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AN ENGINER* HOIST WITH HIS OWN PETARD?

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Abstract—The paper describes the results of the author's efforts to comprehend more fully a passage of five lines in which the title above, taken from two lines of Shakespeare's *Hamlet*, is found.

1. INTRODUCTION

The full quotation of interest which is the subject of this essay is to be found in *Hamlet*, Act III, Scene IV, lines 207–211.‡

> For 'tis the sport to have the enginer*
> Hoist with his own pètard: and't shall go hard
> But I will delve one yard below their mines
> And blow them to the moon: O, 'tis most sweet
> When in one line two crafts directly meet.

The first part of the second line provides us with a common metaphor used frequently in contemporary English conversation. It gives rise to two questions which many must have put to themselves. What is a "pètard" and could an "enginer" be "hoist" by it? An endeavour to answer these questions certainly caused the writer to expend considerable energy, especially as associated with the succeeding three lines.

The pètard is an explosive device for blasting open the doors of fortified structures and some details of it are given below. Hoisting, given its present-day meaning, seems to be entirely metaphorical, not literal: how anyone could be hoisted, literally, with a pètard is difficult to understand. The only way which one can see to do this would be for men using grappling hooks and ropes to seize the pètard from above§ and perhaps to hoist an unwary engineer up a wall or fortification as the device was being set to discharge. Mainly, however, hoist seems to be poetic licence, implying simply that the engineer in firing his pètard—apparently always an uncertain device—might well be killed by its premature explosion or with fragmentation in unforeseen or random directions. Most annotations to *Hamlet* equate "hoist" with being "blown in the air", and imply that to be "hoist" was to be blown up. However, hoisting, today, certainly does not mean being blown up.

Taken together with the third and fourth lines about mining, to use this information as he gives it, Shakespeare must certainly have been well informed. Writing *Hamlet* just after 1600, the Huguenot political and religious troubles in France and the wars waged against them, must have been a considerable topic of conversation among literary men at this time. The pètard and ideas of counter-mining were likely well described to Shakespeare by colleagues acquainted with sapping in military engineering. It is the merest speculation, but tempting, perhaps even naive, to guess at who may have introduced Shakespeare to this topic. Recalling that celebrated conversation and tippling was much associated with gatherings at the Mermaid Tavern on the south bank of the Thames, near to the Globe Theatre, one supposes a clue might be afforded by perusing the biographies of his friends, and trying to deduce which of them might have provided such information. Of the travels and activities of all those mentioned in easily available literature, none seems better fitted to supply it, or at least discuss

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* Shakespeare's original spelling. See NOTE 1.

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‡ Though now part of the authentic *Hamlet* these lines are not to be found in the *Hamlet* in the First Folio edition of Shakespeare's work of 1623.

§ Or with a gin (or trap), see the end of the next section.

it, than Ben Jonson* (see NOTE 2), for according to the *Concise Dictionary of National Biography to 1900* (O.U.P., 1969), he was in Flanders as a soldier and returned to England after about 1 year, in 1592. The Spaniards and Dutch in the Wars of Succession were savage enemies in the Low Countries at this time, as one encounter in Section 3 below well typifies.

The fifth line of the initial quotation seems to imply a collision course with happenings or encounters in the same path. The metaphor is earlier used in *King John* (1596) Act IV. Scene III, as

> Now Powers from home and discontents at home,
> *Meet in one line:* and vast confusion waites. . . . .

2. THE PETARD† : FORCING A GATE

This was an invention of 1579 attributed to the Huguenots. It was made of metal, hollow and hat-shaped, or a truncated cone, or bell-shaped with four handles, but containing a touch-hole at its breech or closed-end, see Fig. 1, which originally is taken from an Italian work (see NOTE 2), but here from *Stone*'s‡ book. It was more or less completely filled with fine, well rammed-in gun powder.§ The device† may be thought of as a kind of mortar used for securing a strong thrust rather than for issuing projectiles. The unit was sealed by a wad and a tightly fitting piece of wood. Wax or pitch was also run in to fill up any empty space and to make for good contact explosive performance. The whole was covered with a waxed cloth, presumably to exclude the entry of moisture. Two methods of applying the device seemed to have prevailed. In one of them the pètard mouth or muzzle was set into a close-fitting recess in a thick wooden plate or madrier, being firmly fastened to it with cords using the handles or hooks, see the lower portion of Fig. 2; the device was screwed, nailed, propped, hung or chained to the door or gate (using supporting rods) which it was proposed to dislodge, perforate or burst open. Once the fuse was ignited the pètardier quickly retired hoping that the time to ignition was long enough to allow him to remove himself to a safe distance. In the other method the pètard was attached to an iron-bound beam and rolled into contact with the target door, see the upper portion of Fig. 2 and Fig. 3. The latter original figure appears in a book by F. Malthus of 1629 (see NOTE 3), whilst Fig. 2 is reproduced from Grose's *Military Antiquities Respecting a History of the English Army* (London, 1801).

The pètard, if strong and well enough constructed, could blow in a gate. It was reputed to act with the noise of a thunderous passing of wind; etymologically, pètard was or is French for a passing of wind. Of course, the bell on firing, quickly came to be full of hot, high-pressure combustion products, and must have shot backwards as momentum was imparted to the objective.‖ However, frequently the set-up "back-fired" on its users and did more damage to them than to the door or gate attacked. In the setting off of this device in sight of a fort's guards by affixing it to a door, there was the strong likelihood of being shot by arrows or otherwise attacked and seriously hurt. The second system was most likely adopted for placing the pètard surreptitiously and quietly during darkness. For both these sets of reasons—firing and affixing—"the engineer's" or the pètardier's operation was a dangerous

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* Since this hypothesizing about Jonson, I have learned from Ivor Brown's *Shakespeare* (The Reprint Society, London, 1951, pp. 69–70) " . . . that Shakespeare was a lodger with Christopher Mountjoy, a *Huguenot* tyre-maker at the corner of Silver Street in Cripplegate, London, from 1602". The date and the Huguenot facts (see below) are matters well worthy of due attention.

