THE EQUIPMENT AND FIGHTING POTENTIAL OF THE SPANISH ARMADA

Colin John Mackenzie Martin

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By

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Summary

This study is based on the archaeological investigation of three wrecks from the Spanish Armada of 1588. As a result of these discoveries it has been possible to assess in practical terms the equipment and resources with which the Spaniards intended to invade England, and to identify their strengths and weaknesses. The ships were in general sturdy and well handled, but most of them were merchantmen and few could stand up well to heavy gunnery. The use of artillery at sea forms a major part of the study, and the extensive collection of guns and associated equipment recovered from the wrecks has helped to show why the Spaniards' performance in this respect was all but ineffective. Relics of the invasion army's weapons and matériel, which include parts of a dismantled heavy siege train, indicate on the other hand that the troops carried by the fleet were well equipped and likely to have been, if given the chance ashore, a formidable and fast-moving force.

A fresh examination of the historical material, studied in conjunction with the archaeological evidence, has thrown new light on the campaign as a whole. The threat which England faced in 1588 is shown to have been a very real one. If the original plan put forward by the Spanish commanders to mount a self-contained task force from Lisbon had prevailed, the enterprise would almost certainly have succeeded. But Philip II's insistence on using the Army of Flanders as the main invasion force, with a smaller-scale Armada to escort it across the Channel in barges, gave rise to difficulties which proved insuperable. As an armed convoy the Armada might indeed have proved invincible, but as a battle-fleet it was almost inevitably bound to fail.

I, Colin John Mackenzie Martin, hereby certify that this thesis, which is approximately 100,000 words in length, excluding tables, appendices and footnotes, has been written by me, that it is a record of work carried out by me, and that it has not been submitted in any previous application for a higher degree.

30 April 1983

I was admitted as a research student under Ordinance No. 12 in October 1975, and as a candidate for the degree of Ph.D. on 5 May 1976; the higher study for which this is a record was carried out in the University of St Andrews between 1975 and 1983.

30 April 1983

In submitting this thesis to the University of St Andrews I wish access to it to be subject to the following conditions: for a period of 3 years from the date of submission, the thesis shall be withheld from use. I understand, however, that the title and abstract of the thesis will be published during this period of restricted access; and that after the expiry of this period the thesis will be made available for use in accordance with the regulations of the University Library for the time being in force, subject to any copyright in the work not being affected thereby, and a copy of the work may be made and supplied to any <u>bona fide</u> library or research worker.

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I hereby certify that the candidate has fulfilled the conditions of the resolution and regulations appropriate to the degree of doctor of philosophy of the university of St Andrews and that he is qualified to submit this thesis in application for that degree.

date
30 April 1983

supervisor

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SUMMARY OF CONTENTS

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In 1971, shortly after the wreck of La Trinidad Valencera was discovered off Donegal, I was invited by the City of Derry Sub-Aqua Club to direct the archaeological investigation of the site. This was the beginning of a happy and productive association which still continues. I would like to thank the many amateur divers, mostly but not exclusively members of the Club, who have worked with me in Donegal. Their disciplined enthusiasm and concern for the site have made the whole undertaking, for me, an enjoyable and very rewarding experience. I have been fortunate, too, in the support given to me, often in trying circumstances, by my professional colleagues; Jeremy Green, Keith Muckelroy, Celie O'Rahilly, Nick Dixon, and my wife Paula, as fellow archaeologists, and Tony Long (whose engineering skills and genius for improvisation were so dependable that they came to be taken for granted) as my diving technician.

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Dates, weights, and measures

At the time of the Armada the Spaniards were following the calendar as adjusted by Pope Gregory XIII in 1582, while the English still adhered to the old Julian system. English dates therefore appear to fall ten days earlier than their Spanish counterparts. Gregorian dating has been followed throughout this study, except when English documents are cited directly, in which case the initials OS (for Old Style) appear in brackets after the date.

The Castilian libra of 460 grams, and the quintal of 100 libras, were the main weight units used in the Armada preparations. Libra is abbreviated as lb or lbr (for "pounder") in the text; quintal is qtl or qtx (plural). Where the word "pound" is employed the indication is general and non-specific, unless it is used in an English context, in which case its value, as today, is 454 grams.

Other relevant units may be defined as follows:

Onza (oz)	=	one sixteenth of a libra
Azumbre	=	2.017 litres
Cuartillo	=	0.504 litres
Arroba (as a weight)	=	25 libras
(as a liquid measure, oil)	=	12.56 litres
(as a liquid measure, wine)	=	16.13 litres

These values are extracted from the official correspondence tables of 1852, which convert the ancient measures of the various Spanish provinces to the metric system. They are published in the Enciclopedia Universal Ilustrada, vol. 34, pp. 1306 - 1314. Further information on individual units can be found under the appropriate headings in the same work. The volume of a cask, or pipa, at the time of the Armada is uncertain, although a discovery from La Trinidad Valencera suggests that it was about 590 litres (pp. 350-1).

The fieldwork recorded in these pages spans a period during which the metric system replaced Imperial measurement as the standard employed in British archaeology. Some of the earlier work, notably that conducted on the <u>Santa Maria de la Rosa</u> site, was recorded in feet and inches, and this standard has been retained in the drawings prepared at the time. Otherwise, the metric system has been used throughout.

Captions for figures (in separate portfolio)

Unless otherwise specified, the figures are the work of the writer

Frontispiece. The amphibious landings at Terceira in July 1583. It was to mount just such an operation against England that the Armada was launched. Fresco in the Hall of Battles at the Escorial, 1590 (reproduced from Tenison, Elizabethan England, portfolio of plates, no. 9).

1. The proposed formation of the Armada, as sent to the Grand Duke of Tuscany by his ambassador to Spain on 18 May 1588. The Grand Duke's own ship, the Florencia [8] , is shown as number 14 (reproduced from Walker, The Armada, p. 88).

2. The theatre of operations, showing the Armada's track and the subsequent track of ships mentioned in the text.

3. General locations of the five wreck sites.

4. Kinnagoe Bay, County Donegal, where La Trinidad Valencera was wrecked on 16 September 1588 (cf. Figure 5).

5. The Trinidad Valencera wreck site and its environs.

6. The Trinidad Valencera wreck site showing the main excavation grid, and the results of the metal detector survey.

7. The jet-probe survey on the Trinidad Valencera site, superimposed on the main grid. The shaded areas denote a sediment depth of less than 3 feet, while the asterisks show the soundings where organic material was encountered.

8. South sector of the main grid, showing the areas excavated up to 1976.

9. North sector of the main grid, showing the areas excavated up to 1976. Grid references in the text, which are prefixed by "Grid", refer to measurements in feet, first horizontally and then vertically, from point A on the baseline.

10. The area to the north-east of the main grid, showing the extent of the organic deposit and a series of dislocated ship's timbers. A section through the deposit is shown below.

11. A concretion deposit centred on Grid 40.100. The material, which consists largely of iron nails, is probably spill from the barrel represented by the two iron hoops in the right-hand concretion.

12. An organic deposit, partially excavated at Grid 52.166, which includes a wooden lantern top (note the burn mark at its centre) and, within a matrix of splintered debris, a leather bottle.

13. Features at Grid 17.147. The upper part of the large wooden sheave block lay within the zone of biological and mechanical degradation. Below that level, where the sea bed is stable, the organic material is well preserved. A corner of the block rests on the rim of a 10-spoked limber wheel. Scale in inches.

14. Blasket Sound, photographed from the cliff above Coumeenoole Strand, where the only survivor from the *Santa María de la Rosa* was probably cast ashore (*cf.* Figure 15). The ship sank beyond the Lure, the hump-backed rock in the upper centre. Great Blasket Island lies in the background.

15. The sequence of events in Blasket Sound on 21 September 1588, based on the *relación* of Marcos de Aramburu and on finds made in the course of the 1968 swimline searches.

16. Anchors identified as belonging to the *San Juan of Castile* (left) and the *Santa María de la Rosa* (right).

17. Rim of a pewter plate showing the name of (Francisco Ruiz) Matute of the *Santa María de la Rosa*.

18. General plan of the *Santa María* wreck site at the completion of excavations in 1969.

19. Structural elements and other finds at the forward section of the *Santa María* wreck.

20. The damaged mast-step complex on the *Santa María* wreck. This feature was only partially excavated.

21. Lower frame timbers of the *Santa María*, revealed during excavation. Scale in feet.

22. Stroms Hellier, Fair Isle, where *El Gran Grifón* was wrecked on 28 September 1588. This photograph was obtained through the kindness and skilful piloting of Captain Alan Whitfield of Loganair.

23. Topographical survey of Stroms Hellier, showing the area (defined by the square labelled "Grid") within which the wreckage of *El Gran Grifón* was contained.

24. *El Gran Grifón's* wreck site, showing the areas excavated. The grid system, in metres, is read horizontally and then vertically, as on *La Trinidad Valencera*.

25. A cast-iron gun, sectioned by abrasion, lying within the concretion matrix in the excavated gully bottom at Grid 28.17.

26. Section through the concretion deposit at Grid 30.17.
Key to deposits:
1. Regularly mobile shingle
2. Partially stable shingle, with organic staining
3. Black sand
4. Concretion layer, overlain by bronze gun
5. Black organic layer
6. Clean shingle

27. Impacted lead shot from the Gran Grifón wreck, of musket and arquebus calibre (1.3 and 1.9 cm). This is presumably English shot fired at the ship during the engagements in the Channel or off Gravelines, and it indicates the very close range at which some of the fighting was conducted.

28. The San Martín after the battle of Sao Miguel in 1582. Detail from the fresco in the Hall of Battles at the Escorial, 1590 (reproduced from Walker, The Armada, p. 23). Cf. my reconstruction of the San Martín's internal layout on p. 189.

29. Profile of a Spanish galleon, from an original by Diego Garcia de Palacio, 1587 (reproduced from Waters, The Elizabethan navy and the Armada of Spain, p.135).

30. A galley offloading ordnance with a block hung from her lateen yard (reproduced from Gentilini, Instruttioni di Artiglieri, p. 64).

31. Another method of getting guns ashore from a galley, using a ramp formed with its own oars (reproduced from Capo Bianco, Corona e palma militare, p. 46).

32. The square-rigged Armada galleass from the Greenwich cartoon (reproduced from Sténuit, Treasures of the Armada, p. 28).

33. Bartolomeo Crescentio's Mediterranean galleass of 1607 (reproduced from his Nautica Mediterranea, p. 62).

34. A large Mediterranean merchant ship from the tomb of Alessandro Contarini of Padua, who died in 1555 (reproduced from Braudel, The Mediterranean, vol. 1, plate 10).

35. Structural timbers from the wreck of La Trinidad Valencera.

36. A Baltic hulk from a woodcut after Breughel, c. 1560 (reproduced from Martin, Full Fathom Five, plate 9).

37. A flat-bottomed barge with ramps at either end, and other Rhine river craft; detail of a woodcut by Anton Woensam, 1531 (reproduced from Geisburg, The German single-leaf woodcut, vol. 4, p.1520.

38. Medias culebrinas from Juan de Acuña Vela's submission to Philip II, 25 July 1587 (from a photograph supplied by the Archivo General at Simancas, M y P, V-17, per Geoffrey Parker).

39. Different sizes of iron roundshot and their windages, from a memorandum sent by Juan de Acuña Vela on 20 January 1590 (from a photograph supplied by the Archivo General at Simancas, M y P, V-20, per Geoffrey Parker).

40. One of the matched pair of cañones de batir cast by Remigy de Halut, recovered from the wreck of La Trinidad Valencera.

41. Hinged vent covers for the Remigy guns.

42. Cañones de batir from Juan de Acuña Vela's submission to Philip II, 25 July 1587 (from a photograph supplied by the Archivo General at Simancas, M y P, V-18, per Geoffrey Parker). The lower gun may be the missing piece from La Trinidad Valencera (see note 34 to Chapter Three).

43. 20-lbr medios cañones from Juan de Acuña Vela's submission to Philip II, 25 July 1587 (from a photograph supplied by the Archivo General at Simancas, per Geoffrey Parker).

44. Bronze guns from non-Spanish sources: top, a French medio cañón from the San Juan de Sicilia [71] ; second, a Venetian medio cañón from La Trinidad Valencera; third, a Venetian sacre from La Trinidad Valencera; bottom, a Venetian media sacre from La Trinidad Valencera.

45. A cañón pedrero (reproduced from Collado, Plática Manual, f. 35). Note also the rammer and ladle.

46. Wrought-iron breech-block, probably belonging to a pedrero-type gun, from La Trinidad Valencera.

47. Casting specification for a culebrina, 25 July 1587 (from a photograph supplied by the Archivo General at Simancas, per Geoffrey Parker).

48. Bronze media culebrina (top) and media sacre (bottom) from El Gran Grifón. The error in the alignment of the bore of the media culebrina is shown projected from the broken muzzle end.

49. Histogram of iron roundshot recovered from El Gran Grifón, and its relationship to the guns she carried.

50. Cast-iron guns from El Gran Grifón. 1, long media sacre; 2, short sacre; 3, eroded breech end of a sacre similar to 2, showing the location of ball, charge, and wadding (cf. Figure 51).

51. Sectioned breech of a loaded cast-iron sacre from El Gran Grifón (no. 3 in Figure 50). The gunpowder residues have been removed. Part of the breech has been cut clean to reveal its void-free, true section.

52. (a) Falcón pedrero from La Trinidad Valencera, and (b) Moretti's petriero á braga (reproduced from his Trattato del artiglieria, p. 37).

53. Wrought-iron guns and breech-blocks from El Gran Grifón. 1, lombarda; 2-5, breech-blocks from similar pieces; 6, part of a falcón pedrero; 7 and 8, swivel gun breech-blocks.

54. Bronze esmeril from the Girona, showing its own breech-block and the breech-block of a larger but similar type.

55. Bronze esmeril from the San Juan de Sicilia, now in the School Museum at Charterhouse.

56. A 4-truck carriage from the Mary Rose, wrecked in 1545 (reproduced from Peter Whitlock, note in Mariner's Mirror, 66 (1980), p. 345).

57. English naval truck carriages emplaced ashore with anchor holdfasts: a detail from the Smerwick map of 1580 (from a photograph supplied by the Public Record Office, MPF - 75, per Tom Glasgow, Jr.).

58. Late sixteenth-century Spanish sea carriage (from a photograph supplied by the _Archivo General_ at Simancas, M y P, XVIII-48, per Geoffrey Parker).

59. Another type of Spanish sea carriage (source, as above, M y P, XVIII-49, per Geoffrey Parker).

60. Sea carriage illustrated by Pietro Sardi, 1621 (from his _Artiglieria_, p. 130).

61. Guncarriage components from _La Trinidad Valencera_: top, 10-spoked wheel of a type associated with carriages on the _Mary Rose_; bottom, tripartite wheel and axle.

62. Top, a wooden musket stock from _La Trinidad Valencera_; bottom, an incomplete arquebus stock from the same site.

63. A wheel-lock musket of c. 1600 at the moment of firing. Note the forked rest with which it is operated. These tests, which were carried out for the BBC by Mr A.C. Carpenter, showed that beyond 15 metres accuracy was poor, and that it was almost impossible to hit a man-sized target at 30 metres.

64. Wooden powder flasks from _La Trinidad Valencera_. The flask for the main charge, on the right, would hold about 1½ _libras_, while the smaller priming flask has a capacity of about 4 _onzas_.

65. Concretion cast showing the imprint of elaborate decoration on the surface of a morion. Scale in centimetres.

66. Brass plume-holder from a morion. Scale in millimetres.

67. The remains of a leather shoe with its silk lace _in situ_. Scale in centimetres.

68. The fore part of a cloth anklet, 15 cm wide, with fabric-covered buttons.

69. Leather water or wine bottles from _La Trinidad Valencera_, with wooden funnels and stoppers. Scale in centimetres.

70. A 10-spoked limber wheel with its associated concretions, _in situ_ on the _Trinidad Valencera_ site.

71. Reconstructions of the artillery undercarriage assemblies from _La Trinidad Valencera_. Top, main carriage assembly; bottom, limber assembly.

72. Drawing of a field gun's undercarriage assembly by Pietro Sardi (from his _Artiglieria_, Figure 13).

73. Reconstructed side elevation of a mounted cañón de batir from La Trinidad Valencera, based on the archaeological finds and on information given by Pietro Sardi.

74. Heavy oak swingletree, presumably from the draught assembly of one of La Trinidad Valencera's cañones de batir. Scale in inches and centimetres.

75. Charles V's artillery train exercising at Munich in 1530, from a woodcut by Hans Sebald Beham (reproduced from Geisberg, The German single-leaf woodcut, vol. 1, p. 275). Note the limbers to the rear of the unhitched guns, the ammunition wagons, and the tripod hoists for mounting and dismounting the artillery. The nearest limber is fitted with the linkage between its chassis and the axle-ends, as discussed on pp. 334-5.

76. Sponge heads from La Trinidad Valencera, scale in centimetres. In use these would have been cased in sheepskin envelopes, with the wool outermost.

77. Gunner's linstock of wood from La Trinidad Valencera. Scale in centimetres.

78. The detached head of another wooden linstock, with the fuse still in situ. Note the burn mark on the underside.

79. Carpenter's claw-hammer (left) and blacksmith's hammer (right), from La Trinidad Valencera.

80. A pair of bellows from La Trinidad Valencera. Scale in inches and centimetres.

81. Felloe and spoke from a small wheel, 85 cm in diameter, from La Trinidad Valencera. Its size and proportions suggest that it may have been from a light handcart.Scale in inches.

82. Remains of hurdling, perhaps part of a gabion, in situ on the Trinidad Valencera site. Scale in 5-centimetre graduations.

83. Field artillery gabions, from a 1530 woodcut by Ehard Schoen (reproduced from Geisberg, The German single-leaf woodcut, vol. IV , pp. 1210-11).

84. (a) Fir sapling for the construction of defensive obstacles, from La Trinidad Valencera. Scale 1 metre. The two other pieces could have served either as levers or as palisade stakes. (b) A detail from Erhard Schoen's 1530 woodcut shows such defences in use (source as for Figure 83).

85. Remains of a wooden gunpowder keg from La Trinidad Valencera. Scale in inches and centimetres.

86. A ceramic alcancía, or firepot, from La Trinidad Valencera. It is 12 cm high and 10.5 cm in diameter.

87. A firepot with its fuses attached (reproduced from Lucar, *Appendix*, p. 74).

88. The remains of a *bomba*, or trunk, *in situ* on the *Trinidad Valencera* wreck site.

89. Troops carrying flame-emitting *bombas*, a detail from Hogenburg's woodcut of the arrest of the duke of Aarschot in 1577 (reproduced from Decavele, *Eenheid en Scheiding*, Cat. 484). Note also the droop-curved arquebus stocks and the powder flasks.

90. Restored *pipa* (left) and gunpowder keg from *La Trinidad Valencera*.

91. Olive jar of half-*arroba* capacity from *La Trinidad Valencera*.

92. Steelyard, steelyard weights (top centre and right) and a weight from a nested set (top left) from *La Trinidad Valencera*.

93. Turned wooden bowls from *La Trinidad Valencera*. The large one seems suited to a messing sub-unit, or *camarada*, while the two smaller ones might have belonged to individual soldiers.

94. The four common forms of green-glazed Portuguese pottery found on the wrecks. It seems reasonable to link these forms with the *platos, escudillas, ollas y jarros* which the marquis of Santa Cruz proposed should be ordered from the Lisbon potteries in his Armada blueprint of 1586.

95. The Wan-Li bowl from *La Trinidad Valencera*.

96. Religious medallions from *La Trinidad Valencera*.

97. Elements of a wooden lantern with a pewter candle-holder from *La Trinidad Valencera*. Its lights were probably of horn. *Cf.* the lantern shown in Figure 89.

98. Various gunner's rules:

(a) Blade from a gunner's stiletto	(Mann, *Gunner's stiletto* plate 10)
(b) Collado's Italian rule, reversed for convenience	(*Practica Manual di Artilleria*, p. 3)
(c) Gentilini's rule	(*Instruttioni di Artigileri*, p. 4)
(d) Cataneo's rule	(*Dell' Arte militare*)
(e) *Trinidad Valencera* rule (both faces shown)	

99. Wooden shot gauges from *La Trinidad Valencera*. Scale in centimetres.

Introduction

"Now this fleet [the Spanish Armada] is here, and must be waited upon with all our force, which is little enough. There should be an infinite quantity of powder and shot provided, and continually sent abroad; without the which great hazard may grow to our country; for this is the greatest and strongest combination, to my understanding, that was ever gathered in Christendom."(1) John Hawkins wrote this anxious letter "in haste and bad weather" aboard his ship, the Victory, on 10 August 1588 - that is, several days after most historians consider that the Spanish Armada had met an apparantly inevitable defeat at the hands of Queen Elizabeth's navy. A full week later the English commander, Lord Admiral Howard, "in haste and much occupied" aboard his flagship Ark Royal, breathed an audible sigh of relief as his enemies continued to sail away northwards: "Some made little account of the Spanish force by sea; but I do warrant you, all the world never saw such a force as theirs was."(2) On 20 August even the redoubtable Francis Drake was by no means certain that the threat had passed. From the Revenge, he reminded his government: "The prince of Parma, I take him to be as a bear robbed of her whelps; and no doubt but, being so great a soldier as he is, that he will presently, if he may, undertake some great matter...Truly, my poor opinion is that we should have a great eye unto him."(3)

The best-informed opinion in England in 1588 was thus not disposed to underestimate the enormity of the threat posed by Philip II's great fleet. These three commanders were writing from the same flagships aboard which, only a few days earlier, they had fought the longest and fiercest artillery action ever fought at sea. Even as they wrote the Spanish fleet, battered but with its formidable order and discipline still largely intact, was loose in the northern seas. A powerful invasion army of veteran troops, under one of the most determined and capable military commanders of the age, remained on the coast of Flanders, poised to embark. It had been a very close call, and the danger was by no means past. The English fleet, supported as it was by only the most rudimentary and parsimonious supply organisation, had run out of ammunition. The Spaniards, it was widely believed, had themselves expended most if not all of their roundshot, but Howard, Drake and Hawkins knew better than anyone that in a battle without big guns the Spaniards, with their companies of shipboard infantry and superior skill in hand-to-hand fighting, would possess an irresistable advantage. England, at the last, was almost without defence, and her navy could only, in Lord Admiral Howard's words, "set on a brag countenance and give chase, as though we had wanted nothing, until we had cleared our own coast and some part of Scotland with them."(4)

The bluff worked, and the Armada struggled on past the northern isles into the Atlantic in an effort to gain sea room for a safe run southwards to the ports of Galicia and Biscay. But fortune did not favour the Spaniards. The autumnal gales of that portentous year - the winds of God, as their Protestant enemies would have it - blew early and with unusual violence, driving the returning ships towards the iron-bound Atlantic coasts of Scotland and Ireland. Many were wrecked. For the Spaniards it was an unmitigated disaster, but one brought about as much by the forces of nature as by the hand of man. In English and Dutch eyes, however, it was both an overwhelming naval victory and a clear demonstration of where divine sympathies lay. The anxious realism expressed by the English commanders at the moment of crisis was thus swamped, in the euphoria of deliverance, by a growing tide of patriotic fervour which saw the events as an affirmation of England's inevitable naval and religious superiority over her enemies.

What, then, was the reality of the Spanish threat in 1588? And why, if indeed it was a substantive one, did it fail?

It might be thought that historians have already considered these questions from every conceivable angle, and answered them satisfactorily. The historiography of the Armada is immense: few episodes of naval warfare have received so much attention from English-speaking writers. The conflict, in addition to its appeal as what is often seen to be a climactic finale to the maritime struggle between England and Spain which began in the middle years of the sixteenth century, is in many respects exceptionally well documented. On the Spanish side the years of planning and preparation which preceded it involved decisions of policy at the highest level coupled with a great mass of administrative minutiae through which these policies were put into effect. In consequence the ponderous Spanish bureaucratic machine, of which Philip II was in effect both managing director and chief clerk, generated an enormous volume of paperwork concerning these matters, and much of it has survived in the royal archives at Simancas and elsewhere.

The serious study of this material began in the late nineteenth century with the calendaring and editing of a selection of the Armada documents, particularly by Fernández Duro in 1884 and 1885 (5), by E. Herrera Oria in 1929 (6), and, in English translation, by Martin Hume in 1899.(7) Most of the relevant English documents were published by Sir John Laughton in 1894, (8) while Horatio Brown's translated selection of Venetian state papers contains much valuable comment from well-informed contemporary observers - particularly the ambassador at Madrid, Hieronimo Lippomano.(9) These great works of transcription, together with their excellent commentaries, have formed the basis of most subsequent studies of the Armada campaign. But although their value remains undiminished they are, as their compilers were at pains to point out, no more than edited selections of those documents which were considered to be, in the light of contemporary historical tradition, the most relevant. For almost a century, in consequence, Armada studies have tended to stagnate in the rich but unreplenished pond provided by their late Victorian progenitors.

That this should be so invites the consideration of another factor. Britain, in the late nineteenth century, was at the zenith of her imperial glory; her ironclads ruled the world's oceans, and the battle of Trafalgar, from which her immense sea-power and popular pride in it directly stemmed, was less than a century past. It was therefore natural for Britons (and British historians) to follow their Elizabethan forebears' comfortable belief, born in the afterglow of the Armada's undoing, that their navy was predestined always to thwart invaders before they reached the English coast. Indeed, since then, Britain's navy had almost always won; and its successes were often enough traced back (with varying degrees of justification) to technical or tactical innovations which were first manifested in 1588. In consequence, men like Drake and Nelson were frequently regarded as being separated in time but not in outlook; they were super-heroes cast in the unchanging mould of British naval tradition. But eighteenth and nineteenth century principles of sea-power, so admirably set into perspective by A.T. Mahan, simply did not apply in the sixteenth century.(10) Concepts such as long-term economic blockade, the domination of global shipping-routes, and the physical annihiliation of an enemy's battle-fleet were beyond the grasp of contemporary men's minds and, more to the point, well outside the technical and logistical capacities of sixteenth-century naval administrations. This has tended to obscure the fact that there was no 'right' way, in 1588, of exercising naval power. More than one approach was possible, and those adopted by England and Spain in their conflict were indeed fundamentally different. That the English approach did, in the end, succeed, does not prove that it was bound to do so. As we shall see, it might very easily have failed.

We should not therefore base our assessment of the Armada campaign on the application of Mahanian principles two centuries ahead of their time, as many modern historians have sought to do; nor should we allow the cloud of patriotic dogma which sits over most English views of the event to influence our judgement of what actually happened. Much of history, it has shrewdly been observed, is the propaganda of the winning sides, and this is manifestly so - in some instances much more blatantly than in others - of most versions of the Armada story, from the proliferation of triumphant broadsheets issued by the victors and their sympathisers, almost before the gunsmoke had cleared, to the compilations of modern writers (few of whom have been Spanish) from Froude to the present day.(11) Even Garrett Mattingly's magisterial Defeat of the Spanish Armada, by far the best account so far published, treats the campaign as incidental to the broad surge of military, political and dynastic events surrounding it, and adds little to conventional interpretations of the fighting.(12) It is true to say that no comprehensive and objective study of the naval and military aspects of the 1588 campaign has yet been written from the Spanish point of view, and that the written sources, extensive though they are, are not likely in themselves to supply all the answers.

There exists, however, a primary source of evidence which has not, until now, been considered by historians. In the terrible aftermath of the campaign, thirty or more Armada ships were lost off the western coasts of Scotland and Ireland. The sites of five of these wrecks are known and four or them have been subjected, in recent years, to careful archaeological investigation. Physical evidence from the wrecks can now be studied against the unusually full documentary background, the one source complementing and illuminating the other. But, far from simply confirming the 'conventional' historical interpretations, this new material has pointed to hitherto unsuspected anomalies and gaps in the documentary evidence, and laid the foundations for a radically new assessment of the event as a whole. It is with this reassessment, and particularly with the archaeological evidence which supports it, that my thesis is concerned.

I am aware that the task I have set myself is, in some respects, beyond the capacity of a single researcher. It would have been impossible for me to have consulted all of the potentially relevant documentary material: many distinguished scholars, working over a span of more than a century, have so far failed to exhaust it. But the fact that so much scholarship has already been expended on the subject has left rich opportunities for synthesis, and this is the course I have followed in studying the written material, seeking always the sources upon which interpretations are based rather than attaching undue weight to the interpretations themselves. This I have been able to augment with some unpublished documentary evidence from Simancas, kindly made available by Professor Geoffrey Parker and Dr. I.A.A. Thompson, whose generosity I most gratefully acknowledge. I have also found a rich source of complementary information in the technical and military literature of the period.

My primary evidence, however, comes from the wrecks. Through the skills of archaeological colleagues, the disciplined enthusiasm of fellow divers, and the dedicated expertise of museum staff, the fruits of these exciting but fragile discoveries have themselves become archives, as relevant a source of information as any written document. I have found, as I have worked with this material and with the written sources, that intellectual distinctions between them become ever more blurred. Is this thesis therefore a work of history, or of archaeology? I do not know, and I do not think it matters.

Part I: The Historical Background

Chapter One: The origins of the Armada, 1580-1588

In 1492 Columbus discovered America, and in Spain the last stronghold of the Moors at Granada fell to Ferdinand and Isabella. Either event might be taken as the point at which the mediaeval period in that country ended. One laid the foundations of Spain's emergence as the world's first truly oceanic power, while the other sowed the seeds of her imperial destiny. In the century of meteoric development which was to follow no change was more revolutionary than that which took place in military organisation and technology. From mediaeval traditions of chivalry and crusade - though these were never entirely lost - there sprang a new and radically different breed of fighting man: the trained and disciplined professional foot-soldier. Since the days of Don Gonsalvo de Córdoba the Spanish infantry had shown their solid worth, and by the end of the century Parma's veterans in the Netherlands had reached a peak of fighting efficiency and endurance which has seldom been surpassed.(1)

Technical and tactical developments in sea warfare over the same period were in some respects less radical, because for the most part they were confined to the Mediterranean and involved, almost exclusively, the fighting galley. By the sixteenth century this highly specialised craft had more than two millennia of development behind it, in the course of which the fundamental principles governing its use had changed little.(2) First, it was a wholly offensive fighting machine; its only modes of defence were either to attack or to run. Second, its fighting capacity and radius of operation were limited by the weight of its armament and of the supernumeraries it carried (i.e. those whose muscle-power was not utilised for propulsion), and of the provisions needed to sustain them and the rowing crew. This weight factor in turn influenced the equation between displacement and sprint performance upon which the galley's fighting ability depended.(3) Finally, it was extremely expensive to build, man, and maintain.(4)

These factors imposed severe restrictions on the way in which galley fleets could be employed. They could not, for instance, be used to sweep the seas of enemy craft; and, even if they could, there was no way in which they might then exploit the supremacy thus gained. Thus the Mahanian strategy of dominating the shipping lanes could not be applied. Neither, because of their limited endurance, could they be used to sustain a blockade, except in the extremely localised circumstances of a coastal siege in which they had the co-operation of supporting land forces and some means of re-supply. And although they could, and sometimes did, engage in formal large-scale battles with their own kind, victory could often, in the long run, prove disadvantageous, for it could not bring with it the domination of an area of ocean, while a reduction in the strength of the victor's galley force - even if the enemy's losses had been proportionally greater - might seriously reduce the strategic influence he had exercised before the battle.

