There were also political defectors from the Roman empire, plus vastly greater numbers of prisoners of war, Roman soldiers, and provincials taken during early Sasanian campaigns, whom we know were settled in the Sasanian empire and put to work.¹¹⁸ The Sasanian military, then, had plentiful means of learning all the secrets of poliorcetics.

As du Mesnil and many others have documented, siege warfare, including sapping and the building of ramps and siege machines, was already well developed

in the Middle East in pre-Greek times, notably by the Assyrians.¹¹⁹ It is less a surprise or a problem that the Sasanian military possessed siege capability than that the Parthians had apparently allowed it to atrophy (unless this also proves to be a distortion of Graeco-Roman propaganda).¹²⁰ The immense shock that the new Iranian empire evidently inflicted on Rome during the third century clearly shows that it possessed formidable military power, capable of defeating the standing imperial armies that had dominated the Mediterranean world for centuries. The early Sasanian military was a highly skilled, well-led, and demonstrably innovative force that behaved ruthlessly and brutally—just like its Roman antagonist. In contemplating the evidence for the deadly duel of stratagems beneath Tower 19, du Mesnil was left wondering whose military skill to admire more.¹²¹

Du Mesnil was not, then, suffering from orientalist prejudice against the Partho-Sasanians in failing to consider that the Persians might have used a technique such as smoke generators in the Tower 19 mines. Rather, he ridiculed the historicity of such methods in antiquity at all. In his final publication on the Dura siegeworks, during a general survey of ancient siege warfare, he actually refers to Polybius' (21.28) account of the use of burning-feather smoke at Ambracia but expressed his skepticism, while treating Aeneas Tacticus' (*How to Survive Under Siege* 37) advocacy of the use of wasps and bees in enemy tunnels as a joke.¹²² Why du Mesnil was so dismissive of this literary evidence is not immediately clear; he would surely have reconsidered, had Mayor's study been available to him.¹²³ It is especially curious that a soldier from a society that had bitter memories of gas warfare in World War I did not make the connection himself. However, he was evidently satisfied with his initial hypothesis for how so many Romans met their deaths in the mine, and looked no further.

The grim testimony of the siege of Dura strongly impressed du Mesnil, as it impresses and chills me, with the power and proficiency of the early Sasanian military. It is somewhat ironic that some have accused me of exhibiting long-standing western anti-Iranian bias¹²⁴

¹¹⁷ For the fall of Hatra, see Dignas and Winter 2007, 19–21. For Hatrene use of powerful artillery and burning naphtha against Severus' troops, see Cassius Dio 76.10–12; Mayor 2003, 234. For remains of a catapult frame from Hatra, see Baatz 1978, 3–9.

¹¹⁸ Flights and defections across the Partho-Sasanian border are recorded from the case of the "rogue" Roman general Q. Labienus onward (Cass. Dio 48.24). For mass deportations and resettlement in Sasanian territory, see Dignas and Winter 2007, 254–63.

¹¹⁹ du Mesnil 1944. Assyrian reliefs show use of siege towers and elaborate wheeled machines wielding battering rams, as well as mining operations (Collins 2008, 36–7, 50–1, 91).

¹²⁰ As Leriche (1993, 87–8) has suggested. For a recent reappraisal of the Parthian military, see Hauser 2006.

¹²¹ du Mesnil 1936b, 199.

¹²² du Mesnil 1944, 44–5.

¹²³ Mayor 2003.

¹²⁴ Yeganehshakib and Rezakhani 2009.

and even of deliberately propagating hostile, politically motivated propaganda aimed at the Islamic Republic of Iran with this new gassing hypothesis. Presented at the Archaeological Institute of America meeting in Philadelphia in January 2009, the “Dura chemical warfare story” was rapidly picked up by global print, broadcast, and Internet media. Some weeks later, I was informed by Iranian sources that it was being used in propaganda dueling on message boards and blogs between right-wing western elements presenting this as evidence that Iranians have always been brutally violent and Iranians who saw the news story as deliberate defamation linked to western governmental pressure on Iran over its nuclear program. This all came as a complete surprise to me, and it is questionable whether an interview on the BBC Farsi radio service is likely to have dispelled any of these wild misrepresentations.¹²⁵ To be clear: the implication of the chemical warfare hypothesis is that the early Sasanian military was, for its time, highly sophisticated and effective and neither significantly more nor less brutal than the Roman military that confronted it. Both were effective instruments of ruthless imperial powers. Any negative implications for modern Iran are entirely in the minds of the beholders, eastern or western, in the prevailing febrile political climate.