† The etymology and usage of the word is given with many examples in *The Oxford English Dictionary, being a corrected re-issue with an Introduction, Supplement and Bibliography, of A New English Dictionary on Historical Principles.* Founded mainly on the materials collected by *The Philological Society*, Vol. VII, N-Poy. Clarendon Press, Oxford.

‡ I have relied for some of the detailed information given here on—but have copied Figs 2 and 3 from—*A Glossary of the Construction, Decoration and Use of Arms and Armor* by George C. Stone, published by Jack Brussel, New York, 1984.

§ C. Duffy in his *Siege Warfare* (Routledge & Kegan Paul, London), p. 111, gives the year as 1580. He also writes that the powder charge was "calculated at about 12 lb to every pound of metal" and further, that the ball was usually of bronze.

‖ A propos of Fig. 3, one author says that the bell shot backwards and that the beam was simultaneously propelled through the door, smashing it to splinters. How this could be so is not clear to the writer.

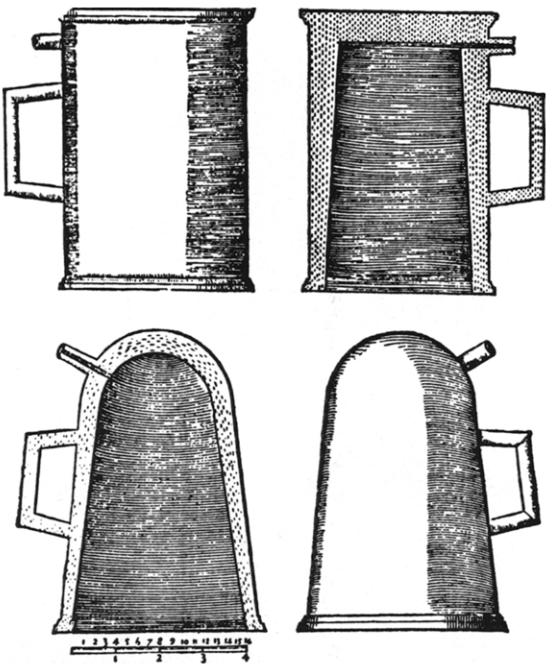


FIG. 1. Two Spanish pètards of the early 17th century in outside view and section. From *Discusso de la Artilleria* as printed in *Stone's* book (p. 495).

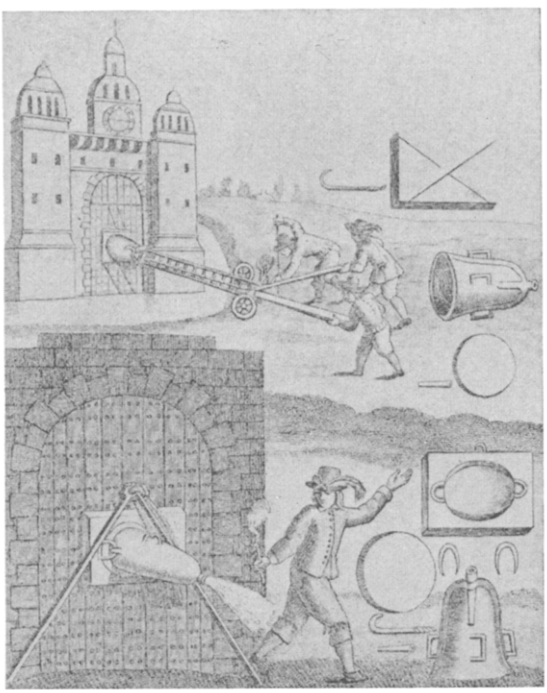


FIG. 2. Two methods of using a pètard are shown. The top one seems to be similar, in principle, to that of Fig. 3. The wooden wad, the madrier and the handle and staples are for fixing it as shown.