What, then, could galleys do? Their most frequent employment was in what has euphemistically been termed 'little wars' or commerce raiding, in which profit to one's own side resulted in loss and disruption to the enemy (theoretically at least: in practice distinctions between friend and foe were often blurred). In a more organised conflict, galleys were at their best very close to their bases, where they could fight light (and therefore fast) or with a greater payload of troops or other armament, and with rowing crews and soldiers in peak condition. An adversary would be disadvantaged in these respects in direct proportion to the distance he had had to come. The key to galley strategy in the Mediterranean, therefore, was to secure and hold bases; it was the anchorages, rather than the vessels in them, which ultimately controlled the sea.(5) Since under normal conditions the bases held advantages which made them virtually impregnable, the deployment of galleys around the Mediterranean reflected a balance of deterrence rather than of overt threat, an arrangement curiously similar to the deployment of missiles in the modern world: if they had to be used, their underlying purpose had failed. Such galley actions as there were almost always concerned attempts to sieze bases, such as

Charles V's capture of Tunis in 1535 or Piali Pasa's spectacular failure to win Malta in 1565. Even Lepanto, in 1571, was in the last analysis a massive defensive effort on the part of the Holy League rather than a profitable victory, for it brought the League no territorial gains. It did, however, prevent the Turks from establishing new naval bases in the western Mediterranean.

Despite these constraints, galleys were often used in conjunction with land forces to help with the prosecution of a siege against a coastal fortress, or to assist in its relief. Such operations were extremely specialised, and conducted according to rules which were (in theory at least) as mathematically predictable as the wider art of siegecraft. In summary, then, galley operations were scientific affairs in which logistics, precision fleet drills, and the fine balancing of complex and subtle variables were the ingredients of success. In these matters sixteenth-century Spanish galley commanders, of whom the most outstanding was Don Alvaro de Bazán (who, after 1578, was Marquis of Santa Cruz), held a formidable and well-deserved reputation.

Such specialised techniques of maritime warfare did not, however, often extend beyond the Pillars of Hercules, where galleys seldom ventured and where, by the late sixteenth century, the broadside-carrying sailing warship reigned virtually supreme. But until 1580 Spain did not possess an effective sailing navy in the Atlantic. As a sea power she had faced, throughout the century, in two directions: towards the Mediterranean and towards the Indies. In the early years of Philip II's reign her naval presence had also extended into the waters of north-west Europe, with a fleet based at Veere in Zeeland, but this facility was lost to the Dutch rebels in 1572 and by 1576 a royal fleet no longer existed in the Low Countries.(6) Nor did Spain exercise real control, in a naval sense, over her convoy routes to the Americas. All trans-Atlantic traffic was organised by the Casa de la Contratación at Seville, and was monopolised by it. Although a squadron of galleons - the Indian Guard - charged with the protection of the Atlantic convoys was supported by the avería, a protection tax imposed by the Casa on all goods carried, these ships were fast and specialised escort vessels rather than true warships and were, as we shall see, very lightly armed. The lack of a secure naval base, and of shipping suitable for oceanic warfare, therefore precluded effective maritime operations against northern European adversaries such as the Dutch or the English.

In the summer of 1580, however, Philip II enforced his claim to the vacant Portuguese throne by capturing Lisbon. The campaign which brought this about was a joint land and sea operation in the classic Mediterranean mould.(7) An army under the Duke of Alba, consisting of 15,000 veteran infantry supported by cavalry and artillery, advanced to the south bank of the Tagus estuary. At the seaward end of the estuary the army made contact with 62 galleys and 25 supporting ships commanded by the marquis of Santa Cruz and, under the fleet's protection, crossed the 3-mile wide river mouth. Alba was now poised to march on Lisbon with his right flank supported by Santa Cruz's fleet. The combination of a fast-moving infantry assault and the aggressive close-range cannonading of the galley squadron proved irresistable, and the Portuguese defences quickly collapsed. Dom António, the Portuguese pretender, fled into exile.

Over the next two years Santa Cruz developed Lisbon as a secure base. The narrow approach at the mouth of the Tagus, already defended by forts, was strengthened with heavy artillery creating, in the wide roadstead beyond, a safe and sheltered haven for the largest fleet. No other port on the Atlantic seaboard of the Iberian peninsula could offer this combination of almost unlimited capacity with total security from enemies and from the weather. It would, if the time for it came, make an excellent base from which to mount an invasion of Holland or England.

The Spaniards had also captured from the Portuguese the nucleus of an Atlantic battle-fleet. Eleven Portuguese royal galleons, big, strongly built, and heavily armed, were taken intact in 1580. To these Santa Cruz could add, as need arose, galleys and galleasses from the Mediterranean fleets, and, by charter or requisition, private vessels from the Baltic to the Adriatic. The light defensive armament which merchant ships usually carried could be reinforced with guns and munitions belonging to the king, and a stockpile of artillery was established at Lisbon for this purpose.

In 1582, Santa Cruz's Atlantic navy saw its first action. After his flight from Lisbon, Dom António had secured the tacit support of the French king, Henry III, who allowed a force of some 60 ships and 6000 troops to muster at Belle Île off the Brittany coast, prior to invading the Azores, which had refused to acknowledge the Spanish succession. Under Filippo Strozzi, a Florentine nobleman well connected at the French court, this fleet sailed on 16 June and reached the Azores a month later. Santa Cruz set out from Lisbon to intercept Strozzi on 22 June but found the French fleet waiting for him off the island of São Miguel. The Spaniards had about 30 ships: the Portuguese royal galleons San Martín, which carried his flag, and San Mateo (both of which were to serve with great distinction in the 1588 Armada); armed merchantmen from Portugal, Castile, the Mediterranean and the Basque ports; cargo hulks from the Baltic; and a number of small dispatch boats. There were no galleys or galleasses; this was to be, for the first time in history, a major fleet action in which the deciding factors would be sails and guns alone.(8)

Rather than wait for the reserve fleet which Juan Martínez de Recalde was mustering at Cadiz, Santa Cruz and his captains elected to risk their numerical inferiority and attack without delay. The Spanish fleet drew up in line abreast, Santa Cruz's flagship at the centre, in the time-honoured formation of a galley force offering battle. Unlike galleys, however, sailing ships could not manoeuvre independently of the wind, and light variable breezes kept the rival fleets fencing for favourable positions over the next two days. On the night of 24 June Santa Cruz gained the advantage of wind, only to lose it when a mishap forced him to take his vice-flagship in tow. At dawn on 26 June Strozzi held the weather gauge, though he seems to have considered the wind too light to justify an assault on the Spanish line, and the stalemate continued. At this point the San Mateo - whether on Santa Cruz's orders, or on the personal initiative of her commander, Don Lope de Figueroa, is not clear - broke station and clawed her way alone towards the French fleet. Strozzi accepted the challenge and moved to attack in his flagship with four strong warships in support. A furious close-range combat developed and for two hours the San Mateo received, and returned, broadside after broadside. But though the French tried repeatedly to board they were repelled by Figueroa's 250 soldiers, who were stationed in the waist, on the castleworks and in the fighting tops.

It took some time for Santa Cruz's main fleet to work its way upwind towards the action. The Spanish rearguard of Guipuzcoan merchantmen under Miguel de Oquendo - who, it was said, could handle his massive Basque-built flagship with the dash of a light cavalryman - relieved the beleaguered San Mateo by ramming clear the remaining Frenchmen grappled on either side of her. A general mêlée developed as the remaining Spanish ships came up. Tactics were simple: individual captains, having singled out an enemy ship, delivered a short-range broadside before grappling and boarding. Santa Cruz in the San Martín, as honour dictated, sought out Strozzi's flagship amid the smoke and chaos and, having found her, pounded her with gunfire until she was close to sinking. Strozzi died of his wounds before he could surrender his sword, and Santa Cruz peremptorily ordered his body to be cast overboard.

The French rearguard, for reasons which have never satisfactorily been explained, had not become engaged, and on the collapse of the vanguard joined in a general flight. Strozzi's fleet lost 11 ships sunk or captured, and well over 1000 men. Spanish casualties were lighter - 224 dead and 553 wounded - but damage to some of their ships had been severe. The San Martín had taken a particularly heavy battering, and had great difficulty in towing Strozzi's captured flagship to port.(9)

From the Spanish point of view the lessons were clear enough. First, naval conflicts in the Atlantic would be decided in future by the sailing ship and the artillery broadside; second, the best tactic to use against nimbler ships which held the weather gauge was to stand in a tight formation and fight in close support, moving the most powerfully armed units in that formation to positions from which they could be used to best effect.

Although Santa Cruz was technically the victor at São Miguel, his fleet was so shattered that he was unable to exploit his supremacy against Dom António's land forces, which continued to hold the rest of the Azores, including the key island of Terceira. But by the following summer, after a year spent in repair and preparation at Lisbon, he was ready to finish the job.

The victory at São Miguel had effectively neutralised the threat by sea to a Spanish force invading the Azores, and so Santa Cruz decided to send an amphibious task force to seize Terceira. In June 1583 this fleet sailed and, according to a summary of the muster held at Lisbon just before its departure, it consisted of the following forces(10):

	Tons	Oarsmen	Seamen	Soldiers
2 galleasses		496	188	315
12 galleys		2212	600	
3 royal galleons	2200		290	524
2 galleons belonging to Santa Cruz	1546		180	486
7 Ragusan great-ships	5092		474	2354
3 Catalan great-ships	2191		203	811
4 Venetian great-ships	2342		229	1158
2 Genoese great-ships	898		87	461
1 Neapolitan great-ship	498		47	274
13 great ships from Guipuzcoa and Biscay	5450		671	2545
1 great-ship (origin not stated)				
12 <u>pataches</u>				
15 <u>zabras</u>				
14 Portuguese caravels				
7 landing craft				

From an advance base on the Spanish-held island of São Miguel this force was able to probe and reconnoitre the enemy defences on Terceira before launching its main attack in mid-July. The Terceirans expected the Spanish to land at the harbours of Angra and Peggia, and had disposed their forces accordingly, but Santa Cruz decided, on the basis of local information and personal reconnaissance, to deliver his main thrust at Mole, a beach 10 miles from Angra which was defended only by light earthworks occupied by infantry with some artillery support.(11) Santa Cruz's own account of the action has a strikingly modern ring:

> "The flag galley began to batter and dismount the enemy artillery and the rest of the galleys did likewise...the landing boats ran aground and placed soldiers at the sides of the forts, and along the trenches, although with much difficulty and working under the pressure of the furious artillery, arquebus, and musket fire of the enemy. And the soldiers mounting the trenches in several places came under heavy musket and arquebus fire, but finally won the forts and trenches."(12)

The confidence felt by Spain's military leaders in the aftermath of the Azores campaigns coincided with a growing belief that open conflict with England was inevitable. Now, surely, was the time to strike. "After the taking of the isle of Terceira", wrote a contemporary observer, "the Captains which accompanied the Marquis of Santa Cruz...said openly now that we have Portugal England is ours, and little by little we shall gain France also."(13) By August 1583 Santa Cruz was himself impressing upon Philip II the feasibility of a maritime expedition against Flanders and England.(14) The marquis's personal prestige by this time was enormous, and an aura of the invincibility of Spanish arms under his direction touched even the cautious spirit of the Prudent King. After 1583 the invasion of England ceased to be a wishful dream; it had become, almost overnight, a practical possibility.

Only one man could organise and lead such an undertaking, and that man must be given extraordinary powers to muster the necessary naval and military resources. On 23 June 1584 the king appointed Santa Cruz to a remarkable and unprecedented Captain-Generalcy;(15) not that of a fleet, or of a province, but of the entire _Mar Oceano_, the Ocean Sea, encompassing all Spanish operations on, or connected with, that vast and unpredictable element, of which Charles V had once enjoined his son most particularly to beware.(16) The marquis was empowered to direct all naval affairs in the king's name, with authority to requisition whatever shipping, Spanish or foreign, he considered necessary for his endeavours. He was to pay especial attention to the administrative and financial problems of arming and manning his ships to appropriate scales. Finally, although his commission nowhere alludes specifically to an invasion of England it mentions, on two occasions, unspecified "new enterprises" which the king might require his Captain-General to undertake. It was not long before these enterprises began to take definite form.

Early in 1586 Philip instructed Santa Cruz to submit plans for what had become known as the 'Enterprise of England', and on 22 March the marquis sent his proposals to the king.(17) They were couched not in the terms of a broad strategic plan, far less as an exposition of the tactics that were to be employed in its execution, but rather as a detailed breakdown of all the resources which would be needed to put it into effect. Nevertheless the figures, if read in conjunction with Santa Cruz's experiences and successes over a long fighting career, and most particularly those which had taken place in the Atlantic since 1580, make his intentions quite clear. The operation was to be built up in the secure and capacious port and roadstead of Lisbon, and launched from there as a single amphibious task force under his direct command. The objective was simple: to land an army sufficiently strong, with all the supporting services it required, at a point on the English coast from which it could speedily achieve a decisive victory.

Santa Cruz's strategy, as reconstructed from his planning document, can be divided into four elements. The first was transport. A large fleet of big sailing vessels would be needed to bring the projected 55,000 invasion troops plus their equipment and supporting services to England. A hundred and fifty ships totalling 77,250 tons were specified for this purpose. They would include 40 large merchant vessels chartered or requisitioned from Ragusa, Venice, Sicily, Naples and the Mediterranean coasts of Spain; 25 Spanish royal galleons and other vessels currently based at Lisbon and Cadiz; 20 ships, including the powerful group of fighting galleons, which had belonged to the Portuguese crown; 35 Basque merchantmen from Biscay and Guipúzcoa; and 30 German hulks which were already under contract to Spain for the transport of naval stores from the Baltic.

The second element in Santa Cruz's plan concerned the defence of this massive fleet as it advanced towards the disembarkation point. In this respect it should be stressed that the Armada's fighting role, _at sea_, was from first to last defensive. São Miguel had demonstrated the futility, from the Spanish point of view, of a naval battle of attrition which achieved a victory over an enemy fleet at the expense of the capacity to exploit that victory ashore. All of the Armada's ships would be armed and, to a greater or lesser extent, able to defend themselves individually or collectively. The fleet formation would have been arranged, no doubt, to utilise the most powerful vessels to best effect, as was to be the case in 1588. Six galleasses and 40 galleys would provide a fighting reserve which could be deployed irrespective of wind direction. Santa Cruz reasoned, we may presume, that strict formation discipline coupled with vigorous self-defence would be enough to bring him through the Channel, if not unscathed, at least sufficiently intact to put the third phase of his operation into effect.

This was to land and secure a beach-head for the army in the Thames estuary. Such an operation would be, without doubt, the most crucial and difficult part of the whole enterprise, but it was one of which Santa Cruz and many of those who would be under his command had recent and successful experience. It would be, after all, little different from the Terceira landings, though on a far larger scale, and Santa Cruz took care to specify just those ingredients which had brought him victory at the Mole beach-head three years before. In this part of the operations the 40 galleys he had called for would come into their own. Unsuited they may have been to open water combat with armed sailing ships; fragile they certainly were in heavy weather; but in the sheltered waters of the Thames, screened from seaward by the main fleet, they would have been as deadly as they had been in the Tagus in 1580. As swift and manouevreable destroyers they could bring down sustained fire on shore positions, operating right up to the beaches, while as support landing craft they could rapidly transfer heavy loads - particularly field and siege artillery - from the fleet to the beach-head. Finally, once the initial landings had been consolidated, and the land campaign launched, the galley force could support the flank of the army as it advanced along the coast, probing up rivers and into harbours as required, as Santa Cruz's galleys had done for Alba's army six years before. Vital though the galleys would be in supporting and assisting the landings, they had not the capacity quickly to transfer large numbers of troops from the fleet to the shore. This task would be carried out by 200 specially designed landing craft - barcas chatas - which, as Santa Cruz emphasised in his proposals, should be of the same type as those used for the Terceira landings.(18)

Once the troops and their equipment had been brought to the beaches the operation would move into its fourth and final phase. This was an advance on London, for which the army was to be provided with everything necessary to ensure success. Speed was of the essence: a swift blow to the heart of Tudor power ("the root of the evil", as Philip put it) would be the most certain solution to the English problem, and probably, in the end, the cheapest one. It is important to bear in mind that territorial gain was not Philip's primary objective, and he was understandably anxious to avoid England becoming another Flanders, with its interminable and profitless drain on resources.

To take the English capital and keep his fleet secure Santa Cruz reckoned he would need 55,000 front-line infantry, made up of 28,000 Spaniards, 15,000 Italians, and 12,000 Germans, who would be armed with pike, arquebus, or musket. Many would be veterans. They would be supported by a large siege train, organised into four batteries of 12 40-lbr cañones and one battery of 2 25-lbr heavy culebrinas. In addition there would be 16 heavy field guns (medias cañones and medias culebrinas), 24 light field pieces (sacres), and 20 heavy swivel guns (esmeriles largos). An appropriate number of draught and pack animals, wheeled transport, and specialist craftsmen would be attached to the artillery train. There would also be a 3000-strong corps of pioneers (gastadores), equipped to construct siegeworks and clear obstacles. Santa Cruz's General Staff would include supply and administrative officers, a medical service, and a strong contingent of military police. And although no mention of it is made in the planning document (perhaps Santa Cruz felt that this was something the king would like to attend to himself), there would certainly have been a chaplaincy department to maintain the crusading zeal of the troops and add spiritual conversion to the temporal subjugation of the heretics.

The whole force, including seamen, oarsmen, unattached officers and gentlemen-adventurers, would amount to 94,222 men all told. It was to be provided with the staggering amount of food, fodder, drinking water and wine necessary to sustain it through a voyage and campaign calculated to last eight months, and with a commensurate supply of ammunition and other military stores. This would involve, to take a few examples, the provision of 379,337 _qtx_ of hard-tack, 22,800 _qtx_ of bacon, 21,500 _qtx_ of cheese, 46,800 _pipas_ of wine, 60,000 pairs of shoes, 40,000 leather bottles, 12,000 wooden shovels, 12,000 _qtx_ of lead, and 22,080 _qtx_ of gunpowder.

To assist in the mustering and preparation of this great force Santa Cruz called for forty large supply vessels and 320 smaller ones to act as fleet tenders. Forty similar vessels were expected to accompany the six galleasses when they came from Naples. These 400 support vessels were not, as has sometimes been supposed, all expected to take part in the operation itself, though some of them undoubtedly would have accompanied the fleet, as they did in 1588, as scouts and dispatch craft.

The whole prodigious undertaking would cost, by Santa Cruz's meticulous reckoning, 1,526,425,798 _maravedís_, or 4 million ducats, and it was no doubt to this colossal figure that the king first directed his glance. Some commentators have accused Santa Cruz of a lack of realism, even of megalomania, in making these proposals; and indeed Philip II was hardly in a position, financially or militarily, to accept them as they stood. But the marquis had been instructed to draft a theoretical costing for the enterprise as a basis for planning and discussion, and it would be natural to suppose that he added a substantial margin to what he deemed in his own mind absolutely necessary. Generals almost invariably over-estimate their requirements when asked by their political masters to draw up plans of action, so allowing for the probability that they will receive far less than they ask for (and, incidentally, reserving for themselves the prospective defence that, should the venture fail, it did so because they had not been given adequate resources). It seems reasonable to suggest, therefore, that Santa Cruz did not expect to be given anything like the resources listed in his 1586 proposals - he must have appreciated the financial impracticability as much as Philip did - and was working on the assumption that a much smaller force could probably do the job, though perhaps with less certainty of outright success.

If, for the sake of argument (for we cannot now penetrate the workings of the marquis's mind), we assume that he had simply doubled up his minimum figures, the result is in many respects close to the force which actually sailed in 1588. But there is one serious discrepancy. Even on the suggested 50 percent scale, Santa Cruz would still have required nearly 30,000 combat troops for his self-contained invasion force; yet the Armada, when it sailed, carried not much more than half that number, many of them raw recruits. Spanish soldiers, as Alexander Farnese, duke of Parma, was fond of remarking, would be the sinews of the whole affair; and, even if a self-contained invasion force could have carried them from Lisbon, it is doubtful whether 30,000 men suitably trained and experienced for the tasks which lay ahead could have been mustered there without dangerously weakening the theatres from which they would have to be drawn. Most of Spain's front-line soldiers, and almost all of her best ones, were in Flanders under Parma, where years of unremitting warfare under the duke's inspired generalship had forged them into the toughest and most professional army of early modern times.

It was the presence of these troops so close to England, and a belief that success in England would seriously weaken Dutch resistance and perhaps even bring about a general collapse of the revolt, that prompted Philip to produce an alternative plan.(19) An Armada would still sail from Lisbon, carrying as many troops as could be mustered, together with most of the <u>matériel</u> needed for the land campaign. The main invasion force, however, would be launched from Flanders by Parma himself, who would effect the short Channel crossing in flat-bottomed river craft. Santa Cruz, with his Armada, would cover this crossing by advancing in defensive formation up the Channel to rendezvous with Parma at some convenient (but unspecified) point, and escort the flotilla of landing craft to a beach-head inside the mouth of the Thames. The Armada's role in these operations would be threefold: first, it would deal with any direct threat presented by English and Dutch naval forces; next, it would provide a wave of 6000 assault troops who would back up Parma's initial landings; and finally, it would off-load the artillery and supplies needed by Parma to mount a rapid march on London. Then, and only then, could the Armada operate as an independent force, though always with Parma's approval and where possible in his direct support; it might attack enemy shipping, capture a port, or ferry reinforcements from Flanders.(20)

It is impossible to emphasise too strongly the significance of this change in plan. There is every chance that Santa Cruz's 1586 proposals, even if they had been applied on a much reduced scale, would have worked. Events in 1588 showed that the Spaniards experienced little difficulty in moving 60,000 tons of shipping in a mutually defensive formation from one end of the Channel to the other, despite repeated assaults upon it, and while the English would certainly have offered fierce resistance had the Spaniards then attempted to force the Thames estuary it is difficult to imagine what might have been done to stop them: "a brag countenance...as if we had wanted for nothing" would, in such circumstances, have been of little avail. The Armada's sole undoing was the Flanders rendezvous, and that rendezvous was, from the outset, an option which neither of the commanders involved considered to be a workable proposition. The responsibility for ordering its attempt rests squarely with Philip II who, once the decision had been taken, would countenance neither delay nor modification in putting it into effect.

By the late summer of 1587 the plan had reached its final form. On 4 September Philip wrote congratulating Parma on the capture of Sluys, a deep-water port linked to its hinterland by a network of canals.(21) It would be, the king pointed out, an excellent mustering point for the invasion boats. He went on:

> "I have been convinced that the most advantageous way will be to join your forces with ours at the same time; and when the junction is effected the affair will be simplified and the passage assured. The whole force can then be applied to cutting to the root of the evil...
>
> "We calculate that by the time you have invested Ostend you will have over 30,000 men ready for the main business, whilst 6000 Spanish infantry, a part of them veterans, will go in the Armada from here, the whole force of soldiers and seamen in the fleet reaching 22,000 men. I have decided that when the Marquis of Santa Cruz arrives with the _flotas_ at Cape St. Vincent, he

> shall leave them there in charge of the Spanish galleys, and go direct to Lisbon. He will then at once take charge of the fleet which will be awaiting him and with God's blessing sail straight to the English Channel...you, in the meantime, will be quite ready, and...you will, if the weather permits, immediately cross with the whole army in the boats which you will have prepared..."

The king's reasoning sounds, on the face of it, plausible enough, but his plan presented difficulties which, to experienced commanders like Parma and Santa Cruz, appeared insurmountable. First, how were two large independant forces, whose operational bases were separated by more than a thousand miles of ocean, to achieve the necessary precision of time and place in effecting their link-up? Second, how could Parma's vulnerable flotilla of landing craft, which would amount to no more than open and unarmed river barges packed with wet and seasick soldiery, cross the Flemish shoals in the face of the almost continuous presence of the Dutch Republic aggressive and well-gunned flyboats and of the less frequent but unpredictable presence of English offshore squadrons? On top of these difficulties, moreover, Philip was now ordering the campaign to start at the approach of the autumnal equinox, when weather both for the crossing and the following campaign was likely to be at its very worst. In his zeal, aggravated no doubt by a growing sense of frustration, Philip's legendary caution seems to have been replaced by the optimistic certainty that divine patronage would ensure success if somehow the whole unwieldy business could be steamrollered through. That he should seriously have considered, at such a time, launching both the Armada and the cream of Parma's army calls into question not only his military competence - there can be little doubt of his shortcomings in that respect - but also his general sanity.(22) "We are quite aware", he concluded his orders to Parma, "of the risk which is incurred by sending a heavy fleet in the winter through the Channel without a safe harbour, but...as it is all for His cause, God will send good weather." Philip's two generals, stalwart Catholics though they were, can hardly have been impressed by such reasoning. Two years earlier, Parma had warned the king, with his customary directness, that God would "grow weary of working miracles for us."(23) Events were to show that he pinned little faith on one manifesting itself now.

But such a miracle could not be worked without a fleet to work it with. Even before a firm decision to send the Armada was taken at the beginning of February 1587 the mammoth task of assembling its component parts had begun.(21) Long-term stockpiling of the fleet's provisions was of crucial importance, for sixteenth-century Europe enjoyed few food surpluses and supplies of the magnitude required might be difficult to obtain, at any price, if the notice given was too short (this consideration was balanced, unfortunately, by the immutable fact that, in an age without tin-cans or freezers, no footstuffs lasted indefinitely). Orders for biscuit and salt meat were sent to Alicante, Cartagena and Málaga - at Málaga alone 40 new biscuit ovens had to be built.(25) Milan was requested to supply a large consignment of rice, while a merchant was dispatched with letters of credit to purchase meat, cheese and fish in Genoa, along the Riviera, and in Sardinia.(26) Twenty Hamburg hulks brought nearly half a million pounds of cheese to Lisbon,(27) while grain purchases in Spain, where there was already a shortage, had an inflationary effect on the market price.(28)

Other agents, meanwhile, were setting in hand bulk contracts for the supply of military equipment. In Seville the duke of Medina Sidonia ordered a large number of campaign tents, and 12,000 sets of shoes, leather canteens, and knapsacks for the invasion troops; later, in the same town, picks, shovels and gabions were ordered for the pioneers.(29) A courier was dispatched in early February to summon veteran troops from Italy, and recruits to take over their garrison duties were later sent by galley from Spain.(30) There was no way in which all this activity could be kept secret. By 10 February the Venetian ambassador at Madrid, Hieronimo Lippomano, reported that the 'business' was growing warmer every day.(31) Little doubt existed in anyone's mind as to the purpose for which the business was intended: ten days earlier, on 31 January, the Venetian ambassador at Rome, Giovanni Gritti, had informed his government that "people think an attack on England is settled", although he added, with diplomatic caution, "the general opinion is that it will be a very difficult affair."(32)

Preparations for the fleet itself also proceeded apace, and shipping began to muster at Cartagena, the Basque ports, Lisbon and Cadiz. New ships were built in Biscay.(33) Although Lisbon was to be the base from which the Armada would ultimately sail, activity at first centred on Cadiz, which possessed extensive facilities for fitting out and victualling the Indies fleets. Vessels began to crowd the anchorage between the seaward peninsula, upon which the town stood, and the mouth of the Guadalquivir, whence supplies could be brought down from Seville. The port, with its wide entrance, was less secure than Lisbon, but it was well defended with forts and artillery, and by a squadron of galleys.(34) By the end of April nearly sixty vessels were in harbour; hulks and coasters loading for Lisbon, fishing craft, and merchantmen of all types from small caravels to a 700-ton 40-gun Genoese great-ship about to depart for Italy with a cargo of cochineal, leather and wool.

On the evening of 29 April there suddenly appeared, in the midst of this apparently secure roadstead, a fleet of more than 20 English ships led by Sir Francis Drake. Neither the Spanish shore defences nor the galleys proved effectual, and only the prompt arrival of land forces under the duke of Medina Sidonia prevented the city itself from being taken and sacked. Nothing, however, could save the shipping, and the English embarked on an orgy of prize-taking and destruction.(35) When it was over, 24 vessels had been captured, sunk or destroyed, and a reported 392 pipas of wine, 3443 qtx of biscuit, 3288 fanegas of wheat, and a large quantity of sailcloth, cordage and ironwork, all bound for Lisbon, had been lost. The cost of the disaster was estimated at 172,000 ducats.(36)

The magnitude of the blow was not to be reckoned only in cash terms. Drake followed his success at Cadiz by landing on Cape St. Vincent, where he took the castle of Sagres and destroyed its artillery.(37) During the following weeks his ships dominated the seas from the Cape to the Straits of Gibralter, bottling up movement from the Mediterranean and devastating the plodding stream of small coasting craft ferrying stores from Cadiz to Lisbon. Many were sunk, including a number of the tuna fishing fleet and several vessels carrying seasoned barrel hoops and staves.(38) Two of the ships captured were laden with oars for the galleys. These losses, on top of those at Cadiz, were a major setback to the Enterprise's already acute commissariat difficulties. As a final insult Drake approached Lisbon itself and, within sight of Santa Cruz's headquarters at the castle of St. Julian, defied the marquis to come out and "exchange certain bullets" with him. The unfortunate Captain-General of the Ocean Sea, though goaded almost beyond endurance, was forced to ignore the challenge, for his ships were not ready to fight. Drake therefore headed for the Azores, intent on intercepting the returning Portuguese and Spanish treasure fleets.(39)

These humiliating reverses, however, in no way lessened the likelihood that the Armada would eventually sail; on the contrary, they made its sailing even more certain. All Europe knew that Spain was preparing a fleet to conquer England and so, whatever the cost, the Enterprise had to go ahead. To abandon it now would be an unacceptable admission of defeat, and each fresh ducat invested in it reinforced the inevitability of the whole ponderous affair. As the Venetian ambassador shrewdly observed, the king had reached a point at which he "could not endure the idea of throwing away such vast treasure...as has been spent this year".(40)

But when would the Armada actually put to sea? Expert opinion advocated a departure in the settled weather of the early spring: the ships would have been careened during the winter months, and fresh stores and troops brought aboard in February and March, so that the fleet might catch the favourable winds which normally blew in early May.(41) The whole summer would then lie ahead for the prosecution of the campaign. Cautionary precedents which demonstrated the inadvisability of embarking upon naval enterprises late in the season were numerous, and the most commonly cited was that of Charles V's disastrous expedition to Algiers in the autumn of 1541.(42) Even without Drake's intervention, however, there was no way in which such a timetable could have been adhered to in 1587; preparation for it had begun too late. Nevertheless the king insisted that the fleet must sail at the earliest possible opportunity. The problems and costs of the Enterprise, it seemed to him, would only escalate while the Armada remained in port. There were, moreover, political factors to consider. The execution of Mary Queen of Scots on 18 February 1587 provided Philip with a cast-iron justification for launching his crusade, and at the same time absolved him of the embarrassing necessity, had she lived, of placing her on the English throne, so opening the way to an inevitable Franco-English alliance. Events were moving in France, too, in ways which indicated there would be no interference from that quarter if a Spanish fleet were to arrive in the Channel bent on an invasion of England.(43) And, of course, the sooner Francis Drake's costly impudence was punished, and his countrymen prevented from acting similarly again, the better. Another consideration also influenced the king. From the very beginning the Armada had been conceived as a force so powerful as to be invincible, and so there was always the chance that its mere appearance in the Channel would force Elizabeth to come to terms.(44) But whether it had to fight or whether it might achieve its objectives simply by a show of strength, the Armada had to be physically capable of putting to sea.