A CASE FOR REEXCAVATION?

One obvious further question is whether there is any way to test the gas warfare hypothesis presented here through new fieldwork, since the Roman countermine gallery is still there—and especially as there is a good chance that we know where the mine bodies are now.

No studies of the bones were undertaken at the time of excavation (paleopathology was barely in its infancy, although the classic study of the medieval war grave from Wisby, Sweden, appeared in 1939),¹²⁶ nor did the excavators retain the remains for possible future study. The Persian’s armor was shipped to Yale, but his skeleton was not. While a few bones are preserved, trapped in or adhering to mail fragments,¹²⁷ we do not know what happened to most of the human remains. It seems likely that these—most, if not all, of which had been moved during the course of excavation, recording, and recovery of the artifacts that lay interspersed

through the bone stack—were simply put back into the tunnel and reburied; as previously mentioned, the countermine was unusual in apparently being back-filled after excavation. The bones, then, likely still lie roughly where they were found, although a lifetime of rains since removal of the protecting embankment may have led to their deterioration.

I doubt, however, whether any physical indications exist that could support or refute the chemical warfare interpretation; it is not clear how further fieldwork could add to the present exercise in archival archaeology. The hypothesized smoke generator would have been removed when the undermining resumed, and any traces on the walls or ceiling of the still-unexplored approach tunnel are likely to have been obscured by the effects of the subsequent firing of the sap above. The tunnel itself and the bodies of the casualties were engulfed in an inferno demonstrably fed with sulphur and bitumen accelerants. No trace of the hypothetical prior gassing with these same agents would be distinguishable in either the soil around the tunnel or the bones of the dead, which would have been unaffected by the agents in question anyway. Examination of the bones for unhealed *perimortem* violent injuries would be equally inconclusive. Absence of skeletal trauma would fit with the gassing hypothesis, but so could its presence, for sharp-force injuries could result from either Persians dispatching gas-incapacitated Romans or the hand-to-hand combat du Mesnil proposed, while blunt-force trauma could result from the impact of the collapsing tunnel roof.

However, if the human remains do still lie in the mine, they may be able to answer some other very important questions, even if the skeletons of the various individuals, hard enough to disentangle at excavation, now lie jumbled together. Here at Dura, there is a strong likelihood that we know the precise whereabouts of something that, given the scale and number of Rome’s wars, is surprisingly unusual: the physical remains of a substantial number of battle casualties, demonstrably a group of men who lived and died at the same time, some (although perhaps not all) certainly Roman soldiers. Given the sophistication of modern paleoanthropological and forensic techniques, the bones might tell us many valuable things, most of which would not have been knowable, or even imagin-

¹²⁵ It may seem naive not to have anticipated hostile reactions, but I would observe that the University of Leicester’s press officer, himself of Persian Mogul origin, was equally surprised; he had thought that the Dura evidence rather showed the cleverness of his ancestors (A. Mirza, pers. comm. 2010).

¹²⁶ Thordeman 2001.

¹²⁷ Including arm bones fused inside a mail sleeve and carbonized finger bones adhering to another mail fragment, both almost certainly from the mine, in the Yale collection (James 2004, nos. 382, 383). Yale holds a few other bones probably from the countermine, e.g., some under acc. no. 1934.463C.