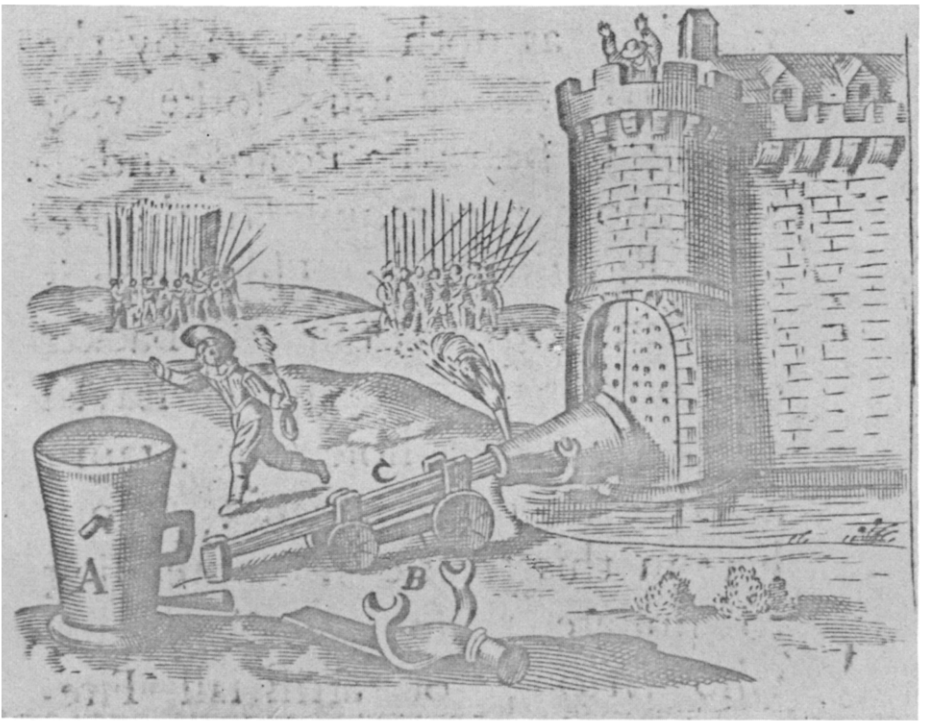
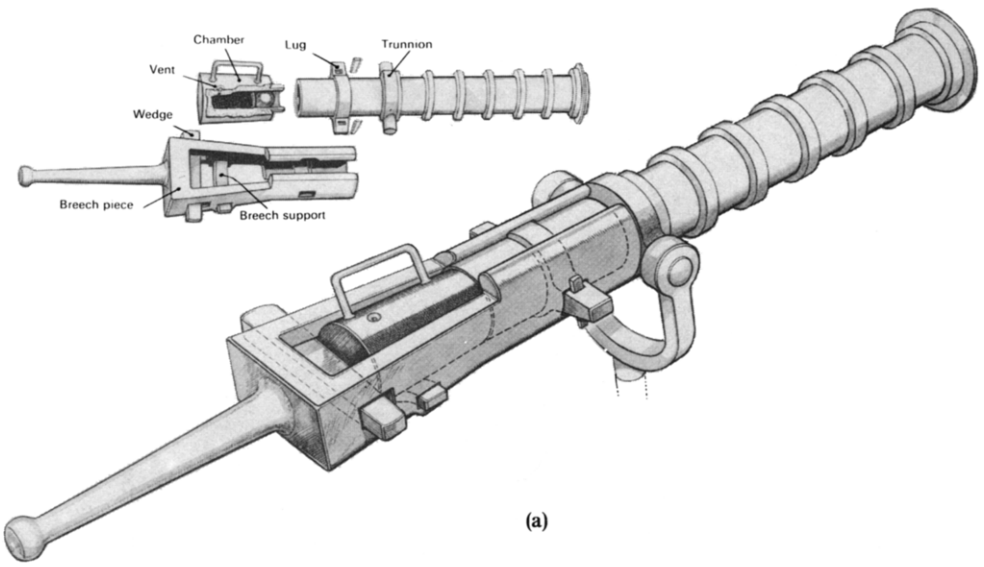
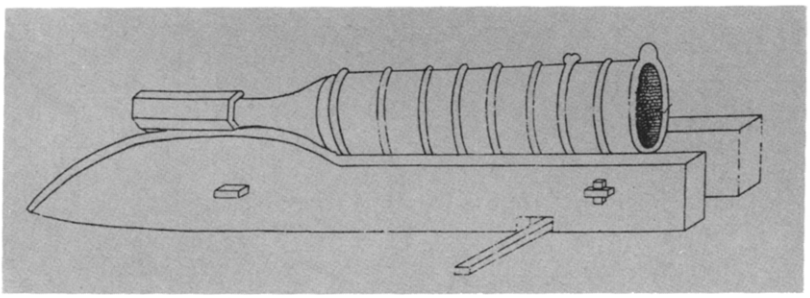


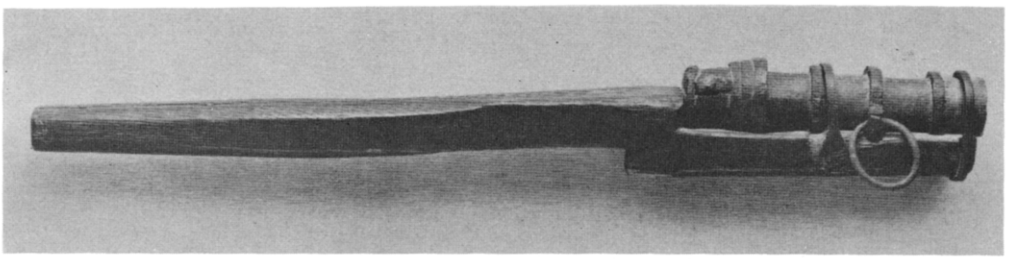
FIG. 3. A diagram of the pètard attached to an iron-bound beam, from the book of 1629 by Francis Malthus, see Fig. 4.



(a)



(b)



(c)

FIG. 5.(a) A petarara of about 1470. Knocking out the wedge allows the chamber to be removed for reloading. It is then reinserted and the wedge hammered-in to force a good seal between the chamber and gun barrel. (b) A diagram of a bombard of about 1460 requiring the addition of a wad and madrier at the muzzle for it to become a pètard, compare Fig. 2. (c) A 16th century hand gun (from D. Pope's *Guns*, Hamlyn, 1969). The above devices may be examined in the Tudor Ship *Mary Rose* exhibition in the Heritage Area within the Royal Naval Base at Portsmouth, U.K.