In the early summer of 1587 Santa Cruz did not believe that it yet possessed that capability, and in any case there could be no question of its setting sail, even in the two separate waves of an advance force and back-up fleet that had been projected, while Drake was loose among the Azores. On 11 July the marquis set out from Lisbon with 40 ships, including the Portuguese galleons, to protect the Indies fleet, which was expected daily, and, if possible, to intercept the English 'corsairs': "If God should allow him [Santa Cruz] to encounter Drake," wrote the king to Bernardino de Mendoza, "I trust he will give him what he deserves".(45) Santa Cruz, in fact, missed Drake, who had rounded off his beard-singeing expedition by capturing the fabulously rich Portuguese Indiaman San Felipe before heading back to England. Little wonder the Spaniards suspected 'El Draque' of keeping a magic mirror in his cabin, through which he could observe his enemies' every move.

The presence of Santa Cruz's squadron off the southern coast of Portugal had, however, allowed the shipping which had been building up for the Armada in the Mediterranean ports and at Seville to move safely to Lisbon. A fleet of 70 vessels, including the squadrons of Levant, Andalusia and Castile, together with 28 Baltic hulks and 4 Neapolitan galleasses, entered the Tagus on 4 August under the command of Don Alonso Martínez de Leyva.(46) As soon as a contingent of Guipuzcoan ships under Miguel de Oquendo came down from the north, and the Portuguese and Biscayan squadrons of Santa Cruz and his vice-admiral Juan Martínez de Recalde returned from the Azores, the Armada would be at its full projected strength.

But, by then, autumn would be well advanced.

At the beginning of September the first troops were embarked on the ships at Lisbon, and forbidden to go ashore on pain of death.(47) But there was little chance of their sailing for some time, since the squadrons which had been on the Azores station, and which had still not returned, would be in no condition to undertake a voyage to England until they had undergone extensive maintenance. Santa Cruz did not bring them into Lisbon until the end of the month, only to find that the king expected him to proceed to Flanders without delay. According to the Venetian ambassador, Hieronimo Lippomano, the marquis replied that he would be ready to sail on 20 October.(48) A few days later, however, after the shipwrights had inspected the Portuguese galleons and Recalde's Biscayan ships, Santa Cruz reported that they could not possibly sail that month, and requested a delay. Philip was furious: it was, Lippomano reported him as saying, a cunning plot on the part of the owners whose ships had been siezed for the Enterprise, in the hope that they might recover their vessels. The ambassador went on: "Those who understand naval matters declare that if his Majesty continues in this resolve he will only succeed in losing the Armada and all his forces. The marquis cannot be ready even for the date he himself has named; but as he sees the king so determined he is afraid to write his own opinion, or to urge the lateness of the season, but he does what he can to put off, as he knows that this is of real service to the king."(49)

On 18 October Lippomano reported that the king had sent a special courier to Lisbon with express orders for Santa Cruz to sail. All the same, he continued, "it becomes clearer every day that the marquis does not wish to take to the sea." The four Neapolitan galleasses were laid up for the winter, and Santa Cruz despatched to Madrid "an expert in naval affairs to point out to his Majesty how great is the danger this season, and to inform him of the bad condition of the fleet, of the large number of soldiers who are dead or have fled, and the great want of sailors, and to assure him that if they sail in this state they will be going to destruction..."(50) Philip sent Santa Cruz's expert back without an audience, with a messenger hard on his heels bearing the king's "will and command" that they fleet was to sail without further delay or excuse. Even if only part of it was servicable, he ordered, that part should put to sea immediately under Don Alonso de Leyva, and Santa Cruz should follow with the rest as soon as they were ready.(51)

The same grisly charade was repeated in November. On the one hand Santa Cruz claimed that he had 600 shipwrights working day and night to prepare the fleet for sea: in another fifteen days all would be ready. On the other, he reiterated his warning about putting to sea in mid-winter, and claimed strong support in this view from the duke of Medina Sidonia who, though neither of them knew it, was to succeed him as the fleet's commander.(52) Lippomano supported his report to the Doge and Senate by referring to a letter, of which he had a copy, which Santa Cruz had sent to the king on 4 November:

> "I should be deeply culpable [wrote Santa Cruz] if I did not set forth the considerations of seamanship, of war, and of state which I hold to be of service or disservice to your Majesty... Your majesty's singular intelligence will perceive the difference between sending out the Armada in December or sending it out in March is the difference of a couple of months, or little more, lost, whereas the gain would be the peace of mind and the certainty of a successful issue, for at the later season the open sea would serve as a port for the Armada...

"...in winter in England there is little more than six hours of daylight, and up to two o'clock the sky is usually clouded with a thick and dense mist; if the wind is from the south, which is favourable to our fleet, the atmosphere is obscured for the whole day, so day might justly be called night, and navigation in unknown waters is rendered highly dangerous; on the other hand, if the sky is clear the wind will be absolutely in our teeth... the objection of all others which weighs with me is this, that during the winter certain winds blow which are deadly to foreigners, and so without fighting there is a great danger of losing soldiers and sailors.

"If it really be decided to go to England itself I would only observe that this Armada, even when united with the troops of the Duke of Parma, which would at this season be embarked and carried over the straits with no small difficulty, does not seem to me sufficient to attempt his enterprise in the very heart of the winter. We have no harbours at hand in case of need, and the tide is extremely strong, the sea open to the south winds. Nor, in my opinion, would it be such an easy matter to take the Isle of Wight, or any other harbour, for the shelter of our fleet, as is represented to your Majesty by those who stake nothing on the risk, and have not been taught the difference between victory and defeat.

"If, after all, your Majesty should insist on my sailing, be assured that you will not have either officer or private who will risk his life with greater alacrity, courage, and ardour. But, as I have humbly expressed it, my opinion is that the sailing of the Armada should be delayed, if not till March, at least till the middle of February to allow the weather to grow milder. And your Majesty must remember that should any misfortune befall the fleet, which God forbid, it would be impossible to put together another such Armada for a long time to come."(53)

Paradoxically the duke of Parma, whose views on the weaknesses of Philip's plan for the Armada coincided with those of Santa Cruz, was meanwhile urging expedition, not delay. In his view secrecy should have been the Enterprise's main protection, and surprise its recipe for success. But with every day that passed, Spanish intentions were becoming more clearly known. He also pointed out that, while it had not been insuperably difficult to get his army and the invasion craft into position, it was virtually impossible to keep them there, at a high state of readiness, for an indefinite period, a difficulty made more acute by the widespread failure of the Flemish grain harvest.(54)

Confident that the Armada was about to depart the king had ordered him, on 4 September 1587, to stand by for the link-up with Santa Cruz. "Pray send me word at once," Philip had written, "that there shall be no shortcoming in these respects."(55) Parma and his men had thereafter waited along the Channel coast, with growing frustration, for the fleet to arrive. The winter wore on, and nothing happened. In December two extraordinary letters arrived from the king which, unfortunately, do not appear to have survived, but Parma's reply to them on 31 January 1588 makes their content clear; Philip was now asking the duke whether he was in England, and if not, why not?(56) In the face of such an inexplicable lack of logic Parma's impatience exploded: the king's letters, he wrote, "seem to infer that I may have done what you Majesty emphatically ordered me not to do until the arrival of the marquis of Santa Cruz with the Armada to ensure the passage across." He went on:

> "I wrote by your Majesty's orders my own opinion, that in the interests of the facility, success, and efficacy of the expedition, it was necessary that secrecy should be maintained, the French kept busy, and these States assured. I said also that the passage across from here was convenient, in consequence of its shortness and the facility of obtaining boats. The latter, however, obviously are not fit for anything but the passage itself, as they are too small for

fighting, and so low that four skiffs of the fleet could send to the bottom as many as they might meet. They could hardly live through a freshet, much less a tempest, so that they can only be used in settled weather. As your Majesty ordered me to undertake this business and make all necessary preparations, although the time given to me was very short, and the supply of money very limited, I have done my best to attempt the impossible. Things have been drawn out longer than I like or than is desirable; both men and money having been delayed beyond the time your Majesty indicated, and particularly the Spanish troops, who are the sinew of the whole business, the numbers, moreover, being less than those agreed upon... In order to keep them near the points of embarkation they are so badly housed that very many of them are missing... I made every effort to get them to the ports in accordance with your Majesty's orders, and went personally to expedite them, on the understanding that there would be no delay in the arrival of the marquis of Santa Cruz with your Majesty's Armada, as your Majesty assured me in your own letters. I now see that everything has turned out the reverse of what I expected and hoped.

Secrecy, which was of the utmost importance, has not been maintained; and from Spain, Italy, and all parts come, not only news of the expedition, but full details of it... the English themselves have promptly and energetically set about their preparations for defence. Your Majesty is perfectly well aware that, without the support of the fleet, I could not cross over to England with these boats, and you very prudently ordered me in your letter of 4 September not to attempt to do so until the marquis arrived. I thought that his coming would be so soon that, notwithstanding my utmost haste, I should not be in time; and I hurried all my men into the port [Dunkirk]. If the marquis had come then, the crossing would easily have been effected with God's help, because, what with the Dunkirk and other coast boats, as well as those I had prepared, I could have taken the men over without the Antwerp boats, neither the English, the Hollanders, nor the Zeelanders being then in a position to offer resistance to your Majesty's fleet...

"Your Majesty has the right to give absolute orders, whilst I can only receive them as special favours, and fulfil them; and for you to write to me now with a presumption diametrically opposite to the orders sent, naturally gives me great pain. I therefore humbly beg your Majesty to do me the great favour of instructing me how I am to act..."

On 22 February Parma and his men were still anxiously awaiting the arrival of the Armada. His own preparations, he reported to the king, were complete.(57) Munitions were on board the transports, the landing craft were assembled at Dunkirk and Sluys, and the men were concentrated near the ports ready for embarkation. Owing to "exposure and evil lodging" the troops available for the crossing had dwindled to 18,000 but their morale, said the duke, was high (that he had been able to keep it so since the previous September says much for Parma's qualities as a general). His letter ends with a reminder that "the Armada [must] come strong enough to assure the victory, and the marquis must remember that the English and the rebels are now strong and fully prepared with their fleets."

But the marquis would never now see the coast of Flanders. Two weeks before Parma wrote this letter the great Santa Cruz had died amidst the chaos of the preparations at Lisbon, broken, it was said, by the demands of the Armada and the lack of understanding shown by his king. Just before his death Philip had sent a special investigator to Lisbon, who found Santa Cruz in a state of deep despair, trying to direct the fleet's preparations from his sick-bed.(58) The confusion was indescribable. Even when he was in possession of all his faculties the marquis had been a fighting admiral rather than a staff-officer; now, as he lay dying, feebly trying to cope with an impossible situation, the whole Enterprise was on the verge of collapse. The difficulties and uncertainties of the previous winter had reduced the fleet to a shambles of unseaworthy ships and rotting supplies and, more critically, for it is infectious and less easily cured, of dispirited and disillusioned men. Santa Cruz must have found in death a welcome release.

The king now took what was probably the only wholly sensible decision he was to make in the course of the entire unhappy affair. What the Armada urgently needed, if it was to sail at all, was not another fighting admiral but a determined and practical man with outstanding administrative abilities. Such a man was Don Alonso Pérez de Guzmán, duke of Medina Sidonia, whose qualifications to succeed Santa Cruz were impeccable. First, he had taken part in the Armada's planning from the outset. Second, his administrative talents were among the best available in Spain. He virtually ruled the rich southern province of Andalusia, where he was widely respected for his efficiency, humanity, and fair-dealing. Nor was he lacking in military and naval experience, particularly on the all-important logistical side. In 1580 he led the army which received the submission of the Portuguese Algarve, and in the following year he was given the task of organising a naval expedition to North Africa (which did not, in the event, take place).

He commanded the relief force sent to Cadiz at the time of Drake's raid in 1587, and his prompt arrival undoubtedly saved the town from capture: the king himself commended him for it. And from the early 1580s until the end of his life (he died in 1615) he was much involved in the complex administrative business of fitting out and arming the ships of the trans-Atlantic flotas, and in the even more demanding task of procuring supplies and trained crews for them. Finally, and in some respects most important of all, he was the head of one of Spain's most aristocratic and ancient families.(59)

Whatever other failings Santa Cruz may have had in the tragic final months of his life, he had been a commander whose formidable prestige and authority inspired the unquestioning respect and obedience of his subordinates. In an age when social position was all-important, he was difficult to replace. If one of the abler squadron commanders - Recalde, perhaps, or Oquendo - had been appointed over the heads of his brother officers, sensitive veins of pride would have been deeply touched, and dissention would inevitably have followed. Medina Sidonia so outranked them all that none could feel - nor did they feel - any resentment at serving under him.

For all this, the duke was most reluctant to take command, and the reasons he advanced for being excused the appointment have been used, by some historians, to discredit him. "I have not the health for the sea," he wrote to the king's secretary, Juan de Idiáquez, on 16 February, "for I know by the small experience I have had afloat that I soon become sea-sick, and have many humours... the force is so great, and the undertaking so important, that it would not be right for a person like myself, possessing no experience of seafaring or war, to take charge of it. I have no doubt that his Majesty will do me the favour which I humbly beg, and will not entrust me to do a task of which, certainly, I shall not give a good account; for I do not understand it, know nothing about it, have no health for the sea, and have no money to spend upon it."(60)

Was Medina Sidonia really the ignorant, faint-hearted coward his own words seek to imply? Or were there deeper, unstated reasons behind his self-professed unsuitability for the appointment? When it came to the fighting in the Channel, and particularly during the bloody battles off the Flemish coast, nothing whatever was found wanting in the duke's abilities as a commander or in his personal courage under fire. We must therefore seek another explanation for his unwillingness to accept the appointment. Might it perhaps be that he knew he was the only man in Spain who could actually get the Enterprise under way and that, in consequence, the best service he could do his king was to hold back and so ensure the Armada would not sail at all? If this were the case, history has vindicated his judgement. But Philip's authority prevailed and Medina Sidonia, his gesture made, hurried to Lisbon.

In the three months which elapsed between the duke's arrival and the sailing of the fleet at the end of May something of a miracle took place. Under his firm but courteous direction, aided by a willingness to seek the opinion of his more experienced subordinates and his own prodigious capacity for work, the fleet was made seaworthy. Guns and ammunition were distributed (shot and powder quotas went up to the unprecedented minimum of 50 rounds per gun), the dismantled siege train and other military stores were packed into the holds, provisions and water were stowed according to a carefully planned turnover system, and the abysmal morale of the men was replaced by a pious fervour to sail.(61) Even the duke, it seems, had become cautiously optimistic about the outcome of the campaign.(62)

On 9 May 1588 a muster was held at Lisbon in which all the ships of the fleet were listed, squadron by squadron, with their tonnages, the number of guns each carried, their crew strengths, and the number of troops on board. The amount of roundshot, gunpowder, lead and match issued to each ship was also recorded. The list of ships was followed with a general break-down of the senior officers, specialist troops, and infantry units attached to the Armada. _Aventureros_ (gentlemen-adventurers) and _entretenidos_ (unattached officers) were included separately. The muster closes with a summary of the artillery, weapons, munitions, general equipment and provisions carried by the fleet.

This list was published at Lisbon before the Armada sailed, and various editions of it appeared throughout Europe within a matter of weeks.(63) The list is supplemented by a summary _relación_ issued by the duke of Medina Sidonia on 14 May.(64) Although it is unlikely that these lists are accurate in every respect they unquestionably provide a broadly reliable picture of the Armada's Order of Battle, which, in modern warfare, would have been a highly secret document. It must be supposed that the Spaniards publicised it in order to underline the reality of the fleet which was about to sail.

The 9 May muster and the 14 May summary have been combined to provide the Order of Battle table presented in Appendix 4. Each ship in the table has been given a serial number to which reference is made, where appropriate, within square brackets in the following text.

Chapter Two: The Armada Campaign, May-August 1588

Advance to contact, 30 May - 30 July

Only the weather could now delay the Armada's departure. After the muster on 9 May Medina Sidonia began moving his ships down-river past Belem, where they anchored to await a favourable wind. But the Atlantic weather, the duke reported on 14 May, was "as boisterous and bad as if it were December", and the fleet was still at anchor on 28 May, with a north-westerly gale blowing down the estuary.(1) Two days later the Armada was at sea, though its progress northward was tortuously slow because of the contrary winds and the poor performance of the hulks.(2) Another more serious problem was beginning to manifest itself. Despite Medina Sidonia's careful precautions at Lisbon the provisions were already beginning to go bad, and some were so rotten that they had to be jettisoned.(3). It took the fleet two weeks to struggle the 250 miles to Cape Finisterre, at which point the ships were ordered to clear their decks for the coming action.(4) But there was to be no fighting yet. The contrary winds persisted, and little further progress had been made when, on 19 June, Medina Sidonia held a Council of War at which it was decided that the whole fleet should put into Corunna for fresh stores and water.(5) By that evening the San Martín[1] and about fifty other ships had reached the harbour but the remainder, which included the galleasses, the clumsy hulks and Levanters, and

Recalde's squadron of Biscayans, stood off beyond the headland in the failing light intending to make their entrance at daybreak.(6)

During the night a violent south-westerly gale blew up, and the ships outside Corunna had to run north-eastwards with it. By the time these scattered ships had been gathered in from as far afield as the Scillies, and their damage repaired, fresh provisions and water stowed, and the fleet once again put in fighting order, a full month had elapsed.(7) Again Medina Sidonia's administrative skills and tireless attention to detail brought the Armada through another crisis, and again he felt constrained to write to the king, even more strongly than before, urging him not to continue with the Enterprise.(8) But Philip remained unpersuaded. The Armada was to sail from Corunna at the first opportunity, even if some of the missing ships had not yet returned.(9)

In fact, when the fleet did sail on 21 July almost all of the stragglers had rejoined and, at last, the weather had turned in the Spaniards' favour.(10) Five days of brisk southerly breezes brought the Armada across the Bay of Biscay to the latitude of Ushant, beyond which lay the entrance to the English Channel. Unfortunately there were some early casualties. Diego de Medrano's four galleys failed to weather the rolling Atlantic swells, and had to run for French ports; one, the Diana[129], was wrecked at the entrance to Bayonne. More unexpectedly, the 768-ton Biscayan capitana Santa Ana[13] also came to grief, and eventually sought shelter at La Hogue, on the eastern side of the Cherbourg peninsula, where she was to remain throughout the campaign.

On Saturday 30 July the Armada sighted the Lizard, and the fleet hove-to. The San Martín hoisted her crusading standard on the maintop, and fired a three-gun signal to summon a Council of War. A suggestion by Don Alonso de Leyva that an attack should be mounted on Plymouth was turned down by the Council; such a move would not help the fleet to achieve its main objective, and the entrance to the Sound was reported to be well guarded. In any case the attempt would be in direct contradiction to the king's orders. It was however decided that the Armada should proceed no further eastward than the Isle of Wight until firm communication had been established with Parma.(11) In spite of repeated requests for information which Medina Sidonia had sent to Flanders by fast pinnace there was still no up-to-date indication of the invasion army's state of readiness. The duke knew nothing of how Parma intended to link up with the Armada, nor of the extent of Dutch and English naval activity off the Flemish coast. Although the option of forcing the Solent was one which the king's instructions countenanced only *if* and *after* the Flanders rendezvous had failed, Medina Sidonia clearly felt that the rendezvous should be held to have failed if, for some reason, Parma was unable to keep it, and that if so it would be better to go for the Isle of Wight without first risking, to no good purpose, the shoals and other hazards of the Flemish coast. As events were to show, this reasoning was entirely sound, and Medina Sidonia took the precaution of communicating it to the king.(12)

The advance up-Channel began the following morning. "Our Armada placed itself in combat formation," runs the duke's entry in his diario of the proceedings, "and the flagship put abroad the royal standard at the foremast."(13) No first-hand plan of this formation has survived, although one undoubtedly existed. But a number of second-hand versions of the Armada's proposed battle array, evidently compiled some time before the fleet sailed, have been preserved.(14) They were included with intelligence reports sent to their governments by several Italian ambassadors and were based, presumably, on an official version issued to each ship along with a mass of other administrative instructions.(15) It was probably not even considered to be a confidential document (cf. the publicity given to the fleet's administrative order of battle). One of these copies - that sent to the Grand Duke of Tuscany by his ambassador at Lisbon on 18 May 1588 - is reproduced in Figure 1. This information can be augmented, and in many respects supported, by a short pamphlet published by Filippo Pigafetta at Rome some months later.(16) While these sources do not necessarily indicate the precise combat order which the fleet actually adopted on 31 July they represent the most detailed contemporary information we possess, and for that reason alone they deserve close study. At the very least we may glean from them pointers to the tactical intentions of the Armada's commanders, however much these intentions may have been modified by the situation which was actually faced on the eve of battle.

Pigafetta's description placed a screen of light craft two miles ahead of the main fleet to probe for the enemy. Their duty was to act as early-warning pickets, and if hostile forces were sighted they would fall back into the main body. The fleet itself was arranged in four divisions. First came a vanguard of twelve powerful vessels set in three ranks. The leading rank comprised the strongest ships of the Levant squadron, with Don Alonso de Leyva's <u>Rata Encoronada</u>[70] on the right and Martín de Bertendona's <u>Regazona</u>[68] on the left. The other two would be, in all probability, <u>La Trinidad Valencera</u>[72] and the <u>San Juan de Sicilia</u>[71], which were the next most senior units in the squadron. Behind them sailed the four galleasses, led by Hugo de Moncada's flagship the <u>San Lorenzo</u>[123]. The rear rank of the vanguard consisted of four Portuguese galleons, with the fleet <u>capitana general</u>, Medina Sidonia's <u>San Martín</u>[1], placed second on the right. A space of fifty paces separated the ranks, and a gap equivalent to the width of two ships divided each vessel from its neighbour. The advantage of this arrangement, according to Pigafetta, was that it left several tactical options open: the front rank could attack on its own, supported by the other two; or the second could move up into the gaps and attack in line with the first, supported by the third; or, indeed, all three ranks could form line abreast.

Half a mile astern of the vanguard came the second division, or main battle. Its first rank was an 18-strong line of warships, set two ship-widths apart. On the right (though Pigafetta also places this ship in the vanguard) was Bertendona's Regazona[68], and on the left the Portuguese San Luís[5]. Four galleys under Diego de Medrano came next. Bringing up the main battle's rear were eight members of the Andalusian squadron under Pedro de Valdes in the Nuestra Señora del Rosario[43], supported by twenty armed caravels.

From each flank of the main battle, and set 300 paces (540m) from it, extended the last two divisions, which formed what Pigafetta called the "horns" of the formation. Each horn consisted of a front line of 15 fighting ships, set the regulation two widths apart, although unlike the vanguard and main battle they did not sail in line abreast but in forward echelon, the bows of each being in line with the mainmast of its outer neighbour. The flagships occupied the seaward stations at either end; on the right horn, Juan Martínez de Recalde's San Juan de Portugal[2], and on the left Diego Pimentel's San Mateo[6]. A hundred paces (180m) behind each horn's front line lay its supports of pinnaces and hulks arrayed in three ranks; in the first, seven pinnaces twenty paces apart, in the second six hulks, and in the third four more pinnaces.

Pigafetta makes it clear that this fleet arrangement was based on the well-tried ordering of a galley force in battle array, and indeed likened it to the famous "eagle" formation with which the Ottoman navy had out-manoeuvred the Holy League's fleet at Prevesa in 1538.(17) The vanguard was the head, the main battle the body, and the two flanking divisions the wings. He also stressed that the supposed crescent-shape of the formation, so frequently portrayed by writers and illustrators from his day to ours, derives from the ignorant imagination of landsmen. A fleet of ships cannot, he pointed out, maintain a curved formation: an order based on right lines is the only kind that can be maintained.

After describing the Armada's formation, Pigafetta went on to analyse its tactical strengths. Its wide front would make it almost impossible, he thought, for an enemy to out-manoeuvre it and so attack its rear or flanks, while its elasticity would give it the capacity to encircle a foe who attempted to approach it from the front. The powerful vanguard, which incorporated the four galleasses, was he believed a sensible development of an idea which had proved successful at Lepanto, when a forward screen of galleasses, set ahead of the main battle, had disrupted the enemy's attack formation before it had become seriously engaged.(18)

Pigafetta's descriptive analysis of the formation, and the Tuscan ambassador's sketch, clearly demonstrated the underlying purpose for which the fleet was designed. Its sole function was to advance towards its objective in such a way as to deny an enemy the opportunity of preventing it from doing so. It was not, in a purely naval sense, an aggressive formation, but it would be a gross misjudgement to think of it as fundamentally defensive. The military strategy which underlay it was clear-cut, single minded, and wholly offensive.

While it seems almost certain that Pigafetta's description and the ambassador's sketches were based on an official formation plan, we have no means of knowing the date of the original, or to what extent it may subsequently have been modified. Some further information can, however, be extracted from a document published by Duro, for which he gives no date or provenence but which can be assigned, on internal evidence, to a date later than 7 January 1588.(19) The document contains a detailed allocation of forty front-line ships to the right and left horns (<u>cuernos</u>) of the formation. That it does not refer to the fleet as it actually sailed is clear from the inclusion of three ships which did not participate in the final muster, but the fact that the rest did merits its transcription in full. The serial numbers of those ships which are listed in the Lisbon muster are added in brackets.

CUERNO IZQUIERDO

San Francisco	P	[8]
Bertendona	L	[68]
Anunciada	L	[73]
Prodoneli	L	[74]
La Visón	L	[76]
Santistena	B	[?57]
Salvador	B	[56]
Santandres	L	
Zabra Julia	P	[12]
Irun Grande	H	[?<u>Gran Grifon</u>]
San Pefro Mayor	H	[85]
Perro Marino	H	[80]
Ventura	H	[94]
Santa Bárbara	H	[95]
Santa Bárbara	B	[59]
San Buenaventura	B	[60]
N.S. de Begoña	C	[37]
San Juan de Fernandomo	C	[40]
San Medelín Celidón	C	[35]
N.S. de Barrio	C	[34]

<u>BATALLA</u>

CUERNO DERECHO

Juan Martínez	P	[2]
San Mateo	P	[6]
Santiago	G	[15]
Belen	G	
La Caridad, Inglesa	Pat	[102]
La Magdalena	G	[18]
San Juan	G	[19]
María Juan	G	[61]
La Manuela	G	[21]
Santa María	G	[58]
El Gato	H	[98]
San Gabriel	H	[100]
Falcón Blanco	H	[81 or 89]
Santandres	U	[90]
Sanson	H	[86]
La Trinidad	C	[38]
San Pedro	C	[29]
Capitana vieja de Oquendo	B	[?55]
Zabra Agusta	P	[11]
San Pedro Amarás	A	

A = Andalusia; B = Biscay; C = Castile; G = Guipúzcoa; H = Hulks; L = Levant; P = Portugal; Pat = Pataches.

Some of the ships, notably the Biscayans and Guipuzcoans, are not assigned to the squadrons with which they ultimately sailed. Not all of the attributions are certain, but they are not worth individual discussion; where the doubt is considerable I have inserted a question mark.

On the face of it, then, this document appears to be part of a written formation plan drawn up not long before the fleet sailed. There must also have been a complementary list setting out the stations of the main battle (batalla), as the heading itself indicates. But even without this additional information we can draw a number of significant conclusions. First, in one fundamental respect, the Spanish version differs from the Italian ones. Instead of four divisions there were only three: a main battle and two horns. That this arrangement was the one in which the Armada actually went into battle is confirmed by the Spanish accounts of the fighting. The most positive assertion comes from an unsigned relación which states that "our fleet was divided into three bodies: the vanguard, commanded by Don Alonso de Leyva; the main battle, under the capitana [Medina Sidonia]; and the rearguard, under the almiranta [Recalde]."(20) Medina Sidonia himself, writing to the king just after the fleet had left Lisbon, confirms this arrangement: "I have taken every precaution," he writes, "as will be seen from the formation I have caused to be adopted. Either of the two horns of our battle formation, with their supports, and two of the galleasses which accompany the first four ships, would be able to cope with one of the enemy's fleets; I, with the rest of our vessels leading, could deal with the fleet in front of us, my centre being supported by the vessels I have appointed for the purpose, and the other two galleasses which are attached to my flagship."(21)

Modern historians of the Armada have based their interpretations of the fleet's formation, as far as I know without exception, on the assumption that the territorial squadrons listed in the Lisbon muster were discrete tactical units which sailed in regular sub-formations under their respective commanders. The Italian sources and the Spanish list, however, demonstrate no such regular groupings. On the contrary, individual members of the various squadrons are scattered apparently at random throughout the fleet. This must surely indicate that the squadrons were administrative units rather than tactical ones. Other evidence supports this conclusion. Diego Flores de Valdes, for example, was the administrative commander of the Castilian squadron, although he never set foot during the campaign on board his capitana San Cristóbal[27]. This was because his tactical function was as chief-of-staff to the duke of Medina Sidonia, a post which demanded his personal presence on board the capitana general, the San Martín[1].

This apparent mobility of command, and the divorcing of administrative from tactical responsibilities, also explains why several ships, not necessarily flagships or vice-flagships, are consistently named by the Italian sources and given precise locations within the formation, while the rest are simply lumped together without any attempt to identify them beyond a very broad definition of ship-type: great-ship, hulk or pinnace. Possibly this was intended simply to underline the presence of the most illustrious officers, and certainly the named ships are those of senior or notably dashing commanders. A more satisfactory explanation for their special mention may, however, be advanced. As we shall see when we come to consider the battles, this relatively small group of named vessels crops up again and again in accounts of the fighting, particularly in Medina Sidonia's own diario. These ships seem to have borne the brunt of the engagements throughout the campaign, and they apparently moved freely to any threatened part of the formation.