able, in the 1930s. Examining the remains could give us an unparalleled snapshot of the stature, health, and life histories of an entire squad of Roman soldiers (and perhaps military servants). Isotope analysis might indicate where these men had lived, and DNA may also point to their genetic origins. Such information would be of great interest to wider Roman provincial and military scholarship. It could also help resolve an abiding mystery of the siege of Dura. It was defended by Roman soldiers, but which Roman soldiers? Were they troops from the Syrian provincial garrison, or at least from the eastern empire, as Gschwind has convincingly argued on the basis of details of manufacture of items of their equipment?¹²⁸ Or were some possibly European expeditionary troops, analogous to the Gallic legionaries trapped in the Persian siege of Amida a century later (359 C.E.), 200 miles to the north (Amm. Marc. 18.8–19.8)? Perhaps the remains of the Persian also still lie in his own, separately excavated section of the mine. Since Sasanian armies often comprised contingents from everywhere from Mesopotamia to eastern Iran and Central Asia, his solitary bones, too, may have an important tale to tell.

Whether they were gassed, as I propose, or fell victim to desperate hand-to-hand combat or flames, as the excavator believed, the bodies of those who perished in the mines beneath Tower 19 might reveal these and perhaps other important secrets about life, as well as death, at Dura and in the Roman/Partho-Sasanian Middle East. But if du Mesnil did indeed have the bones reinterred in the countermine, then it is a war grave. Whether the potential gain in knowledge would justify further disturbing the dead—if they really are still there—is a matter of ethical judgment. I have no current plans to undertake such work, which would anyway require a multidisciplinary approach.

While the bones, wherever they lie, continue to keep some of their secrets, archaeological research has nevertheless recovered remarkable testimony about these casualties of war, their last actions, and their fate. While the Sasanian sapping perhaps ran into weeks, and digging the countermine must have taken days, the events from the moment of Roman breakthrough to the Sasanians firing the Roman gallery probably took minutes. Yet these were desperate and nightmarish minutes, as men toiled, struggled, and died in the gloom of the low, narrow tunnels. The gruesome deposits from the struggle around Tower 19 bring us as close as archaeology ever has to the immediate experience, and the real horror, of ancient combat.

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Works Cited

- Baatz, D. 1978. "Recent Finds of Ancient Artillery." *Britannia* 9:1–17.
- Baird, J. Forthcoming. "Imag(in)ing the Other at Dura-Europos: Archaeological Photography and Archival Archaeology." *AJA*.
- Balty, J.-C. 1987. "Apamée (1986): Nouvelles données sur l'armée romaine d'Orient et les raids sassanides du milieu du III^e siècle." *CRAI* 131 (1):213–41.
- . 1988. "Apamea in Syria in the Second and Third Centuries AD." *JRS* 78:91–104.
- Bellinger, A.R. 1936. "The Coins." In *The Excavations at Dura-Europos, Preliminary Report of Sixth Season of Work, October 1932–March 1933*, edited by M.I. Rostovtzeff, A.R. Bellinger, C. Hopkins, and C.B. Welles, 467–79. New Haven: Yale University Press.
- Collins, P. 2008. *Assyrian Palace Sculptures*. London: British Museum Press.
- Dignas, B., and E. Winter. 2007. *Rome and Persia in Late Antiquity: Neighbours and Rivals*. Cambridge: Cambridge University Press.
- du Mesnil du Buisson, R. n.d. "Les sapes perses de Doura-Europos." Unpublished manuscript. New Haven: Yale University Art Gallery, Dura-Europos Archive.
- . 1933a. "La guerre de sape il y a dix-sept siècles." *L'Illustration* (5 August):481–83.
- . 1933b. "Sixième campagne de fouilles a Doura-Europos." *CRAI* 77:193–204.
- . 1934. "Septième campagne de fouilles a Doura-Europos." *CRAI* 78:176–87.
- . 1936a. "Doura-Europos, la Pompéi de l'Orient." *L'Illustration* (14 March):323–25.
- . 1936b. "The Persian Mines." In *The Excavations at Dura-Europos, Preliminary Report of Sixth Season of Work, October 1932–March 1933*, edited by M.I. Rostovtzeff, A.R. Bellinger, C. Hopkins, and C.B. Welles, 188–205. New Haven: Yale University Press.
- . 1937. "Un guerre de mines en 256 après J.-C.: Le siège de Doura-Europos d'après les fouilles récentes." *Revue du Génie Militaire* 76:5–27.
- . 1939. *Les Peintures de la Synagogue de Doura-Europos*. Rome: Pontificio Istituto Biblico.
- . 1944. "Les ouvrages du siège a Doura-Europos." *MAntFr* 9 (1):5–60.
- Gelin, M., P. Leriche, and J. 'Abdul Massih. 1997. "La porte de Palmyre á Doura-Europos." In *Doura-Europos: Études IV, 1991–1993*, edited by P. Leriche and M. Gelin, 21–46. *BAHBeyrouth* 149. Beirut: Institut Français d'Archéologie du Proche Orient.