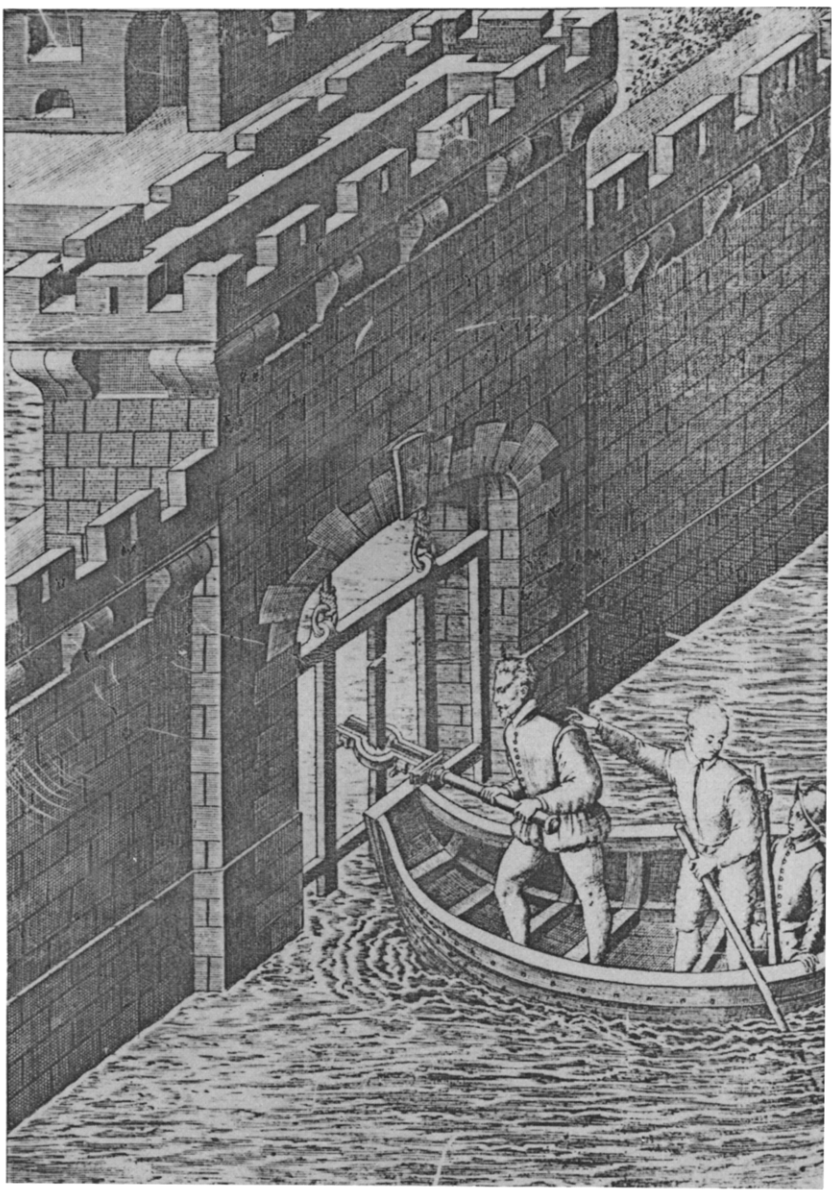


FIG. 6. Wrenching bars of a gate to gain entrance to a town (see footnote, p. 594).

118. Sixteen-twenty-nine. Malthus, Francis.
A | Treatise | Of Artificial | Fire-Works | Both for Warres and Re- | creation: with divers plea- | sant Geometricall obserua- | tions Fortifications, and | Arithmeticall Ex- | amples. | In fauour of Mathematicall | Students. | Newly written in French, and | Englished by the Authour | Tho: Malthus. | *Printed for Richard Hawkins, and are | to be sold at his Shop in Chancerie lane neere | to Serieants Inne.* 1629. |

Octavo.

Collation. Engraved emblematic frontis., signed "T. Cecill", has short title, "A treatise of Artificiall Fireworkes by T. Malthus. London for Richard Hawkins in Chancery Lane 1629."—Tp., A2.—Pref., A3-6.—Verses, A7.—Cts., S4-7.—Diags. and fine engravings.—R.H., varied.—Sigs. in 8^s, A-S; A8 and S8, blank.

Copies. B.M.

Contents. This work, though in advance of anything so far written on the subject in English, does not attain to the standard of Thibourel and Appier. Yet it is with foreign treatises it must be weighed, for Malthus received his training in pyrotechnics abroad. He describes and illustrates the manufacture, uses, etc., of mortars, grenades, fire arrows, and petards, and he explains the manner of charging the last, a detail that even Ufano and Thibourel had failed to understand. As for other writers, they had penned whole

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FIG. 4. Details about the book by Malthus from M. J. D. Cockle's *A Bibliography of Military Books up to 1642*. This extract claims to give a degree of detail about the preparation of pètards which exceeded that given by other contemporary distinguished continental writers on artillery such as Ufano and Thibourel.

one and thus it might well be thought he was easily able to be 'hoist' (blown up) or killed, alongside his own pètard.

The open end of a pètard was usually about 5 in. in diameter at the breech or closed end and 8 or 9 in. at the mouth, the length being 1 ft or less. The total weight has been estimated at 60 lb. The madrier was about 18 in. square and strengthened by crossed bands of iron on the reverse. These lengths seem however to be much exceeded in Fig. 3.

Apparently the pètard was first used successfully in 1580* when *Henri of Navarre* ("*Paris is worth a mass*"—and subsequently Henri IV of France) attacked Cahors. At midnight the pètardiers blew small holes in three of the gates which axe-men widened sufficiently to allow soldiers to crawl through. Dreux was also successfully taken after being attacked by pètards. French pètardiers seemed to be at a premium about 1600. The Turkish fortress of Raab had its gate blown-in in 1598.

Use of the pètard apparently disappeared completely in the second half of the 17th century, an authority, *Chevalier de Guignard*, stating that since 1689 he had neither seen nor heard of it being used to any effect. His contemporary, *Saint-Remy* comments, "to be perfectly frank . . . hardly any officers ever return from these uniquely hazardous expeditions; as soon as the garrison troops see what is going on, they open fire on the pètardier from the gate and the flanking defences. They seldom miss".

The failure of a pètard was usually a setback in a siege because it involved only a small number of troups whilst escalading—attempting to climb ramparts by ladders—frequently involved mass attacks.

Scoffern in his *Projectile Weapons of War*† writes (p. 137), "The Pètard is an arm never I

*See reference to Joseph Haydn, p. 45 in *Dictionary of Dates*, published by Ed. Moxon, London, 1855. V. Biringuccio's renowned *The Pirotechnica*, first published 1540, but in translation, M.I.T. Press, Cambridge, Massachusetts, U.S.A., 1959, is said by his editors to describe a pètard on p. 428, but so little detail is given and no figure, that the allusion is nugatory.

†The third edition revised, was published by Longman, Brown, Green and Longmans, London 1858. It was republished by the Richmond Publishing Co. Ltd., Richmond, U.K., in 1971.

believe used in the present day . . . In former times, various curious devices were employed for preventing this close propinquity between the pètard and the gate; one of the most curious of which was a kind of enormous rat gin (trap) set in such a manner as to close at once on the pètard and the soldiers applying it". An engraving of this gin, he says, is given in *Hanzelet's** *Traités Militaires*, 1598.

It is fascinating to have reinforced, knowledge of the great concern with the penetration of the walls of a town at the period of the French Wars of Religion by methods other than using pètards and battering rams. Figure 6[†] shows the surprise taking of a town, probably by night, by wrenching apart the bars of a little known gate discharging rain water or which was part of a sewerage system. The figure is taken from a book, dated to 1588, by Agostino Ramelli, then "Engineer to the King of France".