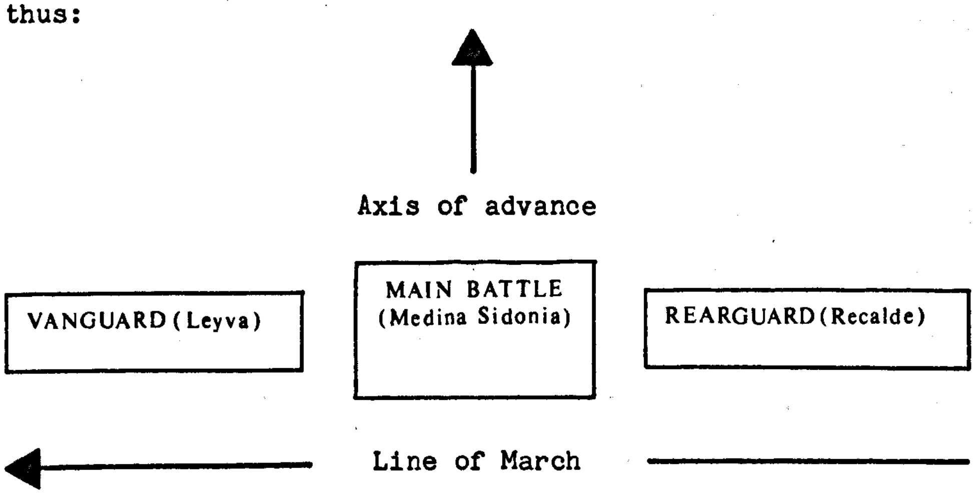
We may, perhaps, see these ships as units specially authorised, no doubt within clearly defined limits, to break station on their own initiative in response to any attack on the formation as a whole. This, if so, would be in marked contrast to the clear responsibility of the rest of the fleet, which was to hold formation at all cost: indeed, one erring captain was to hang for failing to do so, while several others narrowly escaped the same fate.(22)

The argument can be carried further. If we accept the division of the fleet into these two categories, the formation-keepers and the free-lance troubleshooters, we can begin to understand something of the Armada's command structure, an aspect of the campaign which has consistently puzzled modern students of the event. How did Medina Sidonia actually control his great fleet during the battles? His General Orders, which were issued at Lisbon before the Armada sailed, make no mention of a chain of command, and contain only the most rudimentary signalling instructions.(23) Naval signalling in the sixteenth century in any case played little or no part in the actual conduct of fleet engagements.(24) What the duke did lay down, however, was that each day before nightfall it was the duty of all the fleet's principal officers to communicate with the flagship, by sending a _patache_ or ship's boat to receive orders. He also arranged for most of Hurtado de Mendoza's twenty-two _pataches_ or _zabras_, which made up the Armada's communications squadron, to be stationed close by the flagship. They would thus always be available to convey, if necessary to several quarters at once, any further orders that were required.(25)

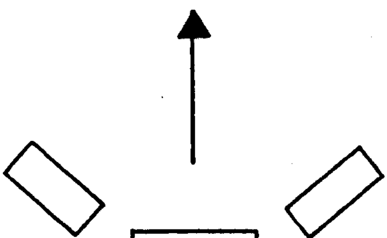
So, it would seem, every ship in the fleet had an overriding duty to keep to its appointed station on the flagship unless the flagship directed otherwise. There were, in effect, no subordinate commands. In this way the duke could direct the defence of the formation, without setting its overall order at risk, simply by moving powerful and well-officered ships to any position he felt appropriate, and by giving them whatever freedom to act he judged fit. Thus, for example, when Don Alonso de Leyva was put in charge of an augmented rearguard in the reorganisation of 1 August, we do not later hear of him actually controlling the rearguard as a coherent force under his personal command. Most of the ships simply plodded on, keeping station, as before. But, thereafter, Don Alonso's great carrack, the Rata Encoronada[70], was to be found wherever the fighting around the rearguard was hottest, blasting away in concert with, but not commanding or commanded by, half-a-dozen or more of his fellow free-lance troubleshooters who had evidently moved from elsewhere in the fleet to support him.

Whatever tactical advantages this system may have had - and in the circumstances they were probably considerable - it also neatly solved a less obvious but no less crucial problem of command. As we have seen, Medina Sidonia owed his appointment, in part at least, to his social position. He far outranked, in terms of nobility, every other officer in the fleet, and no one could object on social grounds to serving under him. But to have placed subordinates in positions of direct authority over their brother officers would have created insuperable problems of precedence, and this factor alone ruled out a hierarchal command structure. Indeed, in his relationship with one senior officer, the fiery Don Hugo de Moncada of the galleasses, even Medina Sidonia was to experience difficulties of this kind.

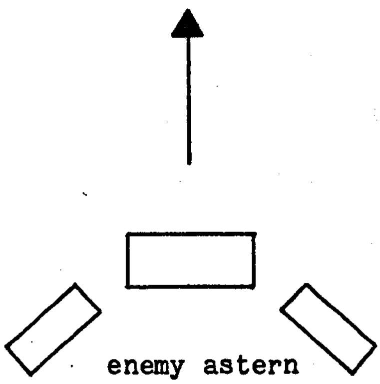
Another question we must consider is that of the technical terms used by the Spaniards themselves in describing the Armada's formation. In what was to follow, Medina Sidonia's diario makes frequent mention of both vanguard and rearguard, but in a way which best makes sense if we understand the terms as referring not to the front and rear of the formation but to the flanking horns, the one on the left being Leyva's vanguard and that on the right Recalde's rearguard. Corbett first made the ingenious suggestion that this apparent contradiction can be resolved by the application of contemporary military nomenclature to distinguish between the marching- and battle-orders of the fleet.(26) On the march, an army's main battle was preceded by its vanguard and followed by its rearguard. In order to form line of battle the vanguard would normally fall back on the main battle's right flank (the post of honour) while the rearguard would take up position on the left. If the threat came from the flank, however, the same disposition only required each man to turn half left or right. A right turn would, of course, place the vanguard on the left of the line, which though technically incorrect was presumably acceptable on the grounds of simplicity. If we imagine the Armada sailing north from Ushant in its order-of-march, Leyva leading, Medina Sidonia next, and Recalde bringing up the rear, we can easily see how, on 31 July, Medina Sidonia brought it smoothly into battle-formation for the advance up-Channel. All the ships simply swung 90 degrees to starboard, facing east, so that Leyva's ships formed the left horn, Recalde's the right, and Medina Sidonia's the main battle. In diagramatic form we can represent the moves thus:



and we may further deduce that the following tactical responses were made according to the position held by the enemy:



enemy ahead



enemy astern

The strength of this formation lay in its ability to defend itself without halting its advance. A force attacking from the rear could be flanked and ultimately surrounded by the horns, while any attempt to impede its progress from the front could be countered by swinging the horns forward. Several related points deserve consideration. The first is the very considerable degree of seamanship and discipline with which the Spaniards adopted and held this large and complex arrangement of ships whose sailing qualities varied but were generally poor. Next we should note that the formation was, to some extent, flexible, particularly with regard to the movement within it of the twenty or so specially assigned troubleshooters. Such movements normally took place, as the accounts of the fighting demonstrate, within the formation and not outside it. When, for example, we hear of Medina Sidonia's San Martín[1], whose station was near the front of the main battle, coming to the aid of ships at the rear of the formation, we need not suppose (as many writers have done) that she had ponderously worked her way round the outside of the fleet; all she would have had to do was to shorten sail and fall back through it. In this connection we should note that as a group the troubleshooters tended to be ships with a superior margin of performance over the progress of the fleet as a whole, which was naturally restricted to that of its slowest member. They could therefore regain station from a rearward position without slowing down the general advance.

Finally, we should consider the fleet's density. This clearly varied according to circumstances, and we have little hard evidence to help us. Pigafetta's two ship-widths of lateral separation gives the formation as he described it an overall front of four miles, while Camden, who was probably working from eye-witness accounts, tells us that the Armada in battle-array covered seven miles from flank to flank.(27) Camden may of course have been exaggerating, and in any case the figure cannot have been more than an educated guess on the part of his informant, but nonetheless his estimation seems entirely reasonable. Pigafetta's spacing should not, I think, be taken literally, since he makes it clear that the spacing is intended to allow two ships actually to take station in each gap, for which a greater provision than the minimum required by their combined beams would obviously be necessary. If we postulate a flank-to-flank front of fifty ships with an average beam of thirty-five feet, and allow room between each two ships for two more to be interposed with a full beam's clearance on either side (which is still uncomfortably close) the formation would span almost exactly six miles. It was certainly much more open than the crowded near-contemporary representations of it, no doubt for good artistic reasons, often suggest.

The fleets in contact, 31 July - 8 August

We are handicapped in understanding much of the action in the Channel by the paucity and partiality of our sources. A large-scale naval engagement is, both for those who undertake it and those who seek to interpret it afterwards, a confusing business at the best of times. Each participant only sees glimpses of what is happening in his immediate vicinity, a vicinity which itself represents a tiny moving fragment of the battle as a whole. Nor is he consciously trying to observe those matters whch will most interest subsequent historians. His attention is absorbed by compelling and often dangerous duties; his senses may be dulled by shock, noise, smoke, discomfort and fatigue; and his recollection of events will almost inevitably be coloured by the excitement, fear, prejudice and uncertainty which surrounded them. The historian of a modern battle can generally draw on an abundance of complementary sources, but, even so, he will rarely find it easy to extract a clear-cut and incontrovertible analysis of the event from the matrix of confusion and complexity which surrounds it. The Armada historian is on even shakier ground. His battle was spread over a wide expanse of sea, and no one had a bird's eye view of it; few of the participants left accounts of their actual experiences in the fighting; and both sides were fighting a kind of action which was without precedent in naval warfare, and for which no guidelines had been formulated or fighting instructions laid down.

In general the Spanish sources are fuller and more reliable than the English ones. Medina Sidonia's diario is, as far as it goes, a straightforward account of the proceedings written by a dutiful and honest man. The duke's account is supported and augmented by several other relaciones from the Spanish side, notably those of Alonso Vanegas, who sailed with the duke aboard the San Martín, or Pedro Coco Calderón of the hulk San Salvador[79], and of an anonymous officer on board the galleass Zuñiga[124]. To these may be added a number of other sources, of varying degrees of consequence and reliability.(28) The only English account of substance is an unsigned Relation of Proceedings which is probably Lord Admiral Howard's "more particular relation" with which he proposed to supplement the "brief abstract of accidents" sent to Walsingham on 7 August (O.S.).(29) This account formed the basis of two Italian manuscripts, dedicated to Howard and Drake respectively, which are now in the British Library.(30) The report is certainly based on official sources, and its general value is considerable, although it is lacking in detailed descriptions of the fighting and, in particular, of the tactics employed.

In attempting to describe the fighting which took place in the Channel and off the Flemish coast I have not therefore attempted to produce a complete narrative; nor have I considered, except in the most general way, the movements and actions of the English fleet. My aim has been to seek information which relates most directly to the achievements and failures of the Spanish side, for it is upon these matters that the archaeological evidence will most directly bear.

Although the fleets were in almost continuous contact from 31 July to 8 August the fighting can be divided, for descriptive convenience, into five distinct phases.

Phase I: the action off Plymouth, 31 July

On the evening of 30 July, as the Armada proceeded eastwards within distant sight of the coast, elements of the English fleet were observed working their way to windward out of Plymouth. A solitary English pinnace, sent to reconnoitre Medina Sidonia's disposition, approached the Spanish fleet and there was some ineffectual cannonading. The following morning it became clear that the English fleet under Lord Admiral Howard had skilfully cut across the front of the Armada under cover of darkness and beaten its way westward to gain the tactical advantage to windward and seaward of the Armada's right horn - the rearguard under

Recalde. This would have been the occasion for the Armada to adopt, if it had not already done so, the trailing horns posture appropriate to an enemy threat from the rear. Such a formation would doubtless have appeared, to an observer close to sea level, as the great crescent which Camden described and the Adams charts depict.(31)

The first formal shot of the campaign was delivered as an old-fashioned gesture of etiquette on the part of the Lord Admiral. He sent an 80-ton bark, appropriately named _Disdain_, to within hailing distance of the Armada's main battle to deliver his 'defiance' - a single token shot discharged into the towering midst of the Spanish fleet. Then, the formalities of warfare observed, Howard launched his preliminary attack.

No Englishman has described the formation in which this attack was delivered, and the English sources offer not the slightest circumstantial clue. But, whatever they were, Howard's tactics surprised and perturbed the Spaniards. Both Calderón and the anonymous author of another _relación_ describe the English fleet as being arrayed _en ala_, while Medina Sidonia commented upon its good order. The duke added that the enemy ships were "extremely well armed, rigged, and handled". Now _en ala_ is a Spanish military term which means 'in file; in a line', and what the Spaniards were witnessing was, in all probability, the first true line-astern attack in the history of naval warfare.

This tactic brilliantly exploited the mobility and firepower of the broadside-armed sailing ship, and presaged the end of rigid line-abreast fleet formations of which the Armada itself was one of the last examples. Its effectiveness lay in its simplicity and adaptability. One ship (usually the flagship) led the attack, and the rest followed in a line with the vice-flagship at the rear, thus bringing each broadside to bear in succession. No rigid formation-keeping was required, and the leader could move as he willed with the rest of his force snaking behind him. As long as each ship kept station on the stern of the vessel to its front the line's cohesion could not be lost, however erratic the flagship's path might be. The whole line, moreover, could be turned about on the flagship's command, to recross the enemy led by the vice-flagship and so present its second broadside. These movements could be carried out as many times as were necessary to keep the enemy, as Sir Walter Raleigh described in his General Orders of 1617, "under a perpetual shot. This you must do," he added, "upon the windermost ship or ships..."(32)

The windermost ships of the Armada were those which lay at the outer ends of its trailing horns. Howard's galleons stormed across the Spanish rear, engaging first Leyva's vanguard and then, on the far wing, Recalde's rearguard. Some ships of the rearguard broke station in the face of this assault, and sought shelter among the main body, but

Recalde himself, supported by his Biscayan _almiranta_ _Gran Grin_[14], stood firm, and for some time most of the English firepower was directed against these two ships.

In their subsequent reports, however, neither side made much of this action. Drake merely commented: "The 21st [O.S.] we had them in chase, and so coming up unto them, there passed some cannon shot between some of our fleet and some of them." Hawkins described the same incident as "some small fight".(33) During the whole engagement Recalde's _San Juan_[2] suffered only twenty casualties, two shots lodged in the foremast, and some stays parted; small enough penalty, it would seem, for two hours of sustained gunfire by the most powerful ships in Elizabeth's navy. But it was long-range gunfire. Pedro de Valdes, commander of the Andalusian _capitana_ _Nuestra Señora del Rosario_[43], tells us that little harm was done "because the fight was far off".(34) Clearly the disciplined formation of the Armada, and its evident strength, was having the effect for which it had been designed: the English were not prepared to close, and beyond point-blank range their guns could do little damage. "We durst not adventure to put in amongst them," wrote Lord Admiral Howard in his report on the first day's fighting, "their fleet being so strong."(35) Henry Whyte, a volunteer aboard the _Mary Rose_, put the matter more bluntly. "The majesty of the enemy's fleet, the good order they held, and the private consideration of our own wants did cause, in mine opinion, our first onset to be more coldly done than became the value of our nation and the credit of the English navy..."(36)

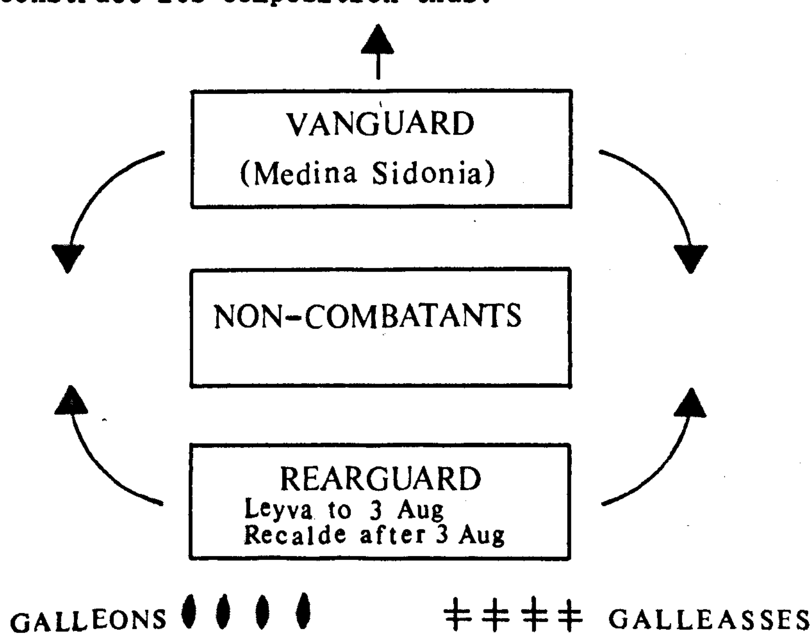
Recalde and his loyal supporter Gran Grin[14] were finally extricated by the San Martín[1] and San Mateo[6], which had fallen back through the fleet to support their beleagured rearguard. By mid-day the Armada, its formation regained, was able to proceed on its way. There followed, in quick succession, two serious mishaps. At 4 p.m. the Guipuzcoan San Salvador[56], one of the most heavily armed ships in the fleet, was suddenly rent apart by a tremendous explosion in her powder magazine, which blew out two decks and the sterncastle.(37) The duke halted the Armada in its tracks, went himself to her aid, and had the fire extinguished. The wounded were taken off, and the damaged ship brought into the safety of the fleet. In the course of these tricky manoeuvres the Nuestra Señora del Rosario[43], capitana of Pedro de Valdes, collided with her Andalusian sister Santa Catalina[49], breaking her bowsprit and foremast. Crippled, she lay to. Two of the galleasses attempted to get a hawser to her, but failed because of the heavy seas. Medina Sidonia then offered to take off her crew but Don Pedro, who believed he could repair the ship, refused to leave. The duke, torn between the Castilian code which demanded that he should stand by a comrade in distress and his clear duty to continue the Armada's advance, quite properly chose the latter. Don Pedro and the Rosario were abandoned to the enemy. Both were later captured by Drake, who deserted his post as the leading English ship the following night to pick up this tempting prize.(38) Even Sir Francis's most fervent apologists concede that his sole motive was to acquire booty, with which the <u>Rosario</u> was amply provided. The outspoken Martin Frobisher later declared that Drake had thought to "cozen us of our shares of 15,000 ducats", and threatened to make him "spend the best blood in his belly".(39) Don Pedro, who had surrendered without firing a shot, later became something of a celebrity in London. He was eventually ransomed. The <u>Rosario</u>, minus her treasure but with most of her guns still aboard, was brought to Torbay.(40)

<u>Phase II</u>: <u>The action off Portland, 2 August</u>

In the face of a strong English fleet to windward, and in spite of two unexpected and serious accidents, Medina Sidonia had demonstrated during his first day of action the tactical and strategic strengths of the Armada, and his own skill in commanding it. The fleet remained more or less intact, and the delay to its progress had been slight. The rendezvous with the Army of Flanders was drawing closer. With that crucial meeting in mind the duke dispatched, on the afternoon of 1 August, yet another <u>patache</u> informing Parma of his situation, urgently requesting information about the proposed link-up.(41) Medina Sidonia still had no confirmation that the invasion force was ready, and he had no idea at all as to how Parma intended to bring it out.

No fighting occurred that day as the two fleets, in wary visual contact with one another, progressed eastwards towards Portland Bill. The duke made use of this respite to reorganise the Armada's formation in the light of the previous day's experiences. Against more nimble ships which clearly did not intend to close to boarding range, the extended horns of the vanguard and rearguard had offered little tactical advantage, yet had proved vulnerable to isolation and attack. Accordingly he joined the two horns into a single body, reinforced by the galleasses and four Portuguese galleons. He also created a new tactical formation. To each of the heavily armed Levanters *Rata Encoronada*[70] and *Trinidad Valencera*[72] were attached a pair of galleasses, so establishing two very heavily-gunned reserve units which could be deployed, by using the towing abilities of the galleasses, irrespective of the wind.(42)

These changes were observed by the English, who from now on describe the formation as a 'plump' or 'roundel'. We may reconstruct its composition thus:



With this change of formation came, apparently, a change of nomenclature. The fleet, in a sense, had reverted from line-of-battle to line-of-march, and so, as Medina Sidonia himself made clear, Leyva's old vanguard and Recalde's rearguard now formed a single coherent rearguard whose duty, as laid down by the duke, was to "withstand the enemy and prevent him from standing in the way of our junction with the duke of Parma." Medina Sidonia's old main battle, at the head of the line of march towards Flanders, now became the vanguard. The hulks and other non-combatants, as before, occupied a relatively safe position at the centre of the formation.

On this day of re-grouping, Medina Sidonia performed another necessary task. The day before there had been a serious breach of formation discipline when some of Recalde's right horn had deserted their posts in the face of the English assault. Six _pataches_, each with a sergeant-major, a provost marshal, and a hangman aboard, now delivered to every ship in the fleet clear written instructions which defined its exact station in the reorganised formation. Henceforward any captain who left his assigned position without authority would be liable to summary execution.(43)

During the night of 1/2 August the wind fell away, and both fleets were becalmed some miles west of Portland Bill. But as dawn broke on the Tuesday a fresh breeze sprang up from the east to give the Spaniards the weather gauge. Howard saw the danger and led his line of galleons, close-hauled, towards the north-north-east in an attempt to place himself between the Armada and the land. With his advantage of wind Medina Sidonia was easily able to block this attempt, and force the English ships to come about in a reach towards the south-south-west. This gave the troubleshooters of the strengthened Spanish rearguard their chance to intercept. For the first time since the fighting began some of the larger ships now came to close quarters - to half musket shot or less - and a heavy artillery fight developed. Bertendona's Regazona[68] pressed the English flagship (or, at least, the ship Medina Sidonia took to be the flagship), clearly intent on boarding, but his adversary turned seaward and opened the range. This general fight continued for more than two hours and was conducted, in Camden's descriptive phrase, "with confusion enough."(44) Certainly the surviving accounts hint at no definite tactics on either side beyond a strong Spanish desire to grapple and board and an equally strong English one to avoid it.

While this action was taking place well to seaward of Portland Bill a separate battle had developed under its lee. When, at dawn, the English fleet had abandoned its attempt to weather the Armada, the seven leading ships found themselves too far inshore to close-haul seawards. Six were medium-sized armed merchantmen of the London squadron, and the seventh was Martin Frobisher's heavily gunned Triumph, the largest ship in the English fleet. To the Spaniards, Frobisher was an irresistable target. Medina Sidonia, whose primary concern was with the engagement developing around his rearguard, sent Don Hugo de Moncada with his four galleasses to deal with Frobisher's isolated force.

The attack was not a success. Earlier in the day Moncada had, according to some accounts, sought permission to engage Howard's Ark Royal but, it was alleged, Medina Sidonia had declined to give it on the grounds that only the commander-in-chief could in honour challenge the English flagship. Whether or not this was so, it is clear that there was ill-feeling between the two and when, some time later, the duke thought the galleasses tardy in pressing home their attack he sent an officer to the flag galleass to "say aloud to Don Hugo de Moncada certain words...which were not to his honour".(45) Moncada had, in all probability, experienced difficulties with the tide race which runs between Portland Bill and the Shambles reef and toward which, no doubt, the wily Frobisher had purposely lured him. At any event the galleasses' attack, when it came, was disappointingly ineffectual. Their oar-given mobility, formidable enough in theory, was itself highly vulnerable. A well directed concentration of English fire on the rowing banks - upon which even a light shot at long range could wreak dreadful carnage and even greater confusion - forced the galleasses to revert to sail power, under which they proved markedly inferior to Frobisher's galleons.

At this point Howard and a number of his more powerful ships disengaged from their combat with the Spanish rearguard and took advantage of a southerly breeze to move in support of Frobisher. Medina Sidonia responded by bringing down his vanguard and a general mêlée developed. In the course of it the San Martín discharged, according to Calderón, eighty shots from one side alone, while in return, he estimated 500 English rounds were fired at her, some of them striking her hull and rigging, carrying away the flagstaff and one of the mainmast stays. Lord Admiral Howard confirmed that in this action a "terrible value" of great shot was expended.

This being so, it is remarkable how little damage was inflicted by either side upon the other, even though at times the range appears to have been 100 yards or less. The injury caused to the heavily engaged San Martín was, by any reckoning, minimal. Both commanders must have been surprised at the disappointing equation between the amount of precious roundshot expended and the damage it was able to cause. For Howard, the moment was one of acute crisis. The fight, as Sir John Hawkins reported to Walsingham, had been "sharp and long", and in it had been spent "a good part of our powder and shot." It was not, he considered, "good to deal with them [the Spaniards] any more till that was relieved."(47) More worrying still must have been the fact that the English artillery, having expended all that shot at moderately close range, had proved incapable of inflicting serious damage on the Spanish ships. But it was also clear to Howard that if his ships came too close they would run the risk of being boarded by the Spanish troops, leading to almost certain defeat. Yet again, in strategic terms, the Armada had proved itself the superior force. As soon as the battle was over, and the English fleet at least temporarily neutralised by its ammunition crisis, it simply shook itself back into formation, its component parts virtually undamaged, and continued the eastward advance.

Phase III: The action off the Isle of Wight, 3/4 August

The Spanish strategy did not depend, however, solely on the continuing progress of the Armada. To succeed, the link-up with Parma had to be effected. It will be recalled that the Council of War aboard the *San Martín* on 30 July had decided that until arrangements for the rendezvous were clear, and Parma's readiness assured, the Armada should proceed no further than the Isle of Wight. Once east of this point the fleet would effectively be committed to the Flanders rendezvous: to beat back westwards in the teeth of the prevailing weather, with the English fleet to leeward, was unthinkable (except, of course, to Philip II). There can be little doubt that by the evening of 2 August, with the Isle of Wight looming on his port quarter, Medina Sidonia was seriously considering a move into the Solent. Unfortunately we have no record of the duke's thoughts or intentions at this point, though he clearly recognised the choice open to him. So, evidently, did his adversaries.

But what could Howard do to prevent such a move? His strategy, insofar as he had one, was to cut out and surround individual members of the Spanish fleet, to "pluck their feathers little by little", as he put it.(48) On the morning of 3 August, having obtained some meagre replenishment to his ammunition stocks, an opportunity for him to do just this presented itself.

As dawn broke a large ship was observed trailing behind the seaward flank of the Armada, a few miles off the dangerous western entrance to the Solent. The straggler was El Gran Grifón[78], capitana of Gómez de Medina's supply-hulks, and although the majority of these clumsy ships were non-combatants their nobly-officered flagship seems to have been one of the fleet's mobile troubleshooters. Those English ships closest to her crowded on sail to catch the light morning airs and cut her off. A nimble and powerful galleon, which is nowhere specifically named but which the balance of probability suggests was Drake's Revenge, glided swiftly abeam the wallowing Grifon and gave her a broadside at close range, swiftly came about and discharged another, and finally crossed her stern to rake her at half-musket shot. It was a devastating example of the mobile tactics which individual English captains were learning by instinct and experience and which, in combination with the line astern formation, foreshadow the fleet tactics which two centuries later would win Trafalgar. In 1588, however, such innovative action and skillful seamanship could not in themselves defeat a determined enemy. Grimly the Grifón hung on, struck by at least forty roundshot, her decks crowded with soldiers who, although taking serious casualties themselves, remained capable of boarding and carrying any English vessel which came too close.(49) The incident neatly illustrates the strength of the Armada as a whole: it might be battered but it could not be destroyed; and yet, unless it was destroyed, its essentially military potential remained as strong as ever.

As the fight developed, the whole Spanish right rear became engaged, and Medina Sidonia sent in the galleasses to extricate the damaged Grifón. Having done so, he gave the signal for a general engagement, at which the English drew off, clearly intent on delaying the Spaniards rather than on precipitating an all-out battle. The duke therefore turned his ships about, and continued on his way.

The next stage of the campaign was a crucial one, although unfortunately neither side has left a full or entirely comprehensible account of it. But the key to understanding what subsequently happened is the Armada's position close to the eastern entrance to the Solent; now, if at all, Medina Sidonia had to put his alternative plan into effect. His dilemma was not an easy one to resolve. Although the king's instructions on the matter had been explicit, that an attempt on the Isle of Wight could only be made if for some reason the rendezvous with Parma had failed, in a sense that meeting had already failed, inasmuch as no practical arrangements for putting it into effect were yet known to the duke. Since, in the event, the Isle of Wight option was not successfully prosecuted, we shall never know for sure whether the Spaniards seriously meant to try it, for Medina Sidonia's _diario_ is understandably silent on the point: if he had made the attempt, and failed, it is expecting too much even of his honest nature that he should have admitted it. But if we assume that the Spaniards did intend to bring the Armada into the Solent on 4 August, much of what followed makes sense.

There are signs, too, that the English recognised the danger. On the evening of 3 August, after the fleets had disengaged, Howard ordered a major reorganisation of his forces.(50) Until then his fleet had been divided into no discernable groupings, and indeed gave the impression of having been little more than an ad hoc agglomeration whose members, apart from a general obligation to support their admiral's flag, were expected to act as their individual circumstances best dictated. This apparently haphazard arrangement might have served well enough in the confusion of a general fleet action, but it could hardly have been employed to secure a wider strategic aim - in this case, to deny the Spaniards entry to the Solent.

Accordingly, Howard held an urgent Council of War aboard the Ark Royal, at which it was decided to organise the fleet into four quasi-independent squadrons under the respective commands of the Lord Admiral, Drake, Hawkins and Frobisher. These squadrons, we may suppose from subsequent events, were each given specific tasks which, taken in conjunction, amounted to a co-ordinated plan to drive the Armada safely eastward of Selsey Bill.

At dawn on 4 August, as the Adams charts clearly depict, the new squadron formations were in being and poised against the Armada's rear. During the night two Spanish ships, the Portuguese San Luís[5] and the Andalusian Santa Ana[48], had lagged behind, and, like El Gran Grifón the day before, presented the English with an obvious target. But this time there was no wind. Hawkins, whose squadron was closest to the Spanish stragglers, lowered his ships' boats and moved to the attack under tow. Medina Sidonia responded by sending in three of the galleasses, one of them towing Leyva's _Rata Encoronada_[70] for additional fire support. Slowly the ranges closed, and the guns began to fire. The galleasses were now the main object of the English attack, and a number of hits were scored. One was seen to list, another lost her lantern, and a third received damage to her prow. But these modest claims, which came from the English side and are therefore likely to be over- rather than under-estimates, indicate that the damage inflicted by the English artillery was again slight. In any case it failed to prevent the galleasses from completing their task, for they were able to take the _San Luís_ and _Santa Ana_ in tow and withdraw from the action. At this point a south-west wind sprang up, and the sailing ships on both sides were again able to manoeuvre.

While the fleets had been becalmed Frobisher's squadron, which was stationed inshore, was carried by tidal drift north of the Armada's left wing, so imposing itself between the Spaniards and the Solent. This move, whether or not intentional, was dangerous: as had happened off Portland, when the wind came Frobisher found himself cut off and to leeward of the Spanish vanguard. The _Victory_ now became the centre of the action as Medina Sidonia and his powerful supports moved to attack her while Howard bore down from windward to her aid. Frobisher launched his ship's boats in an attempt to tow himself clear of the danger but then the wind freshened and the _Victory_ was able to escape under sail. "She got out so swiftly," wrote Purser Calderón in despairing admiration, "that the galleon San Juan and another quick sailing ship - the speediest vessels in the Armada - although they gave chase, seemed in comparison with her to be standing still."

These moves on the part of the English did nothing to deny the Spaniards entry to the Solent; if anything, they left it more open than before. And here our main sources all but desert us. All we know for sure is that by the end of the day the Armada was well clear of the Solent and heading east. Medina Sidonia and Calderón both imply that some further action had taken place, but beyond stating that the Armada's good order remained unimpaired they do not elaborate. A clue to what had happened, however, comes from the relación of an un-named captain of a Sevillian ship which had been stationed on the seaward side of the Armada, who had seen events from a very different viewpoint. "Victory was all but won," he wrote, "when the enemy charged upon the seaward wing in such wise that we who were there were cornered, so that, if the duke had not gone about with his flagship...we should have come out vanquished that day."(51)

Who launched this sudden and decisive attack, which came at precisely the right time and from just the right direction to crowd the Armada to leeward, pressing it towards Selsey Bill and the Ower Banks, from which the only escape was to make all sail east? Long ago Corbett astutely pointed to the fact that Drake is not mentioned in any account of the morning actions, and in consequence the flagship which the Seville captain saw leading the enemy attack in the afternoon can only have been the missing _Revenge_.(52) If so, Drake's move was a brilliant one. While the Lord Admiral, Hawkins and Frobisher had been engaged in the mouth of the Solent, he had worked his squadron unobtrusively seawards, anticipating the change of wind in the afternoon which would enable him to launch his attack. Medina Sidonia's attempt to force the Solent, if that is what he had intended, was foiled forever. He was now east of Selsey Bill with the English fleet at his rear, and before him lay the coast of Flanders.