¹²⁸ Gschwind 2007, 623–25.

- Geyer, B. 1988. "Le site de Doura-Europos et son environnement géographique." In *Doura-Europos: Études [II] 1988*, edited by P. Leriche et al., 285–95. Beirut: Institut Français d'Archéologie du Proche Orient.
- Grenet, F. 1988. "Les Sassanides à Doura-Europos (253 ap. J.C.): Réexamen du matériel épigraphique iranien du site." In *Géographie Historique au Proche-orient: Syrie, Phénicie, Arabie, grecques, romaines, byzantines. Actes de la table ronde de Valbonne, 16–18 septembre 1985*, edited by P.-L. Gattier, B. Helly, and J.P. Rey-Coquais, 133–58. Paris: CNRS Éditions.
- Gschwind, M. 2007. Review of *Excavations at Dura-Europos, Final Report. Vol. 7, The Arms and Armour, and Other Military Equipment*, by S.T. James. *JRA* 20:613–25.
- Hauser, S.R. 2006. "Was There No Paid Standing Army? A Fresh Look on Military and Political Institutions in the Arsacid Empire." In *Arms and Armour as Indicators of Cultural Transfer: The Steppes and the Ancient World from Hellenistic Times to the Early Middle Ages*, edited by M. Mode and J. Tubach, 295–320. Wiesbaden: Reichert.
- Hopkins, C. 1936. Introduction to *The Excavations at Dura-Europos, Preliminary Report of Sixth Season of Work, October 1932–March 1933*, edited by M.I. Rostovtzeff, A.R. Bellinger, C. Hopkins, and C.B. Welles, 1–3. New Haven: Yale University Press.
- . 1939. Introduction to *The Excavations at Dura-Europos, Preliminary Report of Seventh and Eighth Seasons of Work, 1933–1934 and 1934–1935*, edited by M.I. Rostovtzeff, F.E. Brown, and C.B. Welles, 1–3. New Haven: Yale University Press.
- . 1947. "The Siege of Dura." *CJ* 42(5):251–59.
- . 1979. *The Discovery of Dura-Europos*. New Haven and London: Yale University Press.
- James, S.T. 1985. "Dura-Europos and the Chronology of Syria in the 250s AD." *Chiron* 15:111–24.
- . 2004. *Excavations at Dura-Europos, Final Report. Vol. 7, The Arms and Armour, and Other Military Equipment*. London: British Museum Press.
- . 2005. "The Deposition of Military Equipment During the Final Siege at Dura-Europos, with Particular regard to the Tower 19 Countermines." In *Archäologie der Schlachtfelder—Militaria aus Zerstörungshorizonten: Akten der 14. Internationalen Roman Military Equipment Conference (ROMECC), Wien, 27.–31. August 2003*, edited by J. Cencic, 189–206. Carnuntum Jahrbuch 2005. Vienna: Verlag der Österreichischen Akademie der Wissenschaften.
- . Forthcoming. "Dark Secrets in the Archive: Evidence for 'Chemical Warfare' and Martial Convergences in the Siege-Mines of Dura-Europos." *Dura-Europos: Crossroads of Antiquity*, edited by L. Brody and G. Hoffman. Chestnut Hill, Mass.: McMullen Museum of Art, Boston College.
- Kraeling, C.H. 1956. *Excavations at Dura-Europos, Final Report. Vol. 8, pt. 1, The Synagogue*. New Haven: Yale University Press.
- Leriche, P. 1993. "Techniques de Guerre Sassanides et Romains à Doura-Europos." In *L'armée romaine et les Barbares du III^e au VII^e siècle*, edited by F. Vallet and M. Kazanski, 83–100. Rouen and Saint-Germain-en-Laye: Association Française d'Archéologie Mérovingienne and Musée des Antiquités Nationales.