3. MINING AND COUNTER-MINING IN THE NETHERLANDS

Lines three and four of the quotation justify giving the following nearly contemporaneous illustration of mining and counter-mining in the vicious seige of Maestricht, with religious intolerance a primary constituent as elsewhere it was with the Huguenots. It occurred in the year pètards were first said to have been used, but about 25 years before Shakespeare's *Hamlet* was published. The pètard was used not only to force gates but according to military dictionaries[‡] "in counter-mines to break through into the enemy's galleries and so to disappoint their mines". We see below that this indeed occurred, but whether or not a form of pètard was used, is unreported.

The investment[§] of Maestricht commenced upon the 12th March 1579, when the Catholic Duke of Parma tried to take Protestant Maestricht. After a great cannonade of 46 guns had been applied for several days, a portion of the town's brick curtain[‖] had crumbled and through the breach a large terreplein,[¶] well moated, was seen, with an outer wall still unimpaired after 6000 shots. So, 4000 miners were set to work, the besiegers working towards a specific gate from a mine which they had opened. Similarly, from the town, peasants—men *and* women (whose offices were described as mine mistresses)—also started a mine, but outwards. Contending forces met daily underground. A secret dam across the Spanish mine was employed to deluge the invading foe with "hogsheads of boiling water" and beneath ground hundreds were said to have been "scalded to death". Also in the mine, from the firing of piles of fagots, volumes of thick smoke were blown along the passage with organ bellows brought from churches.

Notwithstanding this the besiegers started another mine and in spite of suffering such competent counter-mining, they got beneath a ravelin** and formed a spacious chamber with columns. An enormous explosion followed the distribution throughout it of coffers full of powder. Part of the tower fell, the moat was heaped with rubbish and the ruined part of the fort taken. The town burghers, however, resisted the Spanish, Italian and Burgundian invaders from the walls with pails of boiling water, hurling firebrands and blazing pitch hoops quoited to fall around the necks of the attackers.

A new mine which was to have been sprung between the ravelin and the gate was again secretly counter-mined by the townsfolk and exploded by them when least expected by the beseiging force so that 500 Spaniards were killed. Among them was a Spanish Captain of Engineers, Ortis, who had been inspecting the excavation. He was thrown up bodily from the subterranean cavern, fell back into it and was buried by the fall-back of earth. Forty-five years later his skeleton was found, nominally unmutilated, clad completely in armour, gold chain around his neck and with a pickaxe at his feet: truly he had been "hoist" but whether or not with a pètard is not known.

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*Seemingly more frequently referenced as *Appier, Jean* called *Hanzelet* (learned from my correspondence with The British Library).

[†] From *A Theatre of Machines* by A. G. Keller. (Chapman and Hall, London, 1964.)

[‡] Quoted from *Dictionary of Dates*, 7th Edition by Joseph Hadyn, Ed. Moxon, London 1855, p. 475.

[§] An old military term meaning beleaguerment or blockade.

[‖] In fortification terms this referred to the wall between two towers or bastions.

[¶] A terreplein would be the flat surface of earth behind a wall or rampart on which a battery of guns might be set.

** A ravelin is an outwork of two faces forming a salient angle in front of a curtain.

After 3 months of siege the Spaniards forced their way through a breach in the town walls, took the town and massacred the inhabitants, slaying about 8000 and de-populating Maestricht.*

4. THE AUTHENTIC PLAYS AND *HAMLET* IN PARTICULAR

Pergamon Press recently made available at great cost various editions of Shakespeare's works in a microfiche library, under the heading of *Bibliotheca Shakespeariana* It was stated too that over one million pages had been written about Shakespeare and his contemporaries in the past four centuries. It would therefore be a matter of considerable supererogation on my part, and a gross insult to the many persons who have spent their lives in the field of Shakespearian scholarship for me to try to pass off this section as a true and entirely balanced picture, even if such an endeavour properly belonged to this journal. From some reading of experts in the field I have gathered a number of impressions and some new knowledge which may be similarly enlightening and worthwhile to many engineer–scientists. The notes are intended for those of us today still independent enough to be able to betray an interest in the borderlands between mechanics, history and literature where there will be no pay-off but pleasure. The facts may be as interesting to readers as they were to me.

For reliable and accurate detail and accounts (with references), readers will obviously know that they must consult specialists in Elizabethan literature. However, an impression easily gained by most of us from the study of English literature at grammar school and for some more fortunate ones even at college, is that Shakespeare's plays were always printed and published in the form now received. This turns out to be far from true.† Shakespeare himself did not publish his plays in print; they were meant only for speech and they were regarded as theatrical properties, not works of literature. The then-successful business-like theatre manager, Phillip Henslowe, knew the prices of plays and playwrights—it was said—as well as he knew those of bricks and timber (£6 for a new play, £5 for the almost complete re-working of an original, and as little as five shillings for the revision of old plays). A representative contemporary playwright, Thomas Heywood, could write, "It never was any great ambition in me to be in this kind voluminously read"; Shakespeare's scholarly close friend Ben Jonson, see NOTE 2, was exceptional in valuing the literary quality of his own plays and wanting to see them printed.

One method of recording the plays was that achieved "memorially", that is from the memory of actors, and this gave rise to what are referred to as "bad" quartos: such manuscripts were printed in quarto format. To use the word "bad" is unfortunate; it is only that one text arose which differed from another or the Folio text. Variant-quarto is suggested as a better term. Also, actors or members of a company were probably hard-up and worked for publishers using short-hand; they were also responding to auditors wishing to be pleased by having certain passages to read. Such "maimed" and unauthorized quartos even appeared before Shakespeare's death. Plays also survived in shortened form, as used for prompting. Court performances also required alterations to suit a Sovereign, if only to include a suitable Prologue and Epilogue. "Foul" papers, ones used in the theatre by actors, were also a probable source of play material.