Phase IV: Calais and the fireships, 6-8 August

There can be few sets of military correspondence so one-sided as that which passed between the dukes of Medina Sidonia and Parma as the Armada made its was from Lisbon to Flanders. On 10 June, when Medina Sidonia might reasonably have expected to reach the rendezvous within a fortnight, he sent a _zabra_ ahead informing Parma of his progress, pointing out that because of the Flemish banks and the lack of a deepwater port the link-up would have to take place well clear of the coast. His next letter is dated 25 July, and is simply a confirmation that, after the delay at Corunna, he was again on his way. From then on the letters became increasingly frequent and urgent but, like the first two, they remained unacknowledged. On 1 August he asked Parma to supply more pilots who knew the coast of Flanders. Three days later, after the first bouts of fighting in the Channel, he was asking for two shiploads of powder and shot, and confirming his imminent arrival off Flanders. Still there was no reply.(53)

No fighting took place in the three days required for the Armada to sail from Selsey Bill to the Dover Strait. Both sides were husbanding their precious ammunition for the decisive battle to come. In the late afternoon of Saturday 6 August the Armada reached Calais Roads, where it anchored. A long culverin shot to windward, the English fleet followed suit. To the east lay the Flemish Banks; the Armada could sail no further in that direction. Still there was no word from Parma. "I have constantly written to your Excellency," wrote Medina Sidonia in desperation, "and not only have I received no reply to my letters, but no acknowledgement of their receipt...If you cannot at once bring out all your fleet, send me the 40 or 50 flyboats I asked for yesterday so I shall be able to resist the enemy's fleet until your Excellency can come out with the rest..."(54)

That Medina Sidonia seriously thought Parma could send out fifty flyboats to cover the rendezvous underlines the inadequacy of the information with which he had been provided. Flyboats were shallow-draught coastal gunboats of which Parma possessed none, although the Dutch fleet under Justin of Nassau had twenty-five or thirty of them patrolling the shoal waters between Flushing and Gravelines from bases in the Western Scheldt. Since his flyboats could operate among the shallows close inshore, where the deep-draught ships of the Armada could not venture, Nassau was able to bottle up the Army of Flanders indefinitely in its ports and so prevent a junction with the fleet.

On the morning of 7 August Rodrigo Tellez de Guzmán, the messenger sent to Flanders by Medina Sidonia on 25 July, returned to the anchored San Martín with devastating news. When he had left Dunkirk the evening before Parma was still at Bruges, forty miles away, and the embarkation of troops at Dunkirk had not yet begun. He had seen, moreover, little evidence of any serious preparations for the invasion.(55) On Sunday 8 August Parma at last wrote to explain his army's apparant lack of readiness, but his letter was not addressed to the anxious and now abandoned Captain-General of the Ocean Sea, waiting perilously at anchor only a few miles distant. It was to Philip II, whose geographical remoteness was as nothing compared with his remoteness from the situation into which he had driven his two commanders.(56)

Parma could not come out without exposing his army to an inevitable and entirely pointless disaster among the Flemish shoals, while the Armada, on its own, could neither mount an invasion nor destroy the English and Dutch fleets.

Parma's letter is a masterpiece of veiled cynicism (which, we must hope, was not lost on its recipient). In it he blames the whole débâcle on Medina Sidonia - for doing exactly what the king had ordered. The duke, he said, "still wishes me to go out and join him with these boats of ours...but it is obviously impossible without incurring great danger of losing our army. If the duke were fully informed on the matter [my italics] he would be of the same opinion...What grieves me most," Parma concluded, his cynicism giving way to genuine concern, "is to learn that the duke is in his present position, without a place of shelter in case of necessity..."

Parma was right in supposing Medina Sidonia's position to be a dangerous one. Early on the same Sunday morning Lord Admiral Howard had called a Council of War, at which it was decided to launch a fireship attack on the Armada that night.(57) The conditions were ideal. The Armada was crowded together at anchor, and its commander was uncertain (through no fault of his own) of his next move. To the Spanish lee lay the Flemish shoals. Best of all, the conjunction of spring tides (the very tides which, Medina Sidonia had hoped, should have enabled Parma to get his flotilla to sea) and a freshening south-south-east wind would carry the fireships swiftly into the Armada's heart.

Eight ships were prepared for the attack. They were packed with combustibles, and their guns were left loaded so that they would discharge spontaneously when the heat reached them, so adding a psychological element to the strategem. No one on the Spanish side was unaware of the terrible explosion ships, maquinas de minas, designed by the Italian engineer Giambelli, one of which had smashed the Antwerp boom in 1585.(58) The object of the English attack was not so much to destroy ships as to create confusion and panic throughout the Armada. If that could be done the forces of nature, aided by the English fleet, would do the rest.

Medina Sidonia was well aware that such an attack was likely. Before night fell he set a screen of pinnaces and ships' boats to windward of the Armada, with orders to grapple and tow clear any fireships that approached. At midnight the attack came. Two fireships were intercepted and dragged into the shallows (an act of heroism on the part of the nameless pinnace crews) but the remaining six careered into the midst of the anchored Armada, their red-hot guns exploding as they went. Medina Sidonia at once ordered all ships to cut their cables and move from the path of the fireships, with instructions that as soon as the danger was past the fleet should re-anchor as close to its original position as possible.(59) But the combination of terror and uncertainty was too much for the majority of the Spanish crews, who fled blindly with the wind. The Armada's discipline and tight defensive formation had at last been broken.

Phase V: The battle off Gravelines, 8 August

Panic, however, did not grip the flagship or its loyal group of close supporters. The San Martín[1] immediately anchored, as did Recalde's San Juan[2], Peñafiel's San Marcos[3], and two other Portuguese galleons, perhaps the San Mateo[6] and San Felipe[4]. At dawn on 8 August these five found themselves quite alone, facing the entire English fleet (which, by now, probably numbered 150 ships, including all the Queen's galleons), the rest of the Armada being scattered many miles to leeward. Now there was no impossible choice for Medina Sidonia. He could at last stand as honour demanded, shoulder to shoulder with his comrades, and defy the enemy to his last breath. Even so, he did not neglect his duties as a commander, and the ships' boats were sent away to leeward to rally the rest of the fleet. As they left, the first English ships came within range, and heavy firing began.

At this point Lord Armiral Howard's attention was distracted from the lion-hearted quintet of Portuguese galleons which stood between him and the dispersed Armada. During the confusion which followed the fireship attack Don Hugo de Moncada's _capitana_ galleass, the _San Lorenzo_[123], had damaged her rudder and mainmast, and in seeking to avoid capture she had grounded at the entrance to Calais. Stuck fast on a falling tide, with her seaward broadside pointing impotently to the sky as she heeled over, she could offer little defence. The prize was one which Howard could not ignore (or, at any rate, resist). He dispatched an assault party in boats to take her and, after a fierce struggle which only ended when Moncada was killed, the galleass was boarded and sacked.(60) Because of this incident the main attack on the Armada was delayed for more than two hours.

Medina Sidonia put this unexpected respite to good use by falling back, fighting all the way, to mobilise the defence of his now rapidly re-forming Armada. The troubleshooters began to gather on either side of the flagship, forming a ragged but determined protective screen. William Wynter, a member of Lord Henry Seymour's eastern squadron which had reinforced the English fleet off Calais, observed this re-grouping with detached professional interest: "They went into the proportion of a half moon. Their admiral and vice-admiral, they went in the midst...and there went on each side, in the wings, their galleasses, armados of Portugal, and other good ships, in the whole to the number of sixteen to a wing, which did seem to be of their principal shipping."(61) It was the old trailing-horns defensive posture, this time composed exclusively of the troubleshooters, doggedly prepared for whatever the English might yet throw against them.

The battle which followed lasted nine hours. It was fierce and very confused, but it may be summarised as a running fight in which the Spaniards strove to maintain defence in a close and compact formation, and so work northwards into the open sea, while the English endeavoured to cut off the weathermost ships and force the rest to leeward towards the Flemish banks. A vital factor was the wind, which veered steadily throughout the day from south-south-west to north-west, setting the Spanish fleet at an increasingly greater disadvantage as it did so. The weather too had deteriorated; the sea was now rough and the visibility poor.(62)

Through the confusion, we can detect features which mark this battle as radically different from anything that had gone before. First, much of it was fought at very close range. "Out of my ship the Vanguard," wrote William Wynter afterwards, "there was shot 500 rounds of demi-cannon, culverin, and demi-culverin: and when I was farthest off in discharging any of the pieces, I was not out of shot of the harquebus, and most time within speech of one another."(63)

The fact that the protagonists were at times within hailing distance (which, amid the noice and chaos of battle, must have been very close indeed), is graphically borne out by what Purser Calderón saw of the fighting from the Spanish side:

> "The enemy inflicted great damage on the galleons _San Mateo_ and _San Felipe_, the latter having five of her starboard guns dismounted...In view of this, and that his upper deck was destroyed, both his pumps broken, his rigging in shreds, and his ship almost a wreck, Don Francisco de Toledo [of the _San Felipe_] ordered the grappling hooks to be got out, and shouted to the enemy to come to close quarters. They replied, summoning him to surrender in fair fight; and one Englishman, standing in the maintop with his sword and buckler, called out 'Good soldiers that you are, surrender to the fair terms we offer you'. But the only answer he got was a gunshot, which brought him down in sight of everyone, and [Don Francisco] then ordered the muskets and arquebuses to be brought into action. The enemy thereupon retired, whilst our men shouted out to them that they were cowards, and with opprobrious words reproached them for their want of spirit, calling them Lutheran hens, and daring them to return to the fight."(64)

Some time earlier the San Felipe's sister, the San Mateo, had experienced, according to Calderón, an even closer encounter with one of the English ships. As the two vessels passed one another their sides scraped so close that a single foolhardy Englishman was able to leap onto the Spaniard's deck. No one followed him, and he was instantly cut down.

The English were now, for the first time, pressing their attacks to a range at which real damage could be inflicted on the Spanish hulls. We have already seen the shambles to which the San Felipe had been reduced, and she was one of many. The aggressive and persistent troubleshooters, now fighting to save the Armada from total annihilation, naturally suffered most. The San Martín received over 200 hits, several of which penetrated her hull close to the waterline.(65) Only the heroic efforts of two naked divers with oakum and lead patches kept the leakage under control. The San Mateo, cut off by "13 or 14" English galleons, fought till she was "a thing of pity to see, riddled with shot like a sieve."(66) For all this punishment, surprisingly, only one Spanish ship actually sank during the battles. She was the Biscayan María Juan[20](67), which foundered suddenly at sunset in rising heavy weather. Only a single boatload of her people were saved. Human casualties aboard many other ships were high. Over 200 of the San Felipe's complement of about 500 were reported killed, while there were forty dead aboard the San Martin. In all, calculated Alonso Vanegas, the fleet's total casualties that day were over 600 killed and 800 wounded.(68) But the fighting spirit of the survivors remained strong. At one stage in the battle a great Italian ship, perhaps Bertendona's Regazona[68], was observed to be "all full of blood", though she was still maintaining her position in the defensive rearguard three hours later.

Seen by later standards of sea warfare the damage and casualties suffered by the Armada were not, in fact, particularly severe. Some serious hull damage had certainly been inflicted. Masts, sails and rigging had been shot about. A moderately large number of men had been killed or wounded. But the outcome of the battle was not total defeat. Although they subjected the Armada to a severe battering the English did not achieve their objective of breaking its formation and forcing it onto the sandbanks. Spanish discipline, the English shortage of ammunition, and a providential change of wind to the south-south-west on the Tuesday morning combined to prevent that. And, at the end of it all, the Spaniards were by no means a spent force. They still had, as van Meteren expressed it shortly afterwards, "many great vantages of the English, namely for the extraordinary bigness of their ships, and also that they were so nearly conjoined, and kept together in so good array, that they could by no means be fought withall one to one."(69) The Armada remained undefeated in naval terms; its general order and cohesion remained intact. If circumstances had been different, and if somehow that final battle had been fought with Parma's army shepherded safely in the Armada's midst, who can say what the eventual outcome might have been?

A final point concerning the Gravelines battle must now be considered. If the range at which it was fought was close enough for the English to inflict serious damage on the Spanish hulls, what punishment had the Armada been able to mete out in return? Apocryphal stories of the Spanish bombardment's ferocity abound; the best known, predictably, come from sources close to Drake. In one version a gentleman, "lying weary" in the Revenge's great cabin, had the bed shot from under him by a saker ball; shortly afterwards (the bed having been miraculously restored), a demi-culverin ball discommoded two more gentlemen, one of whom was the duke of Northumberland, in precisely the same place.(70) But whatever superficial if dramatic damage of this kind may have been done to the upper works of Elizabeth's galleons, it is clear that they had suffered no serious hurt. No doubt many minor repairs were carried out by the ships' carpenters without need for comment. As to major repairs, we have the objective evidence of a full dockyard survey carried out on the Queen's ships shortly after the emergency had ended. In it, as we should expect, a number of unservicable components are noted for replacement, being variously described as "worn", "cracked" or "decayed". On occasion these may perhaps be euphemisms for battle damage, though the frequency with which they occur is little greater than might be expected in any routine survey. Some minor damage to spars and ships' boats is indeed directly attributed to enemy action. But of substantial damage to hulls - the kind of damage sustained by so many of the Armada's ships - there is not a single mention.(65)

Why was this so? All the evidence suggests that, at close range, the Spanish armament should have been at its most effective - more effective, indeed, than that of the English. "The enemy's object will be to fight at long distance," Philip II had warned Medina Sidonia, "but the aim of our men must be to bring him to close quarters."(72) To explain the failure at Gravelines it is generally assumed that the Armada had by then almost completely run out of ammunition, particularly in the heavier 'ship-smashing' calibres. Medina Sidonia himself said as much. The most powerful ships, he noted in his diario, were finally rendered ineffective "on account of the cannon fire to which they had been exposed, and their own lack of projectiles."(73) We cannot, of course, ever know the final ammunition state of principal ships like the San Martín, San Mateo and San Felipe, which undoubtedly bore the brunt of the final action. But we do now know that at least five Armada vessels, all of which undoubtedly belonged to the heavily engaged 'troubleshooting' category, ended the fight with substantial stocks of roundshot still on board, especially shot of 'ship-smashing' calibre (9-lbr and above). Evidence to support this contention is archaeological, and irrefutable; it comes from the large quantity of ammunition which has actually been recovered from their wrecks off the coasts of Scotland and Ireland. To seek an explanation of why this shot was not discharged, and why, despite its availability, no damage was inflicted on the English hulls, it is to these wrecks that we must now turn.

Part II: The Wrecks

Introduction

After Gravelines the duke of Medina Sidonia had yet another unpalatable decision before him. On 9 August, with a south-westerly wind blowing the Armada clear of the Flemish shoals and into the North Sea, a Council of War was held aboard the San Martín to determine what strategy the fleet should now adopt.(1) Should it, without hope of replenishment or reinforcement, in the face of the prevailing winds and against an enemy who had proved his superiority over the Armada in battle and who was operating close to his home bases, attempt the rendezvous with Parma once again? Should it perhaps mount some kind of offensive operation on its own initiative? Or should it simply nurse itself back to Spain as best it could, via the north of Britain, and so keep losses to a minimum? The Council's unanimous decision was that, unless the wind changed to a direction which would enable the fleet to regain the Channel, a north-about return should be made to Spain. But this was to be no flight in blind panic. The English fleet was still to leeward, and discipline had to be maintained in case of further attack and to ensure mutual support against the perils which undoubtedly lay ahead. There had been a serious lapse of formation discipline after the fireship attack at Calais and now, with the fleet committed to what might be called a strategic retreat, stern measures were adopted to make sure that there would not be another. On 11 August twenty captains were tried by summary court-martial for breaches of discipline during and after the Gravelines battle, and one of them - Cristóbal de Ávila, of the hulk Santa Bárbara[95] - was hanged, and his corpse paraded round the fleet to drive the lesson home.(2)

Two days later, off the Firth of Forth, the English broke off pursuit.(3) That same day, 13 August, the San Martín issued orders for the homeward voyage. A copy of these orders later fell into English hands on the west coast of Ireland. "The course that is first to be held," the instructions are reported to have read, "is to the north-north-east, until you be found under 61 1/2 degrees; and to take great heed lest you fall upon the Island of Ireland, for fear of the harm that may happen to you upon that coast." After "doubling the Cape" (i.e. reaching a longitude beyond the most westerly part of Ireland), the fleet was to head west-south-west to a latitude of 58 degrees (somewhere to the west of Rockall), and thence south-west to 53 degrees, from where a final south-easterly run might be made to the ports of northern Spain.(4)

There is nothing remarkable about this route since, even in times of peace, ships rarely attempted the notoriously difficult Channel passage from east to west, particularly in autumn or winter.(5) The prevailing south-westerlies made the passage to the Northern Isles relatively easy, and the islands themselves could usually be rounded without difficulty, often with the help of the north-easterly Helm wind which springs up from the high pressure zone frequently found over Arctic Norway. Once sufficient sea room into the north Atlantic was gained progress could be made southwards, even against the prevailing wind, by employing a series of long tacks.

Many ships held to the course given out by the San Martín, including the flagship herself, and most of these, in spite of the appalling weather of September and October 1588, eventually reached home port.(6) It was those which were forced towards the coasts of Scotland and Ireland because of poor sailing qualities, battle-damage, or lack of water - or a combination of all three - that were the most prone to disaster. We do not know exactly how many were lost, but two documents drawn up by the Spaniards in October 1588 are of considerable help. One lists the ships which had safely returned to Spain, while the other records those presumed to have been lost.(7) These documents, which were probably compiled at slightly different dates, are not entirely reliable and do not always agree: some ships are on both lists, while others appear on neither. The information contained in them is included in the order-of-battle tables set out in Appendix 4.

It should be noted that the appearance of a ship on the 'missing' column does not necessarily mean that it was lost. The list was compiled after most of the survivors had returned, but a few had yet to reach port. It is almost certain, moreover, that at least some of the hulks listed as missing had made straight for their home ports in the Baltic, while many smaller craft may have sought shelter on other coasts. Because of this doubt, which can never fully be resolved, it is impossible to reach an accurate estimate of the Armada's total losses; though great, they were probably not as high as is sometimes supposed. Thirty-four percent, or about forty-four ships of all classes, is a likely approximation.(8) Many of the ships which did return, however, were unfit for further service, and human attrition on all of them was high - often in excess of 50 percent. Of the 30,000 or so men who set out in 1588 barely one in three lived to see the following spring.

The most devastating harvest of wrecks and lives was reaped on the coast of Ireland. The first victim, La Trinidad Valencera[72], came to grief on the north coast of Donegal on 16 September 1588. On 25 September three more members of the Levant squadron, the Lavia[69], the Juliana[75] and the Santa Maria de Visón[76] were driven onto the sweeping beach of Streedagh, in Sligo, and beaten to pieces in the shallows.(9) 1,100 bodies were subsequently counted along the sands, together with wreckage "...more than would have built four of the greatest ships...and such masts, for bigness and length, as in my knowledge I never saw any two that would make the like": so the Lord Deputy of Ireland, Sir William Fitzwilliam, reported some days later, after riding along the strand to view the scene.(10) Four days earlier, on 21 September, the worst storm of that whole dismal autumn had wrecked the Biscayan and Guipuzcoan almirantas El Gran Grin[14] and Santa María de la Rosa[55] on Clare Island and in Blasket Sound, the Levanter Anunciada[73] in the Shannon estuary, and Don Alonso de Leyva's Rata Encoronada[70], also of Levant, in Blacksod Bay, Mayo. Don Alonso and most of his men survived the Rata's wreck and transferred to the hulk Duquesa Santa Ana[48] but this ship, in making her way north, was herself wrecked in Loughros Mor Bay, Donegal. Again Don Alonso escaped and, although injured, led his men across nineteen miles of bog and mountain to Killibegs, where the galleass Girona[125] had put in to make repairs to her hull and rudder. At length the galleass, now carrying the combined complements of three ships, set sail in an attempt to reach Scotland. Off the north coast of Antrim her jury rudder broke, and she was driven onto a reef close to the Giant's Causeway. Of the 1,300 or so on board there were fewer than twenty survivors.(11)

Other ships, not all of them identified with certainty, were wrecked among the Blaskets, at Tralee, Doonbeg, Mutton Island, Galway Bay, Inishboffin, on the north Mayo coast, in Donegal Bay and along the north-west coast of Donegal. Elsewhere, the hospital hulk San Pedro Mayor[85], after clearing the Irish coast, was wrecked on Bolt Tail in Devon (12), while Scotland claimed two certain victims, the San Juan de Sicilia[71] and El Gran Grifón[78], and two or more possible ones.(13) There were wrecks on the coast of Norway.(14) Many of these events, and the circumstances surrounding them, are well chronicled, but there may also have been ships, large and small, which foundered unwitnessed in the open sea, or were smashed on reefs or shores so desolate that no one ever knew of them.(15)

Five of the wreck sites are known with certainty today, in the sense that remains have been located and positively identified on the sea bed. These five ships provide an excellent sample of the fleet as a whole, and emphasise the variety of ship-types and geographical origins involved in its formation. The locations of the wrecks are shown in Figure 3. The Tobermory wreck, whose remains have been picked over for nearly four centuries by generations of hopeful salvors seeking an elusive and almost certainly illusory treasure, was the San Juan de Sicilia[71], which came originally from Ragusa.(16) The galleass Girona[125], whose scattered remains were found off Lacada Point in

Antrim by Dr. Robert Stenuit in 1967, had been based at Naples.(17) The Guipuzcoan almiranta Santa María de la Rosa[55], whose wreck was identified by Sydney Wignall and the writer in 1968 at the bottom of Blasket Sound, County Kerry, was built at San Sebastian the year before the Armada sailed. El Gran Grifón[78], capitana of the supply hulks, whose remains were located by the writer off Fair Isle in 1970, was a Hanseatic merchantman from Rostock. Relics from La Trinidad Valencera[72], a Venetian grain-ship which was the fourth largest vessel in the fleet, were found buried and wonderfully well preserved in the sandy sea-floor of Kinnagoe Bay, County Donegal, by members of the City of Derry Sub-Aqua Club in 1971, and the site was subsequently excavated under the writer's direction.

It is with the evidence provided by the last three wrecks that my thesis is predominantly concerned. This section includes a chapter on each of them, in which both the historical background and the nature of the archaeological remains are examined.

Chapter Three: *La Trinidad Valencera*

The Venetian merchant ship *La Trinidad Valencera* (a Spanish corruption of her Italian name *Balanzara*), of 1100 tons and 32 guns, was requisitioned on 18 January 1587 by the Spanish authorities in Sicily to convey troops and war materials to Spain, where they were required for the projected Armada.(1) Her great size, and the fact that she appears to have plied between Venice and Sicily, combine to suggest that she was a bulk grain carrier.(2) Together with four other merchantmen from the Adriatic and western Italy she arrived at Cartagena in May 1587, and by 18 July she was at San Lúcar, where she was credited with a complement of 180 soldiers and 80 seamen, and an armament of 28 bronze guns of unspecified type and size.(3) We do, however, possess a list of the guns carried by the five Levantine ships as a whole, and so the *Valencera's* 28 pieces are to be found among the following: (4)

9 bronze *medios cañones*, 16-19-*lbr*

7 bronze *medias culebrinas*, 12-14-*lbr*

31 bronze *medios cañones pedreros*, 10-16-*lbr*

29 bronze *sacres*, 7-12-*lbr*

31 bronze *falconetes pedreros*, 3-4-*lbr* (stone)

13 bronze *falconetes*, 2-3-*lbr*

6 bronze *versos*, 3-*lbr*

*16 cast iron pieces, 3-12-*lbr*

*4 iron *pedreros*, 12-14-*lbr*

*3 iron _falcones_, 3-_lbr_

*12 iron _versos_, 2-_lbr_

*These iron pieces can, presumably, be discounted from the _Valencera's_ exclusively bronze armament.

Although the _Valencera_ had been impressed only to transport men and stores to Lisbon, when she reached that port in August 1587 she was embargoed to take part in the Armada itself as a member of Bertendona's Levant squadron, an act against which her master, Horatio Donai, protested vigorously but in vain.(5) As will be considered more fully in a later chapter, one of this squadron's tasks was to transport a dismantled siege train for the campaign which was to follow the landing in England. This role is reflected in a list of artillery equipment and stores issued to the ship in May 1588, which included: (6)

3 _cañones de batir_ mounted on sea carriages, with six dismantled sets of field carriages

6 limbers (_armones_) with their fittings

190 _qtx_ of powder, of which 100 were for the siege artillery

1171 _lbs_ of match

400 40-_lbr_ iron balls

80 planks and baulks for platforms

15 hemp cables for gun-hoists (_cabrias_)

1 gun-hoist with accessories

64 levers, 80 spokes (_rayos_), 20 felloes (_pinas_) and

4 naves (macas) for cañón wheels, all of wood

20 woodchoppers' axes

3 rollers (polines) [in the inventory of a sister ship, the San Juan Bautista[71], these are described as 'para embarcar artillería']

6 wooden sledgehammers [the San Juan Bautista's inventory describes these as 'para enrayar' - for spoking wheels]

8 solid wheels (ruedas enteridas)

1000 nails for platforms

1 ladle (cargador) and 3 rammers (atacadores)

24 wooden wedges

Some months earlier the Valencera had been issued with a Turkish gun for which no weight or calibre was recorded, although it is probable that it, too, was a battery cannon.(7) In a deposition after his capture the ship's senior officer, Don Alonso de Luzón, referred to "four cannons of brass" distinct from the 28 pieces belonging to the ship,(8) while his second-in-command, Baltasar López del Arbol, was even more specific, saying that the vessel carried "32 pieces of brass whereof 4 were cannons of the king, the rest belonging to the ship being of divers kinds..."(9)

An addition of four battery cannons to the *Valencera's* original armament would make up the total of 32 which both de Luzón and del Arbol attest. This is ten short of the 42 guns with which the ship is credited in the muster of 9 May 1588, which may either have been a clerical error or, perhaps, an unrealised intention. Even so, and in spite of the contention of an Armada deserter that "the ships of Italy, nominally the largest, were badly provided with artillery",(10) *La Trinidad Valencera* was, in comparison with the rest of the fleet, very heavily armed. Her gunpowder quota of 125 *qtx*, listed in the 9 May muster, was only 15 *qtx* below that of the *San Martín*, which carried the largest supply in the Armada. She was also credited with 2100 rounds of shot (since this figure is based on a 50-per-gun average for 42 guns, it should be treated with caution), 19 *qtx* of lead, and 16 *qtx* of match. In all the ship carried 79 seamen and 281 soldiers, while her rated tonnage of 1100 made her the fourth largest unit in the fleet.

Her commander, Don Alonso de Luzón, was *Maestre de Campo* of the *tercio* of Naples, three of whose 26 companies sailed with the ship.(11) These belonged to Don Alonso himself, and to Captains Hierónimo de Aybar and García Manrique de Lara. Among other attached personnel four *aventureros* are listed in the muster: they were Francisco de Rivadeneira (with 8 retainers), Rodrigo Lasso (5 retainers), Sebastián Zapata (3 retainers) and Diego Fernández de Mesa (1 retainer).[12]

In the storm which forced some of the Armada to shelter in Corunna, and others to ride out the tempest at sea, many of the clumsy Levanters and Baltic hulks were driven towards the Scillies. Among them were La Trinidad Valencera and El Gran Grifón, flagship of the hulks.(13) By 11 July the Valencera had reached Vívero, and was present at the muster held at Corunna on 13 July, where she was listed with a complement of 415 men - and increase of 53 over the Lisbon figure.(14)

As the most heavily armed ship in her squadron, the Valencera was engaged in most of the running fights which took place between Plymouth and Gravelines. She was involved in the long-range exchanges with Lord Admiral Howard and others at the start of the battle, and she became more closely engaged during the actions off Portland Bill and the Isle of Wight.(15) Early in the fighting the Valencera and Don Alonso de Leyva's Rata Encoronada, also of the Levant squadron, were detached as independent battle-groups with two galleasses attached to each great-ship, though evidently these powerfully armed units were never effectively deployed in the fighting.(16) In the final rearguard action off Gravelines the Valencera was one of the twenty or so ships which fought in Medina Sidonia's close support and so saved the retreating Spanish fleet from destruction.(17)

On 20 August the Armada passed between North Ronaldsay and Fair Isle, where Scottish fishermen reported "a very great fleet of monsterous great ships, being about 100 in number", running westward before the wind.(18) On the same day Don Balthasar de Zúñiga, a staff-officer aboard Medina Sidonia's San Martín, landed at Scalloway to take a fast pinnace to Spain with despatches for the king.(19) About this time, or perhaps slightly before, La Trinidad Valencera with three other ships lost contact with the main body.(20) The Valencera's companions were hulks which, like her, had found themselves unable to keep as well to windward as the rest of the fleet. They were El Gran Grifón and two members of her squadron, the Barca de Amburg[83] and the Castillo Negro[82]. Together the four ships struggled south-west for twelve days, making little progress. Then, on 1 September, the Barca de Amburg, her seams open and her pumps choked, signalled that she was foundering. Her company of 250 was transferred to the Valencera and the Grifón just before she sank. Three nights later, somewhere off the north-west coast of Ireland, the remaining ships lost contact with one another. The Castillo Negro vanished without a trace, and was never heard of again. The Grifón was driven northwards, eventually to be wrecked on Fair Isle. The Valencera, which had now sprung a severe leak, headed for the northern coast of Ireland, where, in Kinnagoe Bay, just west of the entrance to Lough Foyle, she grounded on

14 September.(21)

Three witnesses recorded details of the shipwreck, and the significant parts of their statements follow:

Don Alonso de Luzón: "...they landed by shipwreck as many of them as they could in a broken boat of their own, some swam to shore, and the rest were landed in a boat of O'Doherty's country, for the use of which they gave in money and apparel 200 ducats... They were about two days in landing all their men..." (13/23 October 1588).(22)

Baltasar López del Arbol: "...the ship wherein they were took a great leak forty leagues from the coast of Ireland, whereupon they made for Ireland as the next land they knew, and coming on the shore in O'Doherty's country they took to land in an old boat of their own and some did swim to land, and their own boat being broken they gave 100 ducats in money and above 100 ducats in apparel, rings and jewels to a boat of the country to help them to land, which being also broken there came a third boat which they offered to have for their help, but the owners of the boat would not yield thereto, but went for spoil to the ship, and on the sinking of the ship, being entered into her, sank with her. He saith that as they came near the land, he saw some 20 of the savage people standing on a rock and in their landing about 4 or 5 of them came and did help them out of the boat and used them courteously until the rest of the wild people that stood on the rock, and more with them to the number of 40, came together at which time they took from them in money, gold buttons, rapiers and apparel to the value of 7,300 ducats or thereabouts." (13/23 October 1588) [23]

Juan de Nova and Francisco de Borja (two soldiers from the ship who eventually escaped from Ireland and who made statements on their homecoming): "They lost sight of the Armada on the night of 12 September, during a tempest. The same night their ship sprang a great leak forward, and for the next two days and nights they were at the pumps. On the 14th they brought up on the coast of Ireland, towards Blasket [sic], and all the soldiers, except 40 who remained in the ship and were afterwards drowned when she foundered, were put on shore, with their arms, in a little boat." (21 January 1589) [24]

To the above first-hand accounts may be added a second-hand one, in which the numbers of the survivors and victims are patently exaggerated, which was sent to the Lord Deputy of Ireland by Richard and Henry Hoveden, commanders of the local English garrison, in a letter dated 12 September (O.S.): "These 700 Spaniards were driven by force of weather into a creek named Glanganvey, where their ship is drowned with 200 or 300 men in her, and so would all the rest have been, were it not that O'Doherty's men went unto them with boats and did bring them to shore."(25)

From these testimonies, of which del Arbol's is the fullest and probably the most reliable, we can deduce that the ship, close to sinking after springing a leak some 40 leagues (about 120 nautical miles, or 220 kilometres) from the coast, ran aground "in a creek named Glanganvey" on 14 September. By implication the sea conditions were rough, since the *Valencera*'s own boat and then a boat hired from the locals appear to have been wrecked during the transfer of men and equipment to shore. In spite of these difficulties most of the Spaniards were able to disembark, with the evident exception of a few, possibly non-swimmers or the immovably sick.