- Leriche, P., and M. Gelin, eds. 1997. *Doura-Europos: Études IV, 1991–1993. BAHBeyrouth* 149. Beirut: Institut Français d'Archéologie du Proche Orient.
- Leriche, P., M. Gelin, and Alain Dandrau, eds. 2004. *Doura-Europos: Études V, 1994–1997*. Paris: Paul Geuthner.
- Leriche, P., A. Mahmoud, C. Augé, B. Geyer, J.-C. Bessac, E. Will, A. Allara, S.B. Downey, D. Fishwick, and C. Velud, eds. 1988. *Doura-Europos: Études [III] 1988*. Beirut: Institut Français d'Archéologie du Proche Orient.
- Leriche, P., A. Mahmoud, B. Mouton, F. Alabe, C. Saliou, A. Allara, S. Matheson, and S.B. Downey, eds. 1990. *Doura-Europos: Études [III] 1988*. Beirut: Institut Français d'Archéologie du Proche Orient.
- Leriche, P., A. Mahmoud, E. Will, B. Mouton, G. Lecuyot, S.B. Downey, A. Allara, C. Augé, R. Rebuffat, S.T. James, and P. Arnauld, eds. 1986. *Doura-Europos: Études [I] 1986*. Beirut: Institut Français d'Archéologie du Proche Orient.
- MacDonald, D. 1986. "Dating the Fall of Dura-Europos." *Historia* 35 (1):45–68.
- Mayor, A. 2003. *Greek Fire, Poison Arrows, and Scorpion Bombs: Biological and Chemical Warfare in the Ancient World*. London and Woodstock, N.Y.: Overlook Duckworth.
- Needham, J. 1965. *Science and Civilisation in China*. Vol. 4, pt. 2. Cambridge: Cambridge University Press.
- Organisation for the Prohibition of Chemical Weapons. n.d. "Chemical Weapons Convention." <http://www.opcw.org/chemical-weapons-convention/articles/article-ii-definitions-and-criteria/> (19 October 2010).
- Saliou, C., and A. Dandrau. 1997. "Données nouvelles sur les quartiers sud-est de Doura-Europos." In *Doura-Europos: Études IV, 1991–1993*, edited by P. Leriche and M. Gelin, 95–106. *BAHBeyrouth* 149. Beirut: Institut Français d'Archéologie du Proche Orient.
- "Séance du 20 Juin." 1934. *Bulletin de la Société des Antiquaires de France*:175.
- Speidel, M.P. 1992. "The Soldiers' Servants." In *Roman Army Studies*. Vol. 2, edited by M.P. Speidel, 342–52. Stuttgart: Franz Steiner.
- Thordeman, B. 2001. Reprint. *Armour from the Battle of Wisby, 1361*. Highland Village, Tex.: Chivalry Bookshelf. Original edition, 1939.
- Vishnia, R.F. 2002. "The Shadow Army—the Lixae and the Roman Legions." *ZPE* 132:265–72.
- von Gerkan, A. 1936. "The Fortifications." In *The Excavations at Dura-Europos, Preliminary Report on the Seventh and Eighth Seasons, 1933–1934 and 1934–1935*, edited by M. Rostovtzeff, F. Brown, and C. Welles, 4–61. New Haven: Yale University Press.
- Welles, C.B., R.O. Fink, and J.F. Gilliam, eds. 1959. *Excavations at Dura-Europos, Final Report. Vol. 5, pt. 1, The Parchments and Papyri*. New Haven: Yale University Press.
- Whitehead, D., ed. 2002. *Aeneas Tacticus: How to Survive Under Siege*. 2nd ed. London: Duckworth.
- Yeganehshakib, R., and K. Reza khani. 2009. "Sasanian Chemical Warfare?: A Scientific Re-Assessment." <http://www.humanities.uci.edu/sasanika/pdf/Sasanian%20Chemical%20Warfare.pdf> (10 September 2009).