Jaggard and Pavier attempted an unauthorized collection—the False Folio—by binding up real and spurious plays, attributing to some false dates, in 1619. This led to Shakespeare's old friends, actors John Hemminge and Henry Condell, working to produce "a full and worthy" collection that resulted in a large Folio volume in 1623. The Second Folio appeared in 1632, the Third 1663–1664 and the Fourth in 1685: it is said to these "add little of authority" to the text.

Plays were required to be entered at this period in the official *Stationers' Register*, which implied an intention to print; *Hamlet* was so registered on 26 July, 1602. A First Quarto—of

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* *Historians' History of the World*, Vol. XIII, pp. 477–478. The Times, London, 1908, but primarily *History of the Dutch Republic* by J. D. Motley, Chap. II, Part VI, pp. 390–399. S.O. Beeton, London (1856).

† These notes are based especially on George Samson's *Concise Cambridge History of English Literature*, C.U.P., 1944, and various long introductions to collections of the plays of Shakespeare.

which there is only one edition, said to be surreptitious (of 33 leaves)—was printed in 1603 and a second, "Newly imprinted and enlarged to almost as much again—51 leaves—and according to the true and perfect copy", in 1604. The First or "bad" Quarto contains 2154 lines and the Second, "good" Quarto, 3723 lines. The opinion of editors is that the former is "not a prior but a posterior version of a reconstruction" of the play. They obviously have textual differences and are also different from that in the First Folio; these differences are said to present "one of the most difficult of Shakespearian problems". However, accepting the supremacy of the First Folio, on examination it is found *not* to contain the lines quoted. It lacks 230 lines, though these seem to have been deliberately cut, according to present-day editors. Possessed of a facsimile copy of this First Folio, it was not conducive to establishing confidence in the authenticity of the play and enormously surprising to the writer not to be able to find the well-known lines containing this paper's title.* The ultimate source of the *Hamlet* plot is apparently in Scandinavian legends, but the earliest references are British† and the plot was known to Elizabethans mainly from Francois de Belleforest's *Histoires Tragiques*, 1570. *The Historie of Hamblet* was a contemporary parallel to Shakespeare but is of "barbarous, uncouth and scanty materials". There are references to it as a revenge play. It seemed to be in existence "in some shape" as early as 1589; apparently it is on this that Shakespeare constructed his tragedy. A lost *Hamlet* by Thomas Kyd (and his *Spanish Tragedy* contains a play within a play as in *Hamlet*), was in existence in that year. That a production for several days by combined players' companies of the Admiral's Men and the Chamberlain's Men took place in 1594, is recorded by Henslowe.

Since the early 18th century, apparently, it has been standard editorial practice to conflate the two texts, i.e. the Second Quarto and the First Folio, on the assumption that the lines were omitted accidentally. In the recently published *Complete Oxford Shakespeare*, the text is based on the Folio, the lines present only in the quarto being stated as Additional Passages: the assumption is that Shakespeare revised them out of the text as printed in the Folio.‡ The 1623 Folio was obtained from a theatre manuscript, not a now unknown quarto. Acts and Scenes are there marked only in the first and second Acts of *Hamlet*, after which no divisions of this kind are noticed: and where Act III commences is merely a matter of modern conjecture. This division into Acts and Scenes is easily seen to be deficient from the First Folio. It also undermines confidence on looking into the First Folio to find, not a Contents, but a Catalogue separately divided into Comedies, folios, 1–304, Histories, 1–205, and Tragedies, 1–369. But folio 304 refers to the *last* folio of the play, *The Winters Tale*; it should be 277, just as other numbers define the first page of a play. From the Histories pp. 47 and 48 are missing in the first paginated 100; but the next numbered folio is 69, not 101 from which it then carries on correctly to 232. Pagination in the Tragedies starts with pp. 79 and 80; the remainder of this play, 25 pages of *Troilus and Cressida* (though this play itself is *not* given in the catalogue!) is un-numbered; in the next play, *Coriolanus*, we have folio 38 instead of 308. The last play, *Cymbeline*, ends with folios 398 and 993, when the latter should be 399. Experts are indeed needed!

Nicholas Rowe in his edition of 1709, worked on the Fourth, not the First, Folio, and tried to restore "the genuine readings of Shakespeare". He attempted systematic divisions, location of scenes, clear exits and entrances and lists of *dramatis personae*. Later editors included the renowned Alexander Pope, 1725 (for which activity, it is written, "he was totally unfitted"). Then a Sir Thomas Hanmer in 1744 ("everything was handsome about his edition except the text which was naught"). Next, Bishop William Warburton (1698–1779) of which edition it was said it was remarkable for "ignorance and insolence". It was rebutted by Thomas Edwards (1748), whose *Canons of Criticisms*, "took high place" and then Dr Samuel Johnson's edition in 1765, which "atoned for its technical defects by a great preface". Edward Capell (1713–1781), collated nearly all old copies and *his arrangement of lines is now followed*

* Prepared by Helge Kokeritz with an Introduction by C. T. Prouty. Yale University Press, 1955.

† *Encyclopedia Britanica*, Vol. 11, 1946 edition, see article on *Hamlet*.

‡ This paragraph very closely follows the contents of a letter to the author dated 19 January 1987, from Dr S. W. Wells, a general editor of *The Oxford Shakespeare*.

(1768). Alexander Dyce, 1857, prepared the way for the now accepted standard text, *The Cambridge Shakespeare* edited 1863–1866 by W. G. Clark and J. Glover, and re-edited 1891–1893 by W. Aldris Wright. Many other great editors we read have succeeded these, e.g. Howard Furnace, A. T. Quiller Couch and J. Dover Wilson.

What I have tried to do above (and anyone can easily do likewise), is simply to convey in summary a feeling for the derivation, publication and historical redaction of Shakespeare's plays and *Hamlet* in particular (whose vicissitudes are typical of many of his other works), the better for us to appreciate that *Hamlet* is, or was, not one clear item but an indefinite thing which in parts is of uncertain authenticity.