The ship broke up and sank, evidently without warning, on 16 September, drowning a number of local people who were attempting to salvage her contents. Whether or not this was associated with rough weather is not clear, but there is evidence from other sources to suggest that the weather pattern at this time was unusually unsettled and severe, and on the following day "*una grande tormenta*" of unspecified direction was recorded by a Spaniard on board *El Gran Grifón*, which had parted company with *La Trinidad Valencera* only a few days before.(26)

No record of subsequent salvage has been found, although details of the ship's bronze ordnance were known to the English authorities from the interrogation of survivors, and the site was within the working depth of contemporary salvors. Sir George Carew raised guns, some very large, from an Armada wreck off Dunbeg, County Clare, in four and a half fathoms (8 m) of water in June 1589,(27) and later (1 August) was ordered to "repair to that part of Ulster upon the sea where some part of the Spanish fleet perished, and where there are certain pieces of ordnance meet to be recovered."(28) As far as can be ascertained, however, Sir George's Ulster salvage operations only involved the site of the wrecked galleass Girona, near the Giant's Causeway, many of whose guns had already been recovered by Sorley Boy McDonnell of Dunluce, aided by his Scottish kinsmen.(29)

It is however possible that some of the Valencera's guns were recovered in the early seventeenth century. In 1610-11 Sir James Stewart of Glasgow raised 12,000 pounds weight (5443 kg) of assorted brass ordnance from an unspecified Armada wreck off Ireland, under the authority and protection of Sir Arthur Chichester.(30) In 1609, as part of the Plantation of Ulster, Sir Arthur had ousted the O'Doherty clan from the Barony of Inishowen, on the north coast of which the wreck of the Valencera lies, and it is therefore quite probable that this was the source of James Stewart's guns. But, if so, he did not recover them all.

The guns which were to be found by the City of Derry Sub-Aqua Club in 1971 eluded discovery for nearly four centuries, even though at least two of them would have been easily visible from the surface when the water was clear and a busy salmon fishing station later stood within 300 m of the spot.

ii. Location of the wreck

Kinnagoe Bay is situated close to the north-eastern corner of the Inishowen Peninsula, County Donegal, in the Irish Republic (Figure 4). The bay lies between headlands some 2 km apart, and although much of its length is exposed to Atlantic swells its extreme north-western end is well sheltered from all directions except the east and north-east. A long strand fringes the bay almost from headland to headland, with a steep hinterland rising some 120 m above sea level. Thickly tangled vegetation makes this hinterland virtually impassible even today, save where two riverlets debouch through deep gullies at Glenagivney, half way across the bay, and at Port Kinnagoe close to its western end. Clustered at the foot of the Glenagivney gully an O'Doherty hamlet once stood.(31) Traces of foundations and some stone-lined hollows for boats can still be seen, while the almost ploughed-out remains of a small stronghold overlook the village from higher ground. Though many of these remains may be of much later date it was probably from this village, which is less than a kilometre from the wreck site, that the "savage people" came to greet the Spaniards, first to succour them and then to relieve them of their possessions. No doubt it was a Glenagivney boat which "went for spoil to the ship" shortly before she broke up, drowning those who had gone aboard.

Richard and Henry Hoveden, writing two days after the sinking, stated that "the ship is drowned...in a creek named Glanganvey". Today, as the Ordnance maps show, the small rock-girt cove into which the Glenagivney stream now flows is called Glenagivney Bay, and in here fruitless searches were made by several diving teams prior to 1971.(32) In retrospect, however, it seems that because in the sixteenth century Glenagivney was the only place of any consequence within several miles, the whole of the larger bay - and not just the small central cove - was referred to by that name also. But by the 1830s, when data for the Ordnance maps was being gathered, Glenagivney hamlet was deserted and forgotten, and the focus had shifted to the fishing station and coastguard post at Port Kinnagoe, close to the western end of the main bay. It was from Kinnagoe, therefore, and not from the abandoned Glenagivney, that the surveyors took a general name for the whole bay.

In 1969 the City of Derry Sub-Aqua Club began a systematic search for the wreck, coupled with a local enquiry to see whether any tradition of it had survived. No evidence either of oral legend or of place names connected with the event was (or has since been) brought to light, and when underwater explorations of the modern Glenagivney Bay proved inconclusive the search was switched to the eastern end of Kinnagoe Bay with similarly negative results. Not until early 1971 was the western end of the bay tackled, and on 20 February two Club members, Archie Jack and Paddy Stewart, who were part of a 13-man training group led by the Diving Officer, Charles Perkinson, found a bronze gun laying on a shallow rock outcrop.(33) Searches by the rest of the team quickly revealed three more bronze guns, an anchor, the remains of three heavily concreted spoked wooden wheels, and a number of small finds which suggested a late sixteenth century date and an Armada connection. Later investigation revealed that the two largest guns, a pair of full *cañones*, bore the arms of Philip II and the date 1556. These guns can be identified through their weight marks as two of the *cañones de batir* carried by *La Trinidad Valencera*, and prove the identity of the wreck beyond any doubt.(34)

iii: The wreck site

From the outset the City of Derry Sub-Aqua Club has insisted that work carried out on the site, whether by its members or by anyone else, should be conducted as a controlled archaeological operation, to appropriate standards, and that the recoveries should be recorded, conserved, studied and eventually retained as an intact collection. The Club, as a corporate body, remains the legal salvor of the wreck, and is entirely responsible for all work done on it. At the Club's invitation, however, archaeological control of the work has throughout been vested in the St. Andrews Institute of Maritime Archaeology, under the writer's direction. On this basis work was conducted in 1971, 1973, 1974, 1976, 1978 and 1980, amounting in all to some 18 months of active field work on the site. Conservation support has been provided from the outset by the Ulster Museum, Belfast. In February 1982, with the agreement of the City of Derry Sub-Aqua Club and the government of the Republic of Ireland, the whole collection passed into the ownership of the Ulster Museum, where it is now stored and displayed.

The initial finds were made on, around, and to the north of a reef which extends in a north-easterly direction for some 200 metres underwater from an exposed rock stratum on shore, and rises several feet above a stable and very flat sandy seabed ten metres below Mean Low Water (Figures 4, 5 and 6). Some wreckage, notably a large bronze gun and a concreted wooden guncarriage wheel, has found its way into the broad gully to the south of the reef, while in the narrow gullies among the reef itslef a few groups of small finds, and some organic matter, have been noted. The bulk of the remains, however, lie almost wholly buried in the flat bottom of mixed sand and shingle which stretches northwards from the edge of the reef. Surface indications suggested the existence of three main clusters of wreckage: one, just north of the reef, which included three guns, two guncarriage wheels, and an anchor; another, thirty metres north of the first, represented by two more wheels, two wooden axletrees, and a swivel gun; and a third, fifteen metres north-east of the second, indicated by an anchor and an axletree.

Later searches revealed a number of scattered finds extending south-westwards from the main site towards the shore. A total of 43 surf-abraded potsherds with fabrics and glazes similar to those identified on the wreck-site proper have, over the course of the investigations, been picked up from the shingle of the north-western end of the beach, and other pottery finds have been made in the reef gullies between the shore and the site. During a particularly low Spring tide in 1980 a stone <u>falcón pedrero</u> ball was picked up from a tidal pool close to the water's edge. Heavier objects are less widely dispersed, and the most inshore one so far noted, a brass candlestick base, lay about half way between the main site and the beach. Several abraded timbers, apparently from the ship's hull, have been noted in reef gullies to the west and south-west of the main site.

These indications suggest that La Trinidad Valencera, in seeking to run ashore at this sheltered spot, grounded firmly on the reef. Her normal draught would have been in the order of four metres (see Appendix I), and she was no doubt considerably deeper in the water when, in serious distress, she reached Kinnagoe Bay on 12 September 1588. With her bow lodged on the reef and her partially sunk stern sitting on the sand she would have been immobile but relatively secure, although she would have been liable to break amidships in the first appreciable north-easterly swell. In this precarious position she apparently remained for two days, allowing most of her people and some of her portable contents to be brought ashore. The end evidently came with little warning, and was no doubt caused by the pile-driving effect which a swell in the bay would have caused the mainmast to exert on the unsupported keel, so breaking the ship into the two halves which the extent and patterning of the observed wreckage now seem to suggest.

The site is little affected by tidal movement, although seas from the north to north-east direction cause a marked surge on the bottom. During such surges the ridged surface sand moves freely, levelling out any hump or depression remarkably quickly; beneath the immediate surface, however, the sediments are extremely stable, as later observations were to confirm. Nonetheless a complex pattern of sand movement within the bay as a whole is indicated by massive sequences of drifting and erosion at the western end of the beach, obvious during the nine years in which investigations have taken place and confirmed over a much longer period by Mr. Hugh McConway of Kinnagoe, who has known the bay intimately for nearly eighty years.

A heavy growth of *Laminaria digitata* covers the reef. Though mature plants are confined to the rocks, juveniles of this and other species have been observed dragging small pebbles, to which their holdfasts were attached, across the sand, their fronds acting as 'sails' in the to-and-fro surges. Since they are able to climb the shallow forward slopes of the sand ripples, but stick on their steep reverse ones, they tend to move in one direction only, and often cover considerable linear distances. The distinctive trails left by such pebbles are common on the site, which suggests that this factor may account for some of the shingle transport within the bay.

The water is generally clear, with visibility ranging from three metres to as much as fifteen metres on exceptional days. Peaty water deposited in the bay by the Long Glen River after heavy rains can, on occasion, cut visibility almost to zero for several days. These fine peat sediments may, it is thought, contribute to the preservation of organic materials on the site, although this factor is not, as yet, fully understood.

Before excavation began, extensive physical, metal detector and probe surveys were carried out. Two base points 100 feet apart were established on the reef, and from these a grid was constructed by tape triangulation.(35) The primary grid was extended 200 feet from the base line, and marked at ten foot intervals along the outer sides with steel rods driven firmly into the sea bed. Tapes were then stretched between complementary pairs of rods to provide datum lines wherever required, from which rigid surveying equipment was positioned as appropriate. During excavation the primary grid was extended a further twenty feet northwards.

The metal detector survey was conducted by Jeremy Green, then of the Oxford Laboratory for Archaeology, and the writer, in 1971. The area enclosed by the grid was subjected to total and intensive coverage, while a general reconnaissance was made of the surrounding areas, and of the main gully which runs between the wreck site and the shore, to check whether any major deposits lay outside the grid. Targets fell into two categories: those having a large area where high readings were obtained, and those which showed a single point of high intensity. These two categories are indicated in Figure 6.

Following the metal detector survey the site was probed in order to assess the nature and depth of its sediments. A jet-probe was to make sub-bottom soundings to a depth of up to 9 feet (2.74 m). The soudings were taken at 5 feet (1.52 m) intervals along a series of datum lines beginning at the baseline and progressing in 10 foot (3.05 m) parallels to the north end of the grid. The information so derived is presented, in simplified form, in Figure 7.

Contacts within 3 feet (0.91 m) of the sea bed surface are shown as shaded areas. The shallow contours at the bottom corners of the grid, close to A and B, represent rock strata sloping gradually down from the exposed part of the reef. The large zones of shallow contact in the north-east sector of the grid, on the other hand, consist of a massive crust of concreted wreck debris, which in places almost breaks the surface. The more scattered contacts west of this deposit also represent shallow wreck debris as do, apparently, the smaller shallow contacts scattered over the rest of the grid. Little information has been derived about the nature of the deeper strata.

It was noted that each jet probe sounding left a small crater in the sand, and that if any organic material had been encountered during the probe a small sample of it would gather at the bottom of the crater after the turbulence had died down. Soundings which yielded organic indications are noted in Figure 7. From the pre-disturbance survey it was concluded that the grid system as laid out enclosed the probable nucleus of the wreck, and on the basis of this information systematic excavation has progressed. As a result of discoveries in the north-east corner the grid was later extended a further 20 feet (6.1 m) northwards.

Excavation was carried out by the progressive stripping of selected grid units, either down to bedrock or to what appeared to be the lowest level of wreck deposit. A 15 cm diameter airlift was used to remove overburden where the archaeological deposits were scattered or lay at an appreciable depth; most excavation, however, was carried out by hand, with a 10 cm diameter water dredge used to carry away spoil. Spoil was dumped on previously excavated areas to maintain the equilibrium of the site.

The present extent of the excavation, which is not yet completed, is shown in Figures 8 and 9. It appears that the wreck is a well scattered one, without coherent structural remains, although some dislocated components of the hull have been identified. The flat and extremely stable sea bed, however, has been found to contain a number of discrete pockets of wreck material, sealed within lens-shaped depressions, which include a wide range of objects from the wreck, many of them extremely well preserved. All classes of material are represented: wood, leather, plant and animal remains, textiles, ceramics, stone and metal. One such concentration is located at the south-east corner of the grid, one is centred on Grid square 10.150, another at 50.160, and a fourth at 80.200 (Figure 10). Elsewhere on the site there are widely scattered areas of concretion, most of which is derived from hull bolts and other ship's fittings, where little or no organic matter is present (Figure 11). The latter will have been deposited, along with heavy and durable objects like guns, anchors, and guncarriage components, as the vessel disintegrated. It seems likely that while the ship was breaking up on the reef, with the main part of her hull resting on the sand, she formed a massive anomaly which temporarily disturbed the equilibrium of the sea bed and created shallow scour pits around it. In these pits waterlogged material, carried along the sea bed by the bottom surge, would have gathered and become trapped. Loose seaweed also found its way into the scour pits to cap the deposits with a black protective sludge of decayed plant matter. After the hull disintegrated the natural stability of the sea bed reasserted itself, and the pits filled with sand to seal and protect the jumbled archaeological deposits within them. Below a depth of 15 to 20 cm from the present day sea bed the organic deposits are stable and well preserved (Figure 12). The line which divides the surface layer from the stabilised zone is very distinct, as is demonstrated when an object lies partly in one and partly in the other. An example is provided by the large pulley block at Grid 18.149, a corner of which lay on the edge of the guncarriage wheel centred on Grid 17.147 (Figure 13).

The peculiar circumstances of this wreck's environment has ensured the survival of a sample of material which, although it represents only a very small proportion of the ship's original contents, is remarkably comprehensive and well preserved. Since La Trinidad Valencera was one of the largest units in the Spanish fleet, and carried a wide range of stores and equipment connected with the projected landings in England, her wreck is therefore a fundamental source of evidence for understanding the Armada as a whole.(36)

Chapter Four: _Santa María de la Rosa_

The _Santa María de la Rosa_ was built as a large merchant vessel at San Sebastián in 1586/7 by Martín de Villafranca, _vecino_ of that town.(1) By the second half of the sixteenth century Basque shipbuilding was a well-developed industry, the technical competence of which is currently being revealed by the excavation of the remarkably well preserved hull of a 400-ton Guipuzcoan whaling ship, the _San Juan_, which was lost in 1560 at Red Bay, Labrador.(2) By the summer of 1587 the _Santa María_ had been fitted out and was preparing to sail on her maiden voyage when she was embargoed to act as _capitana_ of Miguel de Oquendo's Guipuzcoan squadron, which was on the point of sailing to join the Armada at Lisbon. There, on 31 October, the armament of the ship was inventoried thus: (3)

40 bronze 18-_lbr_ _medios cañones_ from Gregorio Loefer's foundry, all mounted on field carriages

6 bronze _medias culebrinas_ 9-, 10-, and 11-_lbr_; 2 of Remigy de Halut, and 2 from the Ragusan foundry, all mounted on field carriages

480 balls for the above guns, plus 2000 for the _esmeriles_

2 bronze 1 1/2-_lbr_ _falcones_ mounted on old swivels

1 6-oz _esmeril_ with an iron swivel

All the above belonged to the king. The following belonged to the ship:

9 iron _falconetes_ of 1 1/2-2-_lbr_

2 iron _lombardas_ of 4 1/2- and 7-_lbr_ stone shot

1 iron _passamuro_ of 2-_lbr_ iron shot

700 iron balls

On 7 January 1588 the _Santa María_ was credited with a crew of 138, of which 14 were officers, 85 seamen, and 39 ships' boys.(4) At this date she is still described as the squadron's _capitana_. By 19 March, however, she had lost her flag status to the _Santa Ana_[54], in which Oquendo ultimately sailed, and had become the squadron's _almiranta_ or vice-flagship.(5)

A statement of additional artillery required by Oquendo's squadron, remitted with a letter dated 5 March, lists the _Santa María_ as needing an extra nineteen guns.(6) According to an inventory of 14 May, however, she actually received only two of these additional pieces, together with other ordnance stores: (7)

1 _cañón pedrero_ — both of _la nueva fundición_,
1 _media culebrina_ — and both on sea carriages

4 sets of field carriages and limbers for the _media cañones_

2 wooden beds for _esmeriles_, and 2 rammers

1 wheel for a _medio cañón_ field carriage

300 pikes

90 arquebuses

4 rammers with handles

4729 _libras_ of powder

22 wooden wedges and 18 handspikes

30 iron balls

30 stone balls

6575 _libras_ of match

A report of 19 March shows that no structural alterations had been made to prepare to _Santa María_ for the campaign, though other members of the squadron received considerable modifications to convert them from merchantmen into auxillary warships.(8) From this we may infer that the _Santa María_ was from the start considered to be a strongly built ship.

At the final muster on 9 May the ship was listed with a burden of 945 tons, an armament of 26 guns (one less than the total indicated in the documents cited above), and a complement of 297 men, of whom 225 were soldiers. She carried 80 _qtx_ of powder, 20 _qtx_ of lead, 16 _qtx_ of match, and 1300 rounds of shot. Martin de Villafranca, the vessel's unfortunate owner, remained in command, while two captains from the _tercio_ of Sicily, Lope Ochoa de la Vega and Francisco Ruiz Matute, and one officer from Don Francisco de Toledo's _tercio_, Cristóbal Rivero, sailed with elements of their companies. The five *adventureros* aboard included the brother of the marquis of Villena, Don Diego Pacheco, who took with him 19 retainers. The other four, Jusepe Justen, Juan de Alba, Juan Cler and Pedro Dere, were apparently less well connected: they had no followers at all.(9)

In the storm which scattered the Armada off Corunna the *Santa María* was severely damaged, losing her mainmast with all its associated rigging. Several men were injured, and most of the provisions were spoiled.(10) On 10 July the ship was remasted at Corunna, under the supervision of the duke of Medina Sidonia, who wrote to the king the following day to report the fitting of the new mast. The operation had been a major one, taking more than six hours to complete: when it was over, the duke observed with some satisfaction, "I thought we had not done badly..."(11)

While the *Santa María* was out of commission because of these repairs the vice-flag evidently passed to her Guipuzcoan sister-ship *San Salvador*[56], though when a muster was held before the Armada left Corunna the *Santa María* is once again listed as *almiranta*.(12) As such, too, is she rated with her loss off Ireland was finally recorded in Spain.(13)

Though we are nowhere directly told of the ship's part in the battles, that she was heavily engaged is implicit in her only survivor's statement that "this ship was shot through four times, and one of the shots was between the wind and the water, whereof they thought she would have sunk, and most of her tackle was spoiled with shot". In all, the survivor reported, the ship suffered 200 casualties "by fight and sickness".(14)

According to his testimony the Santa María stayed with the main body of the fleet in its north-about course until early in September. Then a storm dispersed them. "Where he left the duke [of Medina Sidonia] he knoweth not...he saw no land and can therefore name no place but they feared by tempest, the duke kept his course to the sea; we drew towards the land to find Cape Clear, so did divers other ships, which he thinks to amount to the number of forty ships..."(15)

Only one other vessel reported having seen the Santa María as she struggled through the north Atlantic. She was the almiranta of the hulks, the San Salvador[56], commanded by Pedro Coco Calderón. "From the 24th [of August]," wrote Calderón, "we sailed without knowing whither, through constant storms, fogs and squalls. As this hulk could not beat to windward it was necessary to keep out to sea, and we were unable to discover the main body of the Armada until 4

September, when we joined it. On this day, as we were sailing to leeward of the body of the Armada, we saw the ship Villafranca of Oquendo [i.e. the _Santa María de la Rosa_] and another Levantine ship fall away towards the Faroes and Iceland. These ships were far to leeward of us."(16)

Seventeen days later the _Santa María_ was off the south-westerly tip of Ireland, in sight of the Blaskets, and in acute distress. Sea and weather conditions were appalling: this was the day of the "great gale" which Edward Whyte, Clerk to the Council of Connaught, described as "a most extreme and cruel storm the like whereof hath not been heard a long time, which put us in good hope that many of the Armada ships should be beaten up and cast upon the rocks."(17) The Blasket Islands, separated from the mainland shore by a narrow sound, offered the _Santa María_ a slim hope of refuge. When, at noon, she entered the Sound from the north she found three other Armada ships already sheltering off Great Blasket Island, though their situation was scarcely less perilous than her own. These ships were Juan Martínez de Recalde's _San Juan_ of Portugal[2], the _San Juan_ of Castile[28], and a _patache_. They had arrived a week earlier, gaining the lee of the Great Blasket by passing through a narrow passage in the western reefs, a superb piece of seamanship on the part of Recalde, who knew this coast well. There they had remained at anchor, making repairs, taking on water, and awaiting a fair wind for

Spain.(17) Marcos de Aramburu, commander of the Castilian San Juan, who was both an eye-witness and a direct participant, recorded the dramatic and terrible events which took place on 21 September in Blasket Sound as follows:

"On the 21st, in the morning, the west wind came with some terrible fury, but cloudless and with little rain. The ship of Juan Martínez drifted down on ours, cast anchor and another cable, and having smashed our lantern and our mizzen tackle and rigging, the flagship secured herself. At mid-day the ship Santa María de la Rosa, of Martín de Villafranca, came in by another entrance nearer land on the north-west side. She fired a shot on entering, as if seeking help, and another further on. All her sails were in pieces except the foresail. She cast her single anchor, for she was not carrying more, and with the tide coming in from the south-east side and beating against her stern she stayed there until two o'clock. Then the tide waned, and as it turned the ship began dragging on our two cables, and we with her, and in an instant we could see that she was going down, trying to hoist the foresail. Then she sank with all on board, not a person being saved, a most extraordinary and terrifying thing. We were dragging on her still, to our own perdition. But our Lord had willed us, in case of such necessity, to put a new stock to an anchor which had only half a stock, which Juan Martínez had given us, with a cable. We cast this anchor, the ship turned her prow; and we hauled in the other anchor, finding the stock with half the shank, for the rest was broken, and the cable chaffed by the rocks over which we were lying."(19)

The sudden sinking of the Santa María was also observed from the mainland cliffs at Coumeenoole by James Traunte, who reported: "...as soon as ever they cast anchor they drove upon a rock, and there, was cast away into the middle of the sea, with five hundred tall men and the Prince [of Ascoli], and no man saved but one, that brought us this news, who came naked upon a board".(20)

The survivor was Giovanni de Manona, a Genoese, son of the ship's pilot. Of the moment of wrecking, he had this to say: "This ship broke against the rocks in the Sound of Bleskies a league and a half from land upon the Tuesday last at noon, and all in the ship perished saving this examinate, who saved himself upon two or three planks; the gentlemen thinking to save themselves by the boat, it was so fast tied as they could not get her loose, thereby they were drowned... He saith that as soon as the ship broke against the rock, one of the captains slew this examinate's father, saying he did it by treason..."(21)

On being pressed for details of "ordnance, wines, and other matters of moment", Giovanni stated that "on the ship here cast away...were fifty great brass pieces, all cannons for the field, twenty-five pieces of brass and cast iron belonging to the ship, there is also in her fifty tuns of sack. In silver there are in her fifteen thousand ducats, in gold as much more, much rich apparel and plate and cups of gold". In a later statement the survivor added that "this ship that is drowned hath in her three chests full of money".

If we discount the fifty great brass pieces, which are surely a misunderstanding, a mistranscription, or a downright lie, the number of guns given by Giovanni is remarkably close to what we know to have been aboard the ship from Spanish sources. His figures for the treasure and wine on board are probably equally close to the mark.

No mention of the Armada wreckings in Blasket Sound is made in the remarkable native literature of the Blasket Island community, (22) although there is a strong tradition on the mainland at Dunquin that the stone-capped mound which stands close to the village is "the grave of the son of the king of Spain". Spotswood Green records that in the mid-nineteenth century Blasket fishermen brought up in their trammel nets a small bronze gun, emblazoned with a coat-of-arms, which balanced muzzle-down.(23) The piece evidently disappeared during the troubles of 1916.

ii. <u>The location of the wreck</u>

The above evidence prompted Sydney Wignall, in 1968, to attempt a search of Blasket Sound for the *Santa Maria*'s remains. Since the area within which the wreck might be supposed to lie covered some four million square metres, the task was a formidable one (Figure 14). That it was accomplished was due to the skill of Commander John Grattan of the Royal Navy, who directed a three-month programme of swim-line searches which, on 6 July 1968, located the site of the wreck.(24) Archaeological survey and a limited programme of excavation began under the writer's direction in the late summer of 1968, and continued for a six-month season in 1969.(25)

The remains lie on a flat shingle bottom at a mean High Water depth of 35 m, a position which represents the south-eastern terminus of a north-west/south-east line across the Sound from the anchorage off Great Blasket Island (Figure 15) This line is indicated first by a sequence of iron anchors, discovered during the searches, and then by the main pinnacle of an underwater reef close to the centre of the Sound's narrowest part. This line reflects the mean influence of wind and tide on 21 September 1588, and the events which these forces precipitated, exactly as described in Marcos de Aramburu's account. The reef pinnacle, Stromboli Rock (it was hit during the nineteenth century by a vessel of that name), is still not adequately marked on Admiralty Chart 2790, published in 1966. It is, in fact, some distance west of its plotted position, and it rises to within 2 m of the surface instead of the 5 m suggested by the chart. On this pinnacle the Santa María struck, having been dragged towards it by a combination of the westerly gale and the two-knot run of the ebbing tide. So quickly did she sink that she hit the bottom only 200 m down-tide of the rock.

Taking the position of the Santa María's wreck as a starting point, we can with some confidence identify the anchors found to the north-west of Stromboli Rock. Two of them, which lie in the sheltered area between Great Blasket and Beginish Island where Recalde and Aramburu first anchored, are almost certainly those lost by the two San Juans when they collided and broke free of their moorings on the morning of 21 September. We can, without serious doubt, ascribe to Aramburu himself the anchor which possesses only its arms and half its shank, and which is surely the missing part of the the "stock with half the shank" which he was able to recover when the crisis had passed (Figure 16). At the northern base of Stromboli Reef, just a cable's length (about 200 m) from the main pinnacle, what must be the Santa María's sole anchor ("for she was not carrying more") still lies hooked foul on a ledge of rock, its shank pointing towards the wreck (Figure 16). Between this anchor and the two lying in the anchorage a fourth was located: this may, perhaps, indicate the spot at which Recalde and Aramburu managed to re-anchor just before the Santa Maria came into the Sound.

Two hours after the Santa María went down a second ship, the San Juan Bautista[40], a converted merchantman of the Castilian squadron, entered the Sound without a mainmast and with her sails in shreds. Some days later this ship also appears to have sunk in or near to Blasket Sound, although her men and some of her guns were taken off by Recalde before she foundered.(26) Unfortunately on 24 September we lose our key witness, Aramburu, who sailed for Spain (which he reached safely on 14 October, followed a few days later by the dying Recalde). We have no means of knowing, therefore, where the San Juan Bautista's wreck might lie, and the possibility must be considered that it, and not the Santa María, is the ship now at the base of Stromboli Reef. Fortunately, two finds made during the 1969 excavations resolve this doubt. They are a matching pair of pewter plates, and each is inscribed on its lower rim with the name 'MATUTE' (Figure 17). Since we know from Spanish sources that a man of this name embarked with the Santa María de la Rosa, and from English sources that he perished with it, this find establishes beyond any doubt the identity of the Stromboli Reef wreck.(27)

iii. The wreck site

The visible remains of the wreck comprise a mound of packed limestone ballast which is merged at its edges with the natural seabed of loose shingle. The feature is 30 m long and 12 m broad at its widest part. Excavation was to show that the average depth of the ballast was about 0.75 m, suggesting a mass in air of about 90 tonnes. The central ridge of the mound runs in a north-south direction although, as will be seen, this does not represent the main axis of the wreck (Figure 18).

Towards the south of the mound the eastern and western edges draw together to form a marked 'tail', the tip of which trails away into the natural shingle. On the north and north-western edges of the mound massive concretions of piled iron shot form a solid, larva-like crust, while seven lead ingots were found lying on top of the ballast at its highest point.

Thought was given to the question of identifying bow and stern ends. There exists a description of the well known Tobermory wreck, that of the Levanter San Juan de Sicilia[71], as it appeared to a salvor working on it in the late seventeenth century. The salvor, Archibald Miller of Greenock, had this to say of the ship's remains: "There is no deck upon her except in the hinder part...in the fore part of the ship lie many great ballast stones, with some shot amongst them".(28) The latter part of this description implies a configuration remarkably similar to that observed at the northern end of the Blasket Sound wreck. Miller speaks of a concentration of ballast in the fore part of his ship, just as occurs in the broad head and narrowing tail of the Blasket mound. A consideration of the factors involved in ballasting a ship of this type suggests an explanation. The massive castle-work of the stern, with its associated armament and fortification, must have exerted considerable stern-down component in the trim of such a vessel. Ballast concentrated forward, tapering gradually aft with the run of the hull, would correct this imbalance and would leave on a wreck site a spread of ballast like that noted by Miller at Tobermory and now evident in the Blasket mound. Miller also noted the presence of shot in the fore part of the Tobermory ship, and this is paralleled by the shot concretions at the broad northern end of the Santa María wreck.

The visible features of the wreck on discovery offered no obvious indication of how the ship had broken up. Since the disposition of large metal objects, particularly the ship's guns, seemed a likely indicator of the way in which the hull had collapsed, arrangements were made with the Research Laboratory for Archaeology at Oxford to carry out a metal detector survey on the ballast mound and over the surrounding sea bed. This operation was carried out by Jeremy Green (then of the Laboratory), with the assistance of the writer, and although later excavation confirmed the detector's ability to locate small metal objects, ferrous and non-ferrous, up to a buried depth of at least 0.6 m, no large contacts such as might be expected of a gun were recorded.(29) The metal detector survey, though leading to the discovery of a number of scattered artifacts, thus added little to what was already known about the lie of the wreck, and it was felt that selective excavation of the structural remains which were evidently pinned beneath the ballast mound should proceed (Figure 19).

iv. Excavation

Excavation was first directed along a structural line of axis running north-west/south-east which proved to be the keelson of the forward part of the ship. This feature had been constructed in scarf-jointed lengths, 25 cm broad by 20 cm deep, with rib slots cut into the underside. At 2 m intervals the stanchions which carried the orlop beams were tenoned into the keelson, and some of these posts had survived up to the level of the ballast. Others could be identified by the mortices cut into the keelson to receive them.