CONCLUDING REFLECTIONS

The conclusions are of three quite different kinds: first, of the functioning of pètards themselves, we seem fairly clear. It would now be useful to model them and to conduct tests, perhaps using a large ballistic pendulum, with powder of a composition appropriate to the period of Shakespeare, eventually being able to quantify the momentum developed in relation to other parameters. This might then enable us better to assess how likely to succeed were some forms of 16–17th century military fortification assaults. There are a number of other areas in the play which are the subjects of mechanical and military engineering interest and these are mentioned in NOTE 4. One feels that, unfortunately, not one of them will be a topic of investigation contemporary Offices of Research are likely to fund!

Secondly, students of penetration mechanics do not have the support of an extended history of their subject: this remains to be written. There are many fine compilations about the history of weapons, tools, engines and structures (forts to ships), but their authors usually have different and wholly empirical, views of their subjects; there is seldom inclusion of the scientific quantitative reasons for weapon forms and projectile behaviour. The substitution for purely descriptive accounts of more scientific and quantitative summaries is now probably overdue. It suggests that this particular range of historical–scientific study is a rich and rewarding source of problems for study. Early stone tool forms and their methods of manufacture are well established topics of archeological examination, as are those of naval architecture such as studies of seating in triremes, and the practices of ramming. The point here to note is that the time is ripe for the development of the study of military weapons into a mechanics-related coherent body of knowledge. The student of impact processes needs and deserves better historical background than he currently gets (which is mostly, none). He would be more astutely and critically served with regard to present-day developments if he had.

The third kind has more to do with 'education' in that though this particular ordinary applied scientist finds himself unaccustomed and untrained to research in the topics discussed, yet the results of his efforts on this occasion have enlarged his understanding of at least one small section (in depth) of history and literature: his incomplete accounts—mainly derived from secondary sources—as given above may well do something similar for others of his ilk. The investigations were worthy of pursuit but I came to realise that if I was to endeavour to cover the subject satisfactorily it would require much more time than I could afford or indeed now have. However, the questions it raised, even if incompletely answered, were stimulating, worthwhile and of a different character from those ordinarily encountered in scientific research. Principally, I learned for myself that the body of the works of Shakespeare, as received and presented, are somewhat indefinite and the establishment of the received corpus is the result of long and tedious investigative work. Simply to have ended the study of English Literature with a careful examination of the text of a Shakespeare play, as a youth at school, was to leave out a lot of fascinating discussion about the derivation and transmission of plays; better appreciation of factors like these would have added enormously to education. However, just how much there is to examine, which perhaps renders essays of this kind in respect of Section 4 rather superficial, is suggested by Pergamon Press's new *Bibliotheca Shakespeariana.*

NOTE 1

THE MILITARY ENGINER

This spelling, *Enginer*, occurs in the Second Quarto and according to the notes provided by the ARDEN Edition of *Hamlet* (p. 332, edited by Harold Jenkins, published by Methuen, 1982), indicates "the Elizabethan stress". All annotators concur in defining the "enginer" around 1600 as a "maker of engines of war". Of course the meaning of the term changed over the next four centuries.

NOTE 2

BEN JONSON

(a) *Benjamin Jonson and Shakespeare's Art*

Ben Jonson (or Johnson, though he preferred the former), 1572?–1637, was of border descent (i.e. between England and Scotland when they were separate countries) and attended the ancient Westminster Public School where his master was Thomas Camden, 1561–1623, a well-known Elizabethan antiquary and historian. Jonson did not attend a university though he later received honorary degrees from Oxford and Cambridge. He served as a soldier in Flanders probably under Francis de Vere "carrying a long pike, sword and dagger for nine pence a day" (having run away from "trade"—he was set to bricklaying by his father) and returning to England in about 1592. Nothing seems known of his year abroad and all the books I have consulted join in making the same summary, namely that "he brought little from Flanders, but the reputation of a brave man, a smattering of Dutch and an empty purse".

His relationship with Shakespeare, probably begun in 1598, was of the finest, though not one of closest comradeship, and they shared drinking sessions in the Mermaid Tavern; they were said often to have engaged in contests of wit. His well-known criticisms of Shakespeare consisted in saying that he "wanted art" and in remarking that, "would he had blotted a thousand (lines)", thereby implying that Shakespeare was sometimes too fluent! Voltaire would seem in some sense, to have agreed with him, for in a final verdict he wrote "Shakespeare is a savage with sparks of genius which shine in a horrible night". But after Shakespeare's death, Jonson declared that he "loved and honoured the man on this side of Idolatry". And in an epitaph to him for the First Folio, he judged, "He was not for an age but for all time".

(b) *Jonson and other references to pètards*

Jonson, to whom Shakespeare's ear might have responded as we have noted, may indeed have had some first-hand knowledge of pètards, for he writes in his *Silent Women* IV, v (1609), "He has made a pètarde of an old brasse pot to force your dore". Master Camden, writing in 1614, in *Rerum* . . . (2nd Edn), p. 241, also wrote of ". . . Petrarras of the same brood lately invented". These old references are from the *OED* (see footnote on p. 4). There is, too, a reference to the use of the pètard in England in the fifth decade of the 17th century, i.e. during the Civil War. T. B. Macaulay in his *History of England*, Vol. I, Chap. III, p. 322, 3rd Edition, 1849, wrote about, "A third who had defended his old house till (General) Fairfax had blown in the door with a pètard". The "third" was "an English esquire (an old Cavalier) of the seventeenth century . . . unlettered and unpolished . . . an officer of trainbands . . . who had seen service which was no child's play" and probably "had seen half his manor house blown up" (p. 293).

About the same time too, we can read of the use of the "pittard" to "brake up the utter gate of the Castle of Edinburgh", in a publication by John Row (1598–1672) for the period 1637–1650, in *Historie of the Kirk of Scotland.*

Furthermore the divine, Dr John Donne* ("for whom the bell tolls"), is noted to have

* 1573–1631. He was in foreign service under the Earl of Essex, voyaged to the Azores, in Italy and Spain and on the continent at times between 1595 and the winter of 1597. He also was on an expedition to Cadiz about this period.

mentioned our subject in a sermon before the Company of the Virginian Plantation in about 1622, thus, "Vehiculum Spiritus Sancti, that was the Pètard that broke open the iron gate".

My own recognition of an early reference to "by the help of a pètard we broke open the gate", is to be found on p. 103 of the fictional *Memoirs of a Cavalier: or A Military Journal of The Wars in Germany . . . From the Year 1632, to the Year 1648 . . . Written Threescore Years Ago by an English Gentleman* . . . (O.U.P., 1978). In the Introduction to the latter, Professor J. T. Boulton explains that it appeared anonymously in 1720 but that in a 1784 edition, Daniel Defoe's name was first publicly associated with it. He states however that it was only in 1961 that A. W. Secord argued conclusively with "full documentary proof . . . the case for Defoe as sole author". An Appendix to the O.U.P. edition contains extracts from the *Swedish Intelligence* of W. Watts; and from Part III of it (1633), pp. 292–293, it is written, that ". . . 2 Wagons laden with Pètards . . ." were taken. Also, "*Dubatel*, at his first coming before the Towne; surprises some drowsie Sentinells; . . . and hangs 2 Pètards upon a Sally-port.* These not blowing open the gate, as he expected; . . . other Pètards being by this time put to worke, had forced open the gate; and made an easie passage that way, for the residue of the Swedish . . . ."

(c) *Postscript*

After writing this article I examined diagrams and a photograph of a petarara(*sic*), see Fig. 5(a), in *Guns*, by Dudley Pope (Hamlyn Publishing Group Ltd, 1969) and the immediate basic similarity of its chamber to the pètards of Fig. 1, is obvious. To this (petarara) device is assigned the period of Edward IV of England, 1461–1483. It would appear that with application of a wad and a madrier to the open end of the chamber here, a pètard of the kind in Fig. 2 would result. Further, the similarity of the bombards of these decades, Fig. 5(b) to that in Fig. 3, is remarkable. Substituting a strong madrier for a spherical shot, changes the function of the device from that of a piercer to that of a battering ram. Camden's term, above, seems to have recognized some such connection. The similarity between Fig. 5(c) and Fig. 1 is clear.

NOTE 3

Figure 4 is a copy of an entry about Francis Malthus in *A Bibliography of Military Books up to* 1642 by Maurice J. D. Cockle (The Holland Press, London), the First Edition published being 1900 and the Second Edition 1957. The quaint use of 'Englished' may be noted and that the author was stated to be Tho(mas) Malthus. A resolution of the difference in names is not attempted by Cockle. Sir Charles Oman in his introduction to Cockle's bibliography states that "the men who wrote in the age of Elizabeth had seen all their service in Flanders and France and set to teaching their fellow countrymen the Art of War that had been developed by Spanish and Italian captains. Thus, it was continental writers who made original compositions inspired by their own experiences so that English compilations were largely derivative". In England at this time, "There was no standing army in which the professional soldier could find a regular livelihood and fixed position".

NOTE 4

It is noteworthy that cannons are referred to at least three times in this play. In Act I, Scene II, line 126, as spoken by the King "*But the great cannon to the clouds shall tell*"; Act V, Scene II, a passage between lines 141–187, spoken by Hamlet, "*The phrase would be more (germaine) to the matter if we could cannon by our sides*", and as delivered by the King, Act IV, Scene 1, lines 45–47 in, "*As level as the cannon to his blank. Transports his poisoned shot—may miss your name, and hit the woundless air*". In the latter for "level" we can read "directly aimed" and for "blank", "target"; however the latter lines again do not appear in the First Folio. As with the lines which were our major concern above in consulting standard texts no strong reason why they should have been edited out is apparent. Still with cannon in mind, gun chase reinforcement is evident in Act I, Scene III, line 63 when Polonius intones, "*Grapple them to*

* An exit in a fortified place from which Troops may sally forth.

thy soul(e) with hoop(e)s of steel(e)". The recognition of cementized iron as steele at this time in a playwright, is surely quite surprising.

Other military–mechanical items easily found in *Hamlet* are, the King's observation in Act IV, Scene VII, lines 27–30 as ". . . *so that my arrows Too slightly timbere'd for so loud a wind Would have reverted to my bow again, And not where I had aimed them*". For arrows of small section presumably air resistance or too great an acceleration and perhaps some flexing conspired to make for very poor shooting. Also, Horatio's account of a not untypical encounter in those days at sea, with pirates, Act IV, Scene V, line 236, thus, "*Finding ourselves too slow of sail we put on a compelled valour*; . . . *and in the grapple I boarded them; and on the instant they got clear of our ship*".

NOTE 5

Words spoken by Marcellus, Act I, Scene I, lines 70–78, appropriate to today's industrial climate are,

> Good now, sit down and tell me he that knows Why this same strict and
> most observant watch So nightly toils the subject of the land
> And why such daily cast of brazen* cannon
> And foreign mart for implements of war;
> Why such impress of shipwrights, whose sore task
> Does not divide the Sunday from the week;
> What might be toward, that this sweaty haste
> Doth make the night joint-labourer with the day;
> Who is't that can inform me?

And further in Act I, Scene V, line 142, there is,

> Well said, old mole. Canst work i'th earth so fast? A worthy pioneer!

The French original is *Pionnier* (OED, 1523) and it referred to foot soldiers; later it became pioneer. Such were members of a body of foot soldiers who preceded the advance of an army with spades and pickaxes, etc., to dig trenches, prepare saps and the way for the main body; they were initiators or true pioneers. In World War II the (British) Pioneer Corps generally followed armies and so assumed a reversed role. They were employed to do the humblest jobs. Infantry (everywhere) dug its own slit trenches, etc.

Yet another passage worthy of engineering note occurs in Act V, Scene II, lines 95–110 thus,

> Sir, his definement suffers no perdition in you;—though, I know, to divide him inventorially would dizzy the arithmetic of memory and yet but yaw neither, in respect of his quick sail.

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* Brazen: hard bronze and hard faced, and so generally construed as impudent.