Hard against the port side of the forward stanchions and running along the axis of the keelson were two 6 m planks, each 30 cm broad and 5 cm thick, set on edge one atop the other. They were not fastened in any way, being held in place against the uprights solely by the pressure of the ballast. They can thus be recognised as shifting boards, used when the ballast was moved from one side of the ship to the other during careening, or for the routine trenching which was necessary to check the floor timbers for leaks. They will also have helped to prevent the ballast from shooting sideways in heavy seas, or when the ship was sailing on a tack. Mainwaring, writing in the early seventeenth century, describes the use of such boarding, which he calls "pouching".(30)

10.5 m from the bow end of the ballast, on the keelson axis, a complex structural arrangement was uncovered (Figure 20). Here a series of uprights and boards had formed a rectangular box, now partially collapsed, set lengthwise directly above the keelson. The box had been constructed to withstand pressure from without, which suggests that its function had been to hold an open space within the ballast. Where it passed beneath this space, and for some distance fore and aft, the keelson was 40 cm deep - double its normal thickness. Under the forward part of the box the keelson was massively torn and splintered, as though by the ripping out of a heavy structure once bolted to it. On either side the keelson had been supported by a 10 cm square longitudinal sleeper, the starboard one of which is now displaced sideways. The floor of the box was packed flush with the level of the keelson and sleepers with two runs of planking, evidently in order to secure a flat, firm base for seating and supporting a solid structural unit now no longer in place.

Three heavy timbers were then uncovered, riding athwartships above the main hull frames on the starboard side of the box. Their inboard ends, which were squared off and slightly tapered, lay over the displaced starboard sleeper. Clearly these ends had mated with recesses in a now vanished component, which analogy and structural considerations clearly identify as the mainmast step. The box arrangement around the mast step is paralleled in the remains of a large ship excavated at Woolwich in 1912, variously identified but certainly belonging to the first half of the sixteenth century.(31) The thickening of the keelson at this point of heavy stress is prescribed in an English shipbuilding treatise of 1620. Finally, the supporting riders, intended to buttress the mast step athwartships, are closely paralleled in the arrangement noted on the remains of a vessel discovered at Rye and believed by its excavator to date not later than the end of the sixteenth century.(32)

Structural distortion in the area surrounding the Santa Maria's mast step, and the ripping out of the long iron bolts which had bound the step itself to the keelson fore and aft, suggest that the mast toppled towards the south, the direction in which a strong ebb tide, reaching a surface velocity of nearly three knots, was running when the wrecking occurred. The collapse of the mast in this direction may also explain the absence of corresponding riders in position on the port side.

It is of interest to compare the makeshift appearance of the shoring around the mast step with the solid shipwrightry of the other components, for it will be recalled that the Santa María underwent a remasting operation not long before she sank. It is not unreasonable to see in this shoring a temporary arrangement intended to clear the stepping area of ballast in preparation for the new mast that was fitted at Corunna.

After the keelson sequence and mast step had been examined, a transverse trench was begun on the port bow quarter of the ballast mound in order to locate frame timbers. Fifteen closely spaced ground timbers were uncovered, although unfortunately time did not permit the completion of the trench up to the keelson, as had been intended (Figure 21). Every second timber was found to be 20 cm wide and 30 cm deep, and these main members were spaced on average 15 cm apart. Between each pair of main timbers lay a secondary timber, fitting tightly into the gap between its neighbours with its top just below the level of theirs. The lower hull thus appears to have been solid-framed throughout, without internal strengthening other than the mast-step riders.

The outer planking, in the several places where it could be examined, was 10 cm thick. Except in the region of the mast step, there appeared to be no ceiling planking inside the hull. The outer planks were pinned to the frames with oak treenails 2.5 cm in diameter, studded in groups of twos and threes. The plank ends, or butts, where springing stresses were strongest, were bolted with iron, just as Mainwaring prescribes.(33) These bolts were clenched on oakum washers as a protection against salt-water corrosion ("iron-sickness", as Mainwaring called it). Evidence was found of lead patching over leaky treenails.

Just aft of the mast step the structural sequence along the keelson ended abruptly while the last part of the structure showed evidence of distortion and fracture. At this point the ballast mound sharply changed direction, trailing off some 50 degrees to port of the wreck's forward axis. From this it was concluded that the hull had broken just aft of the mainmast, and that the forward section had pivoted to match the run of the ebbing tide. Whether this part of the ship actually broke free, spilling its ballast and drifting down tide, is not yet known; only further excavation will tell. It is more than possible, however, that the starboard side of the hull was extensively damaged when the ship hit Stromboli Reef, and that this break was continued to port with the subsequent ripping out of the mainmast. If so, the stern will have gone completely, perhaps taking with it much of the upper decks with their contents and guns. Relieved of its ballast, the main part of the ship might well have drifted down-tide into very deep water before eventually breaking up. The tapering nature of the tail of the ballast mound, and its close alignment with the run of the tide, supports such a hypothesis. But all that can be said with certainty at present is that the entire lower forward hull and the bulk of the ship's ballast are still on the site.

Small finds made in the course of these excavations were not numerous. To the north of the ballast mound a concreted deposit, which lay beneath a shallow covering of shingle, was excavated. This contained a number of concreted musket and arquebus barrels, a pike butt, the 'Matute' plates, a pewter medallion, and two glass beads. Shot of various calibres was sampled, though the bulk of it was left on the site. The sizes were found to agree broadly with the calibres of guns associated with the ship in documentary sources. A group of 13.2 cm calibre iron balls is appropriate to the four 18-lbr medios cañones, while another group, averaging 10.7 cm in diameter but showing variations extending from 10.2 cm to 11 cm would neatly straddle the three calibres (9-, 10-, and 11-lbr) of the six medias culebrinas aboard. A group of smaller iron roundshot, ranging from 2.5 cm to 6 cm in diameter, can be ascribed to the various small calibre guns from the single 6-oz esmeril to the nine 1 1/2- to 2-lbr falconetes. Stone shot of 16.5 cm diameter (about 14-lbr) identifies the otherwise unrecorded calibre of the single bronze pedrero of the 14 May increment, while smaller stone balls of 9 cm and 11 cm confirm the presence of the 4 1/2- and 7-lbr iron lombardas. There is, however, some shot for which guns cannot be found in the documentary sources. Two rounds of 8.5 cm iron shot, suitable for a 5-lbr piece, may represent no more than an administrative error, but it is less easy to dismiss a group of 17.8 cm iron balls, appropriate to full

40-lbr cañones de batir, together with a single 15.3 cm (30-lbr) shot. Either the ship did, in fact, carry cañones de batir which have eluded mention in the documents (and Giovanni de Manona's confused "50 great brass pieces, all cannons for the field", might be taken to support this possibility) or, perhaps more probably, ammunition for the siege train was in some cases carried by ships which did not themselves have any cañones de batir aboard.(34)

Excavation in the area of the mast step yielded a small but varied collection of pottery, part of a pewter goblet, a brass balance pan, fragments of barrel-ends and staves and a brazil nut. Investigation of a metal detector contact at the southern "tail" of the ballast mound revealed part of a human skeleton associated with a pewter plate and two coins - a gold 2-escudo of Philip II, minted at Seville, and a silver 4-real, also of Philip II, bearing the Mexico City mark. Lead shot of musket and arquebus calibre was scattered widely over the site.

Further excavation of this wreck would certainly yield much structural data, and perhaps a considerable number of finds. Unfortunately its depth and exposed position severely restrict the amount of effective work that can be done with limited resources, since without decompression facilities it is only possible to dive for a maximum bottom period of twelve minutes during each of the two daily periods of slack water.

Chapter Five: *El Gran Grifón*

El Gran Grifón, rated at 650 tons and carrying thirty-eight guns, was *capitana* of Juan Gómez de Medina's squadron of supply-hulks (*urcas*). Her port of origin was Rostock, a Hanseatic Free City which bore as its crest a golden griffin from which, no doubt, the ship took her name.(1) She was embargoed at San Lúcar on 1 March 1587,(2) and was again listed among a group of ships "assembling in Andalusia" on 18 July 1587, at which date she had on board 40 seamen, 50 soldiers, and 27 iron guns.(3) The latter presumably represented her original armament as a Hanseatic merchantman, before any additions were made. The ship was present at the muster held at Lisbon on 7 January 1588 and by 19 March she was reported operational.(4) By 14 May she had been issued with an increment to bring her armament up to strength.(5) This included:

4 bronze *medias culebrinas*, on sea carriages

4 bronze *medias sacres*, on sea carriages

(these guns are listed in the final squadron summary as being of *la nueva fundición*)

140 *varas* of linen for cartridges, to be distributed among the squadron

3 *lbs* of stitching thread

150 *bombas*, to be distributed among the squadron

200 *alcancías* to be distributed among the squadron

1 sack of roundshot

20 *pelotas de cadena* and *enramadas*

1420 pieces of iron shot of all calibres

20 muskets

100 arquebuses

253 lbs of musket bullets

425 lbs of arquebus bullets

4165 lbs of arquebus powder

1424 lbs of match

26 cradles and levers of wood

2 rammers

1225 lbs of lead

At the final muster on 9 May 1588 El Gran Grifón had a complement of 43 mariners and 243 soldiers.(6) Most of the seamen were probably her original Rostock crew under their captain, Burgat Querquerman, who was later to die on Fair Isle.(7) The soldiers were from the tercio of Nicolas de Isla, and three of their company officers - Patricio de Antolinez, Pedro Hurtado de Corcuera, and Estéban de Legorreta - sailed with them. Also on board was the squadron commander, Juan Gómez de Medina; a minor aventurero called Vasco de Lago; and three expatriate Irish catholics.(8)

The muster of 9 May also records totals for the ship's quotas of roundshot, powder, lead and match: 1900 pieces of shot, 48 qtx of fine-grained powder, 19 qtx of lead, and 15 qtx of match. Apart for the eight bronze pieces added at Lisbon we know nothing from documentary sources of her armament, except that the 27 guns with which she arrived at San Lúcar were all of iron, and ranged in calibre from 4-ozs to 6-lbs. The nature of the additional three guns which brought her final total to thirty-eight is not known.

Thus the ship's armament, while not particularly heavy (we may hazard a total firepower of a little over 100 libras), was nonetheless appropriate to her status as a non-combatant flagship. It puts her in the same category, for example, as most of the Castilian galleons.

As things turned out, however, El Gran Grifón was to see a good deal of action. She was involved in some desultory prize-chasing off the Scillies when the main body of the Armada was stuck at the Corunna rendezvous,(9) and during the action off Portland on 2 August her name again crops up.(10) On the following morning, off the Isle of Wight, she was attacked and all but cut off as she straggled behind the Armada's exposed windward wing by a strong English force almost certainly led by Francis Drake. After sustaining severe damage and casualties in this action El Gran Grifón was towed out of the mêlee by one of the galleasses, and brought to the comparative safety of the fleet's centre to make emergency repairs.(11) Six days later she seems once again to have been in fighting trim, for she is mentioned by a witness aboard the galleass Zúñiga among the fifteen or so ships which, led by Medina Sidonia's San Martín, fought the dogged rearguard action which saved the

Armada from rout off Gravelines.(12)

Perhaps because of battle damage sustained during these engagements - an account by an anonymous survivor, possibly Juan Gómez himself - tells us that one of her seams gaped a hand's breadth apart - and no doubt also because of her inherently poor sailing qualities - the Grifón lagged behind the main body of the fleet during the north-about voyage.(13) After a harrowing series of misadventures in the north Atlantic and off the Irish coast she was driven back to the north, eventually fetching up into the lee of Fair Isle stricken and close to foundering. There, on 28 September, she was wrecked, although all on board came safely ashore. Fifty of the castaways, among them the master and mate, died of privation during their six week stay on the island although most of the rest, including Gomez de Medina, returned at length to the Netherlands and Spain via Shetland, Anstruther and Edinburgh.(14)

ii. Location of the wreck

The whereabouts of the Grifón's wreck, handed down in a Fair Isle folk memory through four centuries which is now confirmed by archaeology to be entirely accurate, is the narrow cave-ended geo of Stroms Hellier, close to the south-eastern corner of the island (Figure 22).(15) The geo is relatively sheltered from the prevailing south-westerly winds, and salvage operations were evidently contemplated in 1595 (if not before), when a contract was signed between Earl Patrick of Orkney and William Irvine of Sebay to raise the ship's guns.(16) It is not known whether these operations were carried out with any success, but in 1728 two noted "wrackmen", Captain Jacob Rowe and William Evans, working with Rowe's patented diving equipment, recovered two bronze guns "of a large size" from the wreck, which they were exploring in the mistaken belief that the vessel was the flagship of the whole Armada which, as well as mounting "130 brass guns or thereabouts" (even the real San Martín had only carried 48), contained a fortune in treasure.(17) The confusion doubtless sprang from Gómez de Medina's name, and as for the treasure, although the Grifón had undoubtedly carried some, it was saved by the survivors and brought "unspoiled" to Edinburgh.(18) Rowe's fruitless work on the site was abandoned after only two months in favour of a much more productive wreck, that of the Dutch east Indiaman Adelaar, which sank in March 1728 off Barra with a large quantity of coined and bar silver on board.(19) Thereafter, so far as is known, no further diving operations were carried out on the <u>Grifón</u> site until 1970.

iii. The wreck site and its interpretation

In June 1970 the writer, in conjunction with Sydney Wignall, Christopher Oldfield and Simon Martin, located the remains of *El Gran Grifón* on the south-eastern side of Stroms Hellier. Three months of survey and limited excavation under the writer's direction followed. A brief visit to the site was made in 1973, and in 1977 a team from the Institute of Marine Archaeology, led by the writer, carried out a four-month programme of excavation. The finds are now lodged in the Shetland County Museum, Lerwick, and no further work on the site is planned.

The strata of Old Red Sandstone on the eastern side of Fair Isle incline towards the north-west at an angle of some 60 degrees. Stroms Hellier itself has been formed by the collapse of two caves which ran at right angles to the trend of the strata and whose inshore ends now penetrate deep into the cliff base (Figure 23). The tilting plate which once divided these caves survives as a spine of rock running northeast-southwest through the centre of the *geo*, rising above sea level at its inshore end and terminating to seaward where the shore line existed prior to the penetration and collapse of the caves. This geology gives the north-west facing rock slopes, above and below the water, a tendency to overhang. The central spine divides the *geo* into two deep gully systems which narrow progressively as they run inshore towards the caves. At their inshore ends both gullies slope upwards, and their U-shaped bottoms are well scoured by small quantities of mobile sediment. Only in isolated pockets does relatively stable detritus occur, and even this tends to move in moderate sea conditions. As the gullies widen to seaward the shingle becomes deeper, more stable, and composed of sand, shell, and rounded boulders up to 40 cm in size. In several places large rocks lie jumbled up in the gullies. Some have the jagged edges and rough faces indicative of recent breakage, and have clearly fallen from the overhanging cliff above in the not too distant past. Although the rate of erosion seems fairly slow (no major fall was noted between 1970 and 1977), it is likely that many of these rocks have intruded upon the site since 1588.

Seaward of the *geo* the bottom is relatively flat and open, with large scattered boulders. Water depth increases progressively and rapidly, reaching the 20 fathom (37 m) contour within 80 m. Surface heights and spot depths are indicated on the general site plan.

The shallow parts of the site, especially the top of the spine and the flat platform surrounding Point o' Skairharis, supports a vigorous growth of *Laminaria digitata* and, within the tidal zone, *Laminaria hyperborea*. The gully sides and bottoms, however, carry only a sparse and stunted population of *digitata*. Since this species is adapted to survive in exposed tidal shallows, its poor condition indicates that within this environment extreme conditions of water movement and abrasion prevail. Such conditions are not apparent when diving on the site, since operations are naturally conducted in periods of relative calm. It is possible, however, to assess in general terms the behaviour of the gully environment from surface observation in bad weather.

The _geo_ faces towards the east and north-east, and while these are not the directions of the prevailing wind they are exposed to a substantial proportion of each year's rough weather, particularly during winter. Indeed the worst storms of all - the so-called 'storms of the century' such as the great gale of 1900 - invariably come from this direction. It is still told on Fair Isle how, in 1900, 60-foot seas broke over the south-east end of the island and covered the fields and crofts in white water.(20) A wave of such height, having expended its momentum against the overhanging and narrowing wedge presented by the _geo_, would collapse downwards and impose its full weight directly on the _geo_ bottom. This would force violently seawards, by displacement, the water already in the gullies. Because of the great volume of water involved the resulting velocity in the gully bottoms would be extremely high. It would certainly be capable of displacing and mixing the relatively stable deposits of deep shingle, and of moving large boulders. Clear archaeological evidence of shingle movement up to a depth of 1.6 m was indeed observed (below, p.), while the horizontal displacement of one large boulder by 1.5 m occurred at some time between 1970 and 1977, on which two occasions its precise location was plotted.

It was into such an environment that the wreck of _El Gran Grifón_ was deposited. Little archaeological cohesion can therefore be expected in the remains, for the observed distribution of artifacts has clearly resulted from a total break-up of the ship against the cliff, with subsequent deposition into the deep gully bottoms. No hull structure appears to have survived. However, it may be supposed that the larger and heavier objects have not moved far from the locations of their initial deposition (though they may first have dropped and rolled some distance in getting there) and so their positions probably relate, in some measure at least, to their original positions within the ship.

The wreckage observed lies entirely within the gully system to the south-east of the central spine (Figure 24). A long cast-iron gun, identified as a _media sacre_, was wedged into the narrow gully bottom close to the foot of the cliff, where it is fully exposed to the abrasive effect of the moving sediments which have worn it down so that it is now, in effect, sectioned longitudinally. This gun represents the most inshore wreckage so far noted. Some 5 m seaward of it a group of four lead ingots was found, while two more ingots and a broken cast-iron gun lay 12 m further on, at a point at which the gully begins to broaden and fill with deep shingle. Removal of this shingle - a task which took the most of the 1977 visit to accomplish - exposed a solid mass of iron concretion filling the gully bottom. The concretion was composed almost entirely of iron roundshot, clearly visible in the abraded top surface as a pattern of disc-shaped sections. The smooth top of the concretion, and the bright unoxidised surfaces of the sectional shot, showed that the abrasive effect of moving shingle was regularly active up to at least 1.6 m below its normal surface, which was the maximum depth removed.

Lying directly on the top surface of the concretion were two more guns. One was a bronze _media culebrina_ in relatively sound condition, though its dolphins and muzzle end were missing. A single dolphin was found close to its breech, within the concretion, while the muzzle was located ten metres away in a neighbouring gully. The second loose gun, of which only the abraded breech end survived, was of cast iron.

Within the concretion layer one cast iron gun and three wrought iron breech blocks were discovered (Figure 25). Abrasion had removed most of the cast gun's top part, but the concretion had protected its lower metal so that an excellent longitudinal section of the weapon was preserved.

The main concretion terminated where the gully rises towards its seaward end, and a metal detector survey suggested that, apart for a small deposit of iron shot in a nearby fissure, no further wreckage lies in this direction. Beyond this point the gully is effectively blocked off by the rising bedrock, so creating a natural trap for the wreckage contained within it.

Ten meters or so south-east of the gully just described, and running parallel to it, is a second gully. At its seaward end, which is 19 m below the surface, this gully reaches a width of 12 m, and is here blocked off by rising bedrock. The gully runs close inshore under the shallows around Point o' Skairharis at a depth of 16 m, at which point it lies beneath a considerable rock overhang, and then climbs towards the base of the cliff where it terminates in a rising and narrowing fissure filled with large boulders. In the central part of this gully, at a depth of 16 m, seven guns lay partially exposed. These included a bronze media sacre, three cast iron guns, and three wrought iron gun barrels. Excavation revealed, in addition, four wrought iron breech blocks, a breech fragment from a cast iron gun, and the missing muzzle end of the bronze media culebrina noted in the adjacent gully. This area also yielded lead and iron shot, a curved iron blade which may be a sheer hook, some fragments of copper and pewter utensils, and a silver 4-real coin of Philip II from the Toledo mint. At the seaward end of this deposit a wrought iron rudder pintle was located, which together with eight fragmentary iron bolts, a brass sheave, and two brass sheave bushes, constitute all that can now be recognised of the ship and its fittings.

In all, 370 pieces of iron shot were found on the site, together with six socketed lead hemispheres from bar shot and four lead balls of greater than hand-gun calibre (Figure 49). A total of 4,594 lead balls suitable for musket and arquebus were also recovered.

Seventy m north-east of Point Saider a wrought iron anchor was located at a depth of 23 m. Its proportions and appearance are entirely compatible with its belonging to a large ship of sixteenth century date, and there can be little doubt that it belonged to El Gran Grifón.

An attempt can now be made to interpret, from the observed remains and information gleaned from documentary sources, the circumstances of the wrecking and the nature of the subsequent deposition of artifacts. The ship, according to the anonymous survivor, approached the island on 27 September 1588 from the direction of North Ronaldsay, driven by a south-westerly gale: "The sea kept giving us such dreadful blows, that truly our one thought was that our lives were ended..." Anyone with experience of these waters, where the conflicting tidal streams of the North Sea and the

Atlantic meet, will appreciate the hulk's predicament. It was at this point that the morale of those on board finally collapsed. "Each one of us reconciled himself to God...and prepared for the long long journey that seemed inevitable. As to force the hulk anymore would only have ended it and our lives the sooner, we determined to cease our efforts. The poor soldiers, too, lost all spirit to work at the pumps. The two companies - 230 men in all and 40 we had taken from the other ship the Barca de Amburg, another hulk, which had foundered while in the Grifón's company off the north-west coast of Ireland, had pumped incessantly and worked with buckets, but the water still increased, till there were thirteen spans of water over the mast step [carlinga] and all efforts failed to reduce it an inch. So we gave way to despair..."(21)

Assuming a span to be nine inches, the depth of water in the hold was thus almost 3 m, which must have brought the ship very close to sinking. But at this crucial point, at two o'clock in the afternoon, Fair Isle (Faril) was sighted. The survivor's account continues: "We arrived at sunset, much consoled, though we saw we should still have to suffer. But anything was better than drinking salt water. We anchored in a sheltered spot we found, this day of our great peril, 27 September 1588."

There can be little doubt that the anchor located 70 m north-east of Point Saider identifies the 'sheltered spot' at which the Grifón anchored at last light on 27 September. This, indeed, represents the first sheltered water which a ship approaching from the south in a south-westerly gale would encounter. The spot lies quite close inshore, and so gains the protection of Stroms Hellier's overhanging cliff. Provided that the wind did not back into the south-east, it was as safe an anchorage as could have been found.

The ship evidently rode out the night here, for the survivor tells us that he and his comrades did not land until the following day. It would have been out of the question to attempt a landing on a strange and hazardous coast in darkness. No doubt, with salvation so close, the ship's company found fresh spirit to work the pumps. What happened at daybreak is not entirely clear, for the account makes no mention of the wrecking itself. But, to someone viewing the shoreline from the Grifón's anchorage, only one reasonable course of action presents itself. Just north of Stroms Hellier a long broad inlet, Swartz Geo, penetrates 200 m into the island, terminating in a sloping shingle beach at the foot of the cliff. The approach to this beach, as the Spaniards could easily have ascertained with a small boat and sounding lead, is deep enough at High Water for a vessel of the Grifón's draught (about 4.5 m) to run well into the geo before grounding. In this way those on board would not only have stood a reasonable chance of getting off alive, but also of recovering from the ship, at Low Water, whatever they required to face the perils that lay ahead.

But if this was their plan, it failed. As we now know, the ship was wrecked not in Swartz Geo but against the overhanging cliff of Stroms Hellier. A more forbidding place is hard to imagine, and it cannot have been chosen deliberately. Perhaps the tidal set to the south which runs across the mouths of both geos, though it reaches at full flood no more than half a knot, was enough to upset what must have been a tricky operation, performed as it was with a waterlogged ship manned by exhausted men. At any event, the ship became wedged fast in the south-eastern corner of Stroms Hellier where, in due course, she was to break up and sink.

Luck, however, did not desert the Spaniards. As the survivor relates, all of them managed to escape. Fair Isle tradition adds that they were able to climb up the masts and step directly onto the cliff top, a story which the topography of the site renders entirely feasible. Juan Gómez and his men were, moreover, able to recover their valuables, though the survivor's statement that they were able to save none of their provisions might be taken to imply that little further salvage of the ship's contents was carried out. This need not, however, be the case. Since the ship had arrived at Fair Isle with 3 m of water in her hold it is likely that all of the provisions stowed there, whether in cask, sack or jar, had already been spoiled beyond recovery.

The main features of the wreck as observed in the course of the excavations may now be summarised. Its seaward end is represented by the deposit at the base of the overhanging cliff which drops from the shallows surrounding Point o' Skairharis. Common sense dictates that this is most likely to have been the stern area, a presumption greatly strengthened by the find here of a rudder pintle. The guns found in this area are relatively light, and include parts of small swivel-mounted pieces (a barrel and four breech chambers), which are likely to have been situated in the stern or on its upper castleworks.

Most of the objects recorded in this gully, especially the iron shot and the few small finds, lie close into the cliff base, which suggests a deposition such as would result from sliding across a sloping deck.(22) It is probable, therefore, that the ship broke up into the cliff rather than away from it.

At the inshore end of the site, the most landward wreckage so far noted is the abraded iron <u>media sacra</u> in the narrow gully immediately south-east of the central spine, at the point where it rises above the water to form an exposed narrow reef (a Fair Isle tradition relates that these rocks are themselves the fossilised remains of the ship). This long iron gun would be a suitable piece for one of the bow chasers. Its muzzle is 39 m from the rudder pintle at the other end of the wreck which, allowing for an outspill each way of 4.5 m, suggests 30 m as an approximate overall dimension of the hull. The group of lead ingots 5 m to seaward of this gun thus corresponds well with the location of ingots in the fore part of the Santa María wreck.

These postulated bow and stern termini therefore leave the midships section, which would have held the main part of the ship's armament and other contents, lying awkwardly across the high ridge which separates the two main gullies and the south-east sector of the geo. Here, almost certainly, the ship would have broken her back, in a manner closely paralleled by the Dartmouth wreck in the Sound of Mull.(23) Since no wreckage has been discovered in the gully on the south side of this ridge, while that to the north is filled with it, it follows that this part of the ship (the midships and forward section if my hypothesis is correct) broke up away from the cliff and against the central spine.

As noted above, this gully was filled with concreted wreckage, mainly iron shot, among and on top of which four guns and three breech blocks were found. Many rounds of musket and arquebus calibre lead shot occurred within the concretion and on top of it, but the bulk of the lead shot came from several sandy pockets in the narrow shoreward part of the gully, together with two small sounding leads. In this area no iron shot was found, except for a piece loaded into the iron *media sacre's* breech.

Within the estimated 200 *tonnes* of shingle overburden which covered the main concretion deposit in the wide part of the gully no metallic, ceramic, or organic artifact was found, despite careful screening. The only objects which may have been associated with the wreck to be found within the shingle level were two worn spherical stones of *c*. 12 cm diameter, which are probably though not certainly stone shot for a gun of the *falcón pedrero* class (Figure 26). It was also noted, in 1977, that two objects lost in the gully during the 1970 operations, a lead belt-weight and a photographic light meter of slight negative buoyancy, had worked their way through the shingle layer and had come to rest directly on top of the concretion.

These observations demonstrate that the site's environment exercises sorting mechanisms of two distinct kinds. Apart from the inshore gun, which is large enough and sufficiently well wedged in the gully bottom to resist water movement, only lead ingots and small lead objects - and even then only those which became trapped in shallow rock pockets - remained at the inshore end of the wreck. It is unreasonable to suppose that only lead objects were present at this end of the ship, and therefore the lighter materials must in some way have been removed elsewhere. We have already seen how severe easterly storms are likely to set up considerable water movement to seaward in the gully bottoms, particularly at their narrow inshore ends, and we may therefore presume that this movement is at times sufficiently strong to drive all materials lighter than lead towards the seaward end of the gully. It is in here, therefore, that the main deposit of iron occurs, prevented from further seaward movement by the rising rock formations.

A second sorting effect here becomes apparent. All of the iron, lead, and bronze objects in the wide seaward end of the gully lie within or just above a matrix of concretion stabilised beneath a layer of drifted shingle up to 1.6 m deep. As noted above, the top surface of the concretion shows evidence of continuing if slow abrasion, which indicates that the shingle on occasion moves down to its lowest observed level.

Objects which were deposited upon such a shingle bed, as they must have been immediately after the ship had broken up, would therefore react in one of two ways. Those of greater mass than the surrounding shingle - the metal objects - would tend to move downwards whenever the shingle below them was displaced. They would thus in time either find a level beyond which the shingle was consistently stable, or reach the gully bottom in a solid mass and stabilise there. At this point, as they have done, the individual objects would begin, through the natural processes of corrosion in sea water, to build up around them a matrix within which they would be securely protected, subject only to a slow process of grinding attrition from the shingle above.

Heavy objects, including guns and lead shot, which arrived in the gully bottom as a result of sea bed movement after this process of stabilisation had been completed, would themselves stabilise as soon as they reached the main concretion layer but would lie on its top surface without further penetration. An iron object deposited in this way would then build up its own covering of concretion although, because it was isolated, the concretion would be less resistant to vigorous shingle movement than the consolidated layer. This effect is evident on the two loose iron guns above the concretion deposit which, although themselves heavily concreted at the time of discovery, showed the effects of severe abrasion when the shell of concretion was removed. The explanation must be that from time to time, presumably in those rare 'super-storms' which may occur less than once in a generation, movement within the shingle becomes sufficiently strong to strip the surfaces of concreted iron objects, thus exposing them to abrasion until a new covering develops.

Objects of similar specific gravity to that of the shingle would tend to move up and down freely as the shingle itself moved. As we have seen, two stone balls may have survived in this way. Ceramics, too, might be expected to survive in a similar manner, although not a single scrap of pottery has been identified on the site. Since a considerable amount of pottery was certainly on board the ship, and not all of this is likely to have been salvaged, it must be concluded that four centuries of movement within the shingle layer has effectively ground it to nothing.

Any material lighter than the shingle, such as wood, bone, or leather, would neither penetrate its surface nor stand any chance of surviving above it. No such material, apart from a cork tampion in the broken muzzle of the bronze media culebrina, and some fragments of wadding in the bores and breechblocks of the iron guns, has therefore survived on the site.

Although a careful search was made of the areas surrounding the identified wreck features, no further deposits, or single items which might have been associated with the wreck, were identified. In particular, the deep gully to the north-west of the central spine was scrutinised carefully, both visually and with a metal detector, without result.

A final point must now be considered. In terms of guns and munitions, a considerable proportion of what we know to have been on board the ship when she left Lisbon has now been identified on the site. If we count the two bronze pieces raised in the eighteenth century, fourteen individual ship guns can now be recognised, together with seven breech blocks. This amounts to about 37 percent of the ship's full complement of thirty-eight pieces. Of her quota of 1900 roundshot we have recovered 370, or nearly 20 percent - and this takes no account of unknown but doubtless considerable expenditure of shot during the fighting, and whatever may yet lie undiscovered in the sea bed or have been ground into oblivion by the abrasive processes of the site. We have also recovered 11 1/2 Castilian qtx of lead, in shot and ingot form, out of the 19 qtx listed before the ship sailed - a full 60 percent, which again makes no allowance for whatever may have been discharged in battle. These percentages suggest that our examination of the site has revealed, at the very least, four-tenths of the heavy weaponry and ammunition of all kinds which were present on the ship when she sank.

In contrast, the recovery of every other class of material has been negligible. Certainly, as we have seen, much will have been destroyed by the site's harsh environment. But what of such items as buckles, buttons, coins, pieces of military equipment, parts of metal utensils, even ship's fittings and hull bolts? Had items of this kind been present in any quantity when the hull went down they would surely have behaved in the same way as the iron and lead shot; we should have expected such finds within and on top of the concretion, and perhaps elsewhere on the site. But they are almost entirely absent. The explanation can only be that the ship, before she broke up and sank, was systematically stripped not only of her contents but also of her fittings, perhaps by the Spaniards themselves but much more probably by the islanders, to whom such a wreck would have been an unprecedented economic windfall. Their modern descendants would have done the same, and quite properly so; the vigorous salvage of wrecked property is no more than sound common sense. The efforts displayed by present-day Fair Islanders to recover a cargo of timbers washed into the heads of almost inaccessible geos, and the determined ingenuity which tempered their at times reckless courage, which I observed during the winter of 1972, leaves me in little doubt that had the opportunity presented itself in 1588 the *Grifón* would have been dismantled to the waterline with considerable speed and efficiency. According to recent researches into weather patterns during the Armada and its aftermath, the wind continued to blow from west and south-west until well into October, and so the *Grifón*'s remains, wedged into Stroms Hellier and supported by the rising sides of the central spine, in all probability remained sheltered, largely above water, and relatively intact for several days.

Only the contents of the waterlogged hold - mainly munitions and perishable goods - and the ship's guns, which would have been difficult to remove and in any case of little use to the islanders, appear to have escaped this determined salvage. For the purposes of our study, therefore, the <u>Grifón</u> wreck site has provided significant information about the ship's armament, but almost nothing else. This evidence, however, is crucial in two respects. First, it has yielded a sufficiently high sample of ammunition to show that not only had the ship not run out of round shot at the close of the fighting, but had expended relatively few - perhaps very few - of the heaviest balls she carried (Figure 49). Second, the find of several impacted lead bullets of musket and arquebus calibre, which can only be English bullets fired at the <u>Grifón</u>'s hull, provide conclusive evidence of the very short range at which she had been engaged. The Spanish claim that much of the fighting had been conducted "at half musket-shot" was no mere figure of speech (Figure 27).

Part III: The Equipment of the Spanish Armada

Chapter Six: The Ships

Introduction

It must be stated at the outset that evidence of ship construction and hull form recovered from the Armada excavations is relatively limited. Only on the *Santa María de la Rosa* wreck were substantial remains encountered, and the physical difficulties presented by that site allowed detailed examination only of selected areas. The *Trinidad Valencera* wreck has yielded no coherent remains, although several disjointed components from her hull show something of the ship's structural characteristics. Further data can be extracted about the construction of the Ragusan *San Juan de Sicilia* from reports of early salvors who saw her partially intact wreck at the bottom of Tobermory Bay. Not surprisingly, in view of their harsh environments, the wreck sites of the *Girona* and *El Gran Grifón* have shown no indication whatever of surviving structure.

A good deal of information, however, can be gleaned from documentary sources. Although, so far as is known, no drawings or technical descriptions of any ships involved in the Armada exist, oblique references concerning the construction and internal arrangement both of individual vessels and of general type-groups are numerous. Taken in conjunction with the archaeological evidence, and with other contemporary or near-contemporary written and pictoral material, these sources allow the fleet's major ship-types to be reconstructed and analysed in some detail.

The relationship between hull dimensions and tonnage at the time of the Armada, and the methods of calculation employed, are discussed in Appendix 1.

Ship types

Since the fleet, with its 130 ships drawn from sources which covered the length and breadth of Europe, was an *ad hoc* and bewilderingly cosmopolitan creation, we are unlikely ever to know precisely how many different ship-types and regional varieties of construction were contained within it. Nevertheless we can recognise several broad classes of vessel, each of which presents a common set of general characteristics, however much its individual members may have varied in detail. They are:

Class 1	Portuguese royal warships
Class 2	*Flota* galleons
Class 3	Galleys
Class 4	Galleasses
Class 5	Mediterranean-built merchantmen
Class 6	Atlantic-built merchantmen
Class 7	Baltic hulks
Class 8	Light craft
Class 9	Landing craft and ships' boats

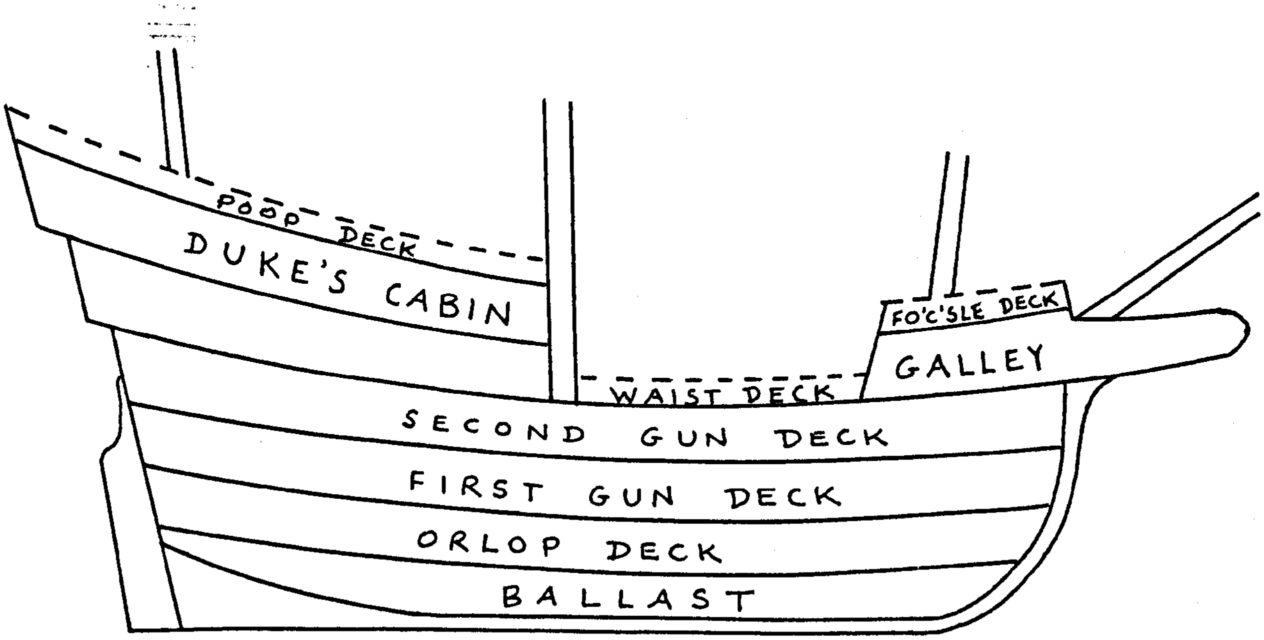
1. Portuguese royal warships

These ships, which had formed the core of the Portuguese fleet, were captured at Lisbon when Spain annexed Portugal in 1580. The largest of them, the *San Martín*[1], which was destined to become the Armada's *capitana general*, was Santa Cruz's flagship in the Azores campaigns of 1582-3. One of the murals in the Escorial's Hall of Battles depicts her at the climax of São Miguel, towing Filippo Strozzi's defeated galleon through the wreckage of the French fleet (Figure 28). These murals were painted in 1590 and their technical accuracy appears generally sound.(1) The _San Martín_ is shown as a three masted vessel of carrack build, high hulled and broad beamed, with two continuous gun decks equipped with lidded ports. She has well defined fighting castles at bow and stern.

The general impression given by this picture is confirmed, and much detail added to it, by the orders which Medina Sidonia issued to the _San Martín_'s company on 7 June 1588, while the fleet was regrouping at Corunna.(2) His allocation of battle-stations to the 100 mosqueteros and 202 _arquebuzeros_ make the ship's internal arrangements quite clear.

Battle-stations	mosqueteros	arcabuzeros	criados
First deck, with the main battery		36	10
Second deck		50	30
Duke's cabin gallery	5	6	
Beneath the stern castle from the mizzen mast to the fore mast (i.e. the waist deck and its extensions fore and aft)	28	52	
On the forecastle (the duke notes that the galley fires (fogones) were located immediately below the forecastle)	12	20	
In the main top	8	4	
In the fore top	4	4	
On the aftercastle	43	30	

On the lower deck (i.e. the orlop): friars, barbers, ship's boys and all the 'unserviceable attendants' (criados inútiles) who, with 8 or 10 seamen, were responsible for tending the wounded and repairing shot damage.



From the above information, and with the Hall of Battles picture as a guide, we can reconstruct the _San Martín_'s general layout as shown above.

What has emeraged is a powerful two-decker capable of bearing heavy ordnance, fitted with dominating castleworks which give room and height for a large complement of troops whose small-arms add considerably to her close-range firepower. The vessel is typical of mid-sixteenth century royal warships throughout Europe. Much the same kind of troop-carrying battleships were to be found in Henry VIII's navy, and the wreck of one of them, the _Mary Rose_, is currently being investigated. It promises to provide much new evidence about the construction, internal arrangement, and armament of such a vessel.(3)

We may note that the short mizzen-mast depicted in the Escorial representation carries a small lateen sail and has no fighting top, a fact confirmed by Medina Sidonia's battle-orders, which place no men here although substantial contingents are stationed in the fore and main tops. The main and fore masts carry two square sails apiece. A bowsprit is shown in the picture and, though it carries no spritsail, we may presume that one existed. Without it such a ship would have been difficult to manage.

This simple rig, coupled with the windage presented by the high sides and castleworks of the hull, particularly at the stern, would not have given her good sailing or handling qualities. Nonetheless these Atlantic-built warships, even if they were somewhat behind the times in 1588, were strong, well-found, and potentially formidable fighting machines. They were evidently seaworthy too. Of the nine which sailed, two (the San Mateo and San Felipe) grounded on the Flemish Banks after the Battle of Gravelines; but of the remainder, even though they had borne the brunt of the fighting throughout the campaign, all save one (the San Márcos) returned safely to Spain.

2. Castilian galleons

These ten ships formed the most homogenous group of vessels within the fleet. Apart from the two largest (the capitana San Cristóbal[27] and almiranta San Juan Bautista[28], of 700 and 750 tons) and the smallest (Santa Ana[36], of 250 tons), all were rated at an identical 530 tons and all of them, except the flagship, carried the same complement of 24 guns, although there is some variation in the types of guns carried aboard individual ships.(4) Nonetheless, a general impression of homogeneity remains. This can be explained by the fact that all these vessels were members of the Indian Guard, the Seville-based fleet of escort warships responsible for the safe trans-Atlantic passage of the treasure-carrying *flotas*, which was maintained by the *Casa de la Contratación* out of the *avería*, a special levy added to the normal duty on goods carried. By rights, these galleons should not have taken part in the Armada at all, but the crisis of 1588 resulted in the cancellation of that year's *flotas* and these ten galleons, along with four Indian Guard merchantmen of apparently similar design and two light craft, were mustered as the squadron of Castile under Diego Flores de Valdes.

Little is known about the evolutionary process by which the late sixteenth century galleon came into being, but D.W. Waters has suggested that its genesis was connected with the raids which the French frequently made on Spain's Caribbean possessions and trade routes from the 1520s into the 1550s.(5) The ability to strike at these rich but distant targets required ships capable of sustained voyages which yet remained fast and weatherly enough to catch stragglers or cut ships out of convoys, and were well enough armed to capture them. These requirements were entirely different from those of a merchantman, particularly merchantmen operating, like the Spanish ones, within a monopoly. The result was a new and highly specialised ship type, the Atlantic-built, oceanic galleon. Such ships were longer in relation to their beam and much lower in the water than merchantmen of comparable tonnage. Their underwater lines were finer, and top-hamper was drastically reduced.

Although the French appear to have produced the first galleons, other countries were not slow to follow their example. From the 1570s the English navy, under the guiding genius of John Hawkins, was revolutionised by it.(6) Spain herself responded to the threat presented by the French galleons, and later by English and Dutch ones, by building her own. In the 1550s Don Alvaro de Bazán (later marquis of Santa Cruz) made strenuous efforts to develop this type of vessel, and in the 1560s a regular route for the trans-Atlantic convoys, in which escorting galleons played a major role, was introduced by Pedro Menéndez de Avilés.(7) The general appearance of a late sixteenth century Spanish galleon is indicated by the sheer plan published by Diego García de Palacio in 1587 (Figure 29).

We may presume that the features indicated above were characteristic of the Castilian squadron's galleons in 1588, although unfortunately we have little documentary and no archaeological evidence to help us. Some statistical material can, however, be cited. The most obvious is that only one of the ten galleons in the squadron, the San Juan of Diego Enríquez[30], was lost on the voyage, giving this group of ships by far the highest survival rate in the fleet. Its 10 percent loss factor contrasts strikingly with the 80 percent losses of the least successful group, the ten Mediterranean-built merchantmen of the Levant squadron, and with the 34 percent ship losses (an approximate figure, this, since we do not know the fates of all the ships) sustained by the fleet as a whole. There is nothing to suggest that the Castilian ships were laggardly in battle, and so their sea-worthiness and general handling qualities both in action and on the north-about voyage must have been much better than average.

Another feature presented by this group deserves comment. Documentary sources, which are complete in this respect, show that the Castilian squadron was not well armed. Even the flagship boasted nothing larger than 9-lbr quartos cañones and 12-lbr pedreros among her 36 guns, while her sister ships were even less well provided for. Since much additional heavy armament was placed aboard the front-line ships of the other squadrons - cañones, medios cañones, and heavy pedreros in particular - we must seek an explanation for the Castilian squadron's evident weakness in fire-power.

The weakness is, in fact, a comparative one. The galleons' armament would have been quite sufficient for their normal escort duties, and indeed it would have appeared, if set beside a typical merchantman's complement of guns, a formidable one.(8) Only the unusual circumstances of the Armada called for the arming of ships far beyond their normal scales. That these galleons were not supplied with heavy guns to bring their armament to that standard suggests that, for some reason, they were incapable of carrying them. This in turn implies that either gun-deck space, or the facilities for mounting heavy pieces, or both, were more restricted on the Castilian ships than they were aboard the fleet's other classes of front-line vessel.

Such restrictions are best explained if we assume that these galleons had only one gun-deck, which was placed well above the waterline so that the ports could be opened safely in most weather conditions. The number of guns which could be carried, and their collective weight (because of their height above the ships's centre of buoyancy), would thus be severely restricted. Such an arrangement fits well with what we know of the duties and capabilities of these ships. It would provide enough space in the narrow hold to contain the provisions required for long oceanic voyages, while still retaining sufficient armament, placed so that it could be used in all weathers and by limited manpower, to fight off any likely attack. The single gun-deck and the cut-down castles would provide adequate accommodation for the relatively small complement of officers and men which the operation of such ships required. This compromise between sailing characteristics, manning, endurance and armament is remarkably similar to that adopted by the highly successful frigate class in the eighteenth century.(9)

That the Indian Guard galleons of 1588, like the later frigates, were based on the concept of a single gun-deck is supported by some further statistical evidence gleaned from the Armada documents. Ton for ton they carried fewer soldiers than did the Portuguese warships whose flagship _San Martín_, as we have seen, was certainly a two decker. How many of the rest had two decks we do not know, but seven of the ten are rated at upwards of 700 tons and it is a fair guess that most if not all of these were constructed in much the same way as the _San Martín_. We can calculate from the figures given in the Lisbon muster that each 2.3 tons of shipping in this squadron of two-deckers supported one soldier, while each soldier in the Castilian squadron required 3.5 tons to carry him. This difference suggests that the Castilian ships offered markedly less accommodation than the Portuguese ones did - a difference best explained by assuming that the flota galleons possessed only one gun-deck, and were fitted with lower castleworks. They were certainly of above average performance, at least in comparison with the other classes of vessel on the Spanish side. Purser Calderón, describing an incident in the fighting of August 4th, singles out the "galleon _San Juan_ and another quick-sailing ship" as being the speediest vessels in the Armada. Unfortunately for the Spaniards, however, the point of his story is that in comparison with the English galleon they were chasing they "appeared to be standing still".(10)

3. Galleys

Four galleys from the squadron based at Lisbon sailed with the fleet, under the command of Diego Medrano. No tonnages are given for them in the documents, but we can assess their relative sizes from the number of oarsmen and other crew members allocated to each one. The figures are:

	Oarsmen	Other crew
Capitana	303	106
Princesa	200	90
Diana	192	90
Bazana	193	72

From these figures it appears that the *Capitana* was some fifty percent larger than the other three. She was presumably a true *galera de lanterna* - a lantern galley - so called because of the increased number (usually three) and magnificence of the stern lanterns, which provided a rallying point at night and allowed a simple code of signals to be transmitted during formation manoeuvres.(11) The three smaller craft seem to have been entirely typical of late sixteenth century Spanish war galleys, which were based and generally deployed in the Mediterranean, and about which much is known.(12) Such a vessel normally measured some 135 feet overall, with a waterline breadth of about 20 feet. Its *chusma*, or rowing gang (made up largely, though not exclusively, of convicts), was organised into 24 banks of oars, each sweep weighing about 125 pounds. Each of the 48 rowing benches accommodated three oarsmen, demanding a 144-strong _chusma_ to man the sweeps at full power. The _Princesa_, _Diana_, and _Bazana_ had _chusmas_ of between 48 and 56 men over this minimum figure, so maintaining a reserve of about twenty-five percent. On this basis we may guess that the _Capitana_ had perhaps 26 or 27 banks, with four oarsmen to a bench, so allowing a similar reserve in her _chusma_ of 303. These estimates gain support from the observations of two Dutch sailors who served with the Armada, who stated that the ordinary galleys had 23 or 24 banks, while the flag galley had 26.(13)

Each galley was armed, according to the Lisbon muster, with five guns whose size is not specified. This number is entirely typical of Mediterranean practice. We may presume a heavy gun - a _medio cañón_, perhaps - mounted at the centerline of the bow on a sliding carriage. This would be flanked by two smaller guns, probably _sacres_, which might also have been mounted on slides. Two light pieces, on fixed mounting, would be positioned on the flanks.(14) An armament on this sort of scale agrees well with the ammunition figures provided by the Lisbon muster. Fifteen _qtx_ of gunpowder were allocated to each of the four galleys, and each gun was provided with 60 rounds of shot. About thirteen percent of the gunpowder allocation was needed for the small arms and so, if we deduct this amount, 13 _qtx_ remain for each set of five guns.(15) Assuming that the charge was approximately half the projectile weight the powder available would be sufficient to service 60 rounds apiece from one 25-lbr medio cañón, two 6-lbr sacres, and two 3-lbr media sacres.

All the guns pointed directly forwards so that the galley was, like a modern fighter aircraft, a weapons system which operated as a single entity to bring her firepower to bear. In battle a galley's artillery was normally discharged at very close range - 'clothing-burning' distance, as it has been described - just before ramming the enemy. To exploit this moment of carnage and confusion troops were stationed on a light platform set immediately above the guns, the arrumbada, from which they could direct small-arms fire or launch a boarding assault. A more substantial platform at the stern, usually covered with a canopy, provided the commander with an elevated post from which to direct operations, and from which reinforcements might be sent to the arrumbada by way of the corsía, a narrow gangway which ran the length of the galley between the rowing benches.(16)

Galleys were equipped with two masts, each of which carried a long diagonal yard with a single lateen sail. Their sailing characteristics were extremely poor. The narrow beam and shallow draught deprived them of effective keel area and made them leewardly, while their low freeboard and lack of lateral stiffness rendered them especially vulnerable to high winds and heavy seas. For steering they relied almost exclusively on their large rudders, and they shared with the galleasses a serious weakness in the design of this vital component. Their low-set bows, weighted down with ordnance, were prone to driving under in all but the lightest swells. Hardly surprisingly, in view of the bad weather which dogged the 1588 operations from the start, all four of the galleys failed to weather the Bay of Biscay: three managed to make port but the fourth, the Diana, was wrecked while attempting to enter Bayonne.(17)

Historians have been inclined to see the inclusion of galleys in the Armada as a gesture of nostalgic pride towards a fighting machine whose past achievements had been glorious, however unsuited such craft undoubtedly were to artillery-based sea warfare outside the Mediterranean.(18) But few fighting men go to war with equipment they do not require, and there is no reason to suppose that Medina Sidonia was one of them. Indeed, he considered galleys to be one of the Armada's most essential ingredients, and he indicated as much in a letter to the king on 16 February 1588:

> "It is of the utmost importance that galleys should go with the Armada; and it will be well, as you say, to take four of the Spanish galleys for that purpose, or even eight, which, joined with those at Lisbon [i.e. the four which actually

sailed with the fleet] would be twelve. They would be of the greatest use and value..."(19)

This was not the ill-informed suggestion of a landsman. Juan Martínez de Recalde, who was unquestionably the most experienced sea-officer in the fleet, also thought that the Armada should include a strong contingent of galleys, and suggested so in a carefully worded but unequivocal letter to the king from Corunna on 11 July 1588 in which he stressed the fleet's most pressing defects. Twelve more galleys, thought Recalde, were urgently needed to reinforce Medrano's small squadron of four.(20)

Galleys had, in fact, been earmarked for the Enterprise from its inception in 1586. In his proposals of that year Santa Cruz had specified forty, and how he intended to use them is clear from his own account of the landings on Terceira in 1583, when twelve galleys were attached to his amphibious invasion fleet.(21) In that action, which was carried out against a well entrenched opposition, the galleys were used as close-support gunboats to cover an infantry assault on the beaches from landing craft. There is no doubt that a similar scenario was envisaged for the Kent beaches, and perhaps the Banks of Flanders, in 1588.

This in itself would provide reason enough for bringing galleys, in spite of all the difficulties, to the shores of England. But it is evident that they were expected to perform another and even more important task. Since their design made them independent of the wind, manoeuvreable in confined waters, capable of beaching, and able to carry and handle items of heavy equipment, they made ideal fleet tenders and harbour tugs. At Lisbon, before the Armada sailed, they had been extensively employed in such duties, not least in assisting with the delivery of heavy siege artillery and its associated equipment to the Levantine ships.(22) The stowage of this siege train was to be, moreover, only one part of the story; at the fleet's destination the same artillery would have to be brought ashore, probably under fire. How this might have been achieved is illustrated by Gentilini, who shows a galley using a tackle suspended from its main lateen yard (which has been firmly secured fore and aft) to swing a piece of heavy ordnance aboard a raft moored alongside. Capo Bianco illustrates a different technique, in which a galley has grounded broadside on to a sloping beach so that her oars can be used to form a ramp down which a gun is being lowered directly ashore (Figures 30 and 31).

The Armada galleys should not therefore be seen as failed oceanic warships, a function for which they were neither intended nor designed. They were, rather, specialised close-support craft whose role lay in the vital operations involved in securing a beach-head and bringing artillery ashore. The wonder is not that galleys were present in the fleet, but that there were only four.

4. Galleasses

The four Neapolitan galleasses which sailed under the command of Hugo de Moncada were front-line fighting ships. They were very heavily armed, carrying between them 21 cañones, 14 medios cañones, 14 medias culebrinas, 31 pedreros, 27 sacres, 15 medias sacres, and 80 esmeriles.(23) Their gunpowder allocations, which averaged 125 qtx per galleass, was exceeded by only four other vessels in the fleet. During the Channel battles their involvement in the fighting was considerable, though it had surprisingly little effect.

Galleasses were, in essence, armed versions of the big merchant galleys which several mercantile powers in the Mediterranean, notably the Venetians, had developed during the fifteenth and sixteenth centuries. Longer and broader than war galleys, and with much more capacious hulls, such vessels were capable of operating economic and reliable long-distance services provided the cargoes involved were of high value and modest bulk. In comparison with true galleys their performance under oars was poor, but rowing was an auxiliary rather than the primary source of motive power, intended to provide manoeuvreability in harbours and port approaches, and to allow some headway to be made in unfavourable winds.(24)

By 1550 the Venetian battle-fleet contained a number of merchant galleys which had been adapted for fighting and which carried a formidable complement of artillery. Although they were exceedingly slow under oars, having a displacement roughly four times greater than that of a comparable galley, they could be deployed within a carefully handled formation to bring devastating firepower to bear at points which a conventional sailing warship might not easily reach. At Lepanto the six Venetian galleasses, operating in support of a classically arrayed galley fleet, were able to play a decisive role in the battle.(25) The Armada galleasses, however, placed against a fleet of sailing warships whose members disobligingly refused to follow the set-piece rules of a Lepanto-type engagement, proved to be clumsy hybrids which suffered most of the failings and none of the virtues of their uneasy parentage.

No structural elements of the galleass _Girona_ have survived on her exposed wreck site, and we must turn again to pictorial and documentary sources. Two of the galleasses which sailed with the Armada had probably taken part in the Terceira operation, and one of these is clearly depicted in the Hall of Battles fresco.(26) It is an awkward looking vessel, in which the rowing frame of a conventional galley has been superimposed over what appears to be little more than an elongated galleon hull. Twenty-one oars are shown on each side. The high freeboard dictates that the oars must have been longer, and consequently heavier, than normal galley sweeps. It would have been structurally impractical and operationally pointless to have mounted guns below the oars, and none are shown in this location on the Terceira galleass, although four gun-ports are visible in the sloping roof of the covered gallery above the side of the _apostis_. The main armament seems to be concentrated in the fore part of the ship, mounted within a massive circular turret reminiscent of the round artillery forts common in the earlier part of the sixteenth century.(27) A heavy ram, apparently shod with iron, juts forward of the bow at the level of the _apostis_.

No stern armament is evident in the Terceira galleass, although Medina Sidonia clearly indicates in his _diario_ that the Armada galleasses carried heavy ordnance aft.(28) John Montgomery, writing in 1588, states that each galleass mounted four great pieces in her stern, firing directly aft, and six firing forwards from the bow. There were also, he says, twelve guns on each broadside in one tier, one between each set of two oars.(29) This suggests 26 banks of oars rather than the 21 visible on the Terciera galleass, and perhaps there may have been two more, as reported by Emanual Fremoso, a Portuguese seaman from Recalde's San Juan who was captured during a foray ashore at the Blaskets. Twenty days before their landfall, he says, they had been in the company of a galleass "of 28 oars of a side".(30)

Guns mounted in this way would have been spaced less than 2 m apart, and are therefore almost certain to have been light swivel-mounted pieces, since there would have been no deck space for carriages. It cannot be coincidence that each galleass was provided, in the 9 July 1587 inventory, with 20 bronze esmeriles, of which the wreck of the Girona has provided a fine example (Figure 54). If Montgomery's sources are accurate, each of the four ships must have received four more such weapons before the fleet sailed to make up a total of twelve per side. That this may well be the case is suggested by a detailed representation of one of the Armada galleasses in an anonymous cartoon of the battle now at Greenwich, which is thought to be closely contemporary (Figure 32).(31) It has a regular line of small guns, evidently swivels, set above the apostis, with a gaudily painted shield between each pair. Thirteen are shown, eleven on the broadside and one pointing sideways at each end - not a bad count if, as we must suppose, this English representation is based on recollected information.

The galleass in the Greenwich cartoon bears a full three-masted rig, with square sails set on the main and fore masts. Her mizzen carries a lateen sail, and she has a large spritsail rigged. The Pine engravings also show the Armada galleasses square-rigged.(32) But this is not so with the Terciera galleass in the Escorial fresco, each of whose three masts carries a single furled lateen sail. There can be little doubt, however, that the Neapolitan galleasses which sailed in 1588 were rigged as the English pictures suggest. One of them, the Zúñiga[124] lay for many months after the campaign at Havre de Grâce in a state of disrepair and, in a report on the storm damage she sustained shortly after clearing that harbour in April 1589, purser Pedro de Igueldo mentions damage to her mizzenmast, jib boom, main topmast and main yard - components which show her to have been rigged as the ship in the Greenwich cartoon.(33)

It is likely that the Neapolitan galleasses which sailed with the Armada had at some intervening time been converted from the Mediterranean-style lateen rig with which they had been equipped for the Terceira operation to a square galleon-type rig more suited to work in Atlantic waters. Indeed Bartolomo Crescentio, in his Nautica Mediterranea of 1607, explicitly stated that "in Spain they have given them [the galleasses] a square rig".(34)

Crescentio also illustrated a Mediterranean galleass of his period (Figure 33) and noted some of its particulars. In general, it looks very much like the ships shown in the Escorial fresco. Some years ago R.C. Anderson analysed Crescentio's somewhat ambiguous specifications and suggested a length for the vessel of c. 160 feet and a beam of 26 feet.(35) Although Crescentio made no mention of the rowing arrangements of his galleass Joseph Furttenbach, a few years later, allows a 'super' galleass 172 feet long and 28 1/2 feet wide 28 oars per side, with six men at each.(36) But six men to an oar, if we accept Fremoso's statement that the Armada galleasses had 28 oars per side, would have demanded chusmas of 38 men more than the 300 rowers with which each was provided. We may therefore postulate rowing benches of either five men (total 280) or, more probably, four (total 224). The latter would allow a reserve of twenty-five percent, which is the figure we have already arrived at for the galleys.

Van Meteren was no doubt exaggerating when he wrote that the Armada galleasses were "of such bignesse, that they contained within them chambers, chapels, turrets, pulpits, and other commodities of great houses"; but it is clear that their size greatly impressed him.(37) A Spanish source, however, rates them at only 500 toneladas.(38)

The Armada galleasses, it would appear, represent a carefully considered attempt to produce a new kind of warship adapted for operations in northern waters. Of their heavy bow and stern batteries, coupled with the mobility provided by a galleon rig reinforced by auxiliary oar power, the Spaniards clearly expected great things. In the event, they were to be disappointed.

5. Mediterranean-built merchantmen

Sir John Hawkins, who as the energetic reformer of Queen Elizabeth's navy can be relied upon to recognise ship types accurately, saw for himself no less than "twenty great Venetians and argosies [i.e. Ragusans] of the seas within the Strait" amongst the Armada when he viewed it off the Channel coasts.(39) His figure agrees closely with what we know from Spanish sources. Ten ships from Italy and Dalmatia were grouped together as the Levant squadron, while a further ten from ports between Barcelona and Cadiz made up the squadron of Andalusia. To these we should add the Grand Duke of Tuscany's new spice carrier Florencia[8], which was originally assigned to Levant but later transferred to Portugal when the rotting San Raphael was scrapped.(40) Together these 21 ships accounted for some 28 percent of the Armada's gross tonnage, a fact which itself underlines the importance with which they were regarded.

Big Mediterranean hulls had, indeed, been earmarked for the Enterprise from its inception. In his proposals of 1586 the marquis of Santa Cruz had called for 40 great-ships from Ragusa, Venice, Sicily, Naples, and the Mediterranean coast of Spain, with an average rating of 600 tons.(41) Such ships did not, of course, belong to the Spanish crown, and forceful steps were often necessary to secure them. In February 1588, for example, the masters of the Venetian merchantmen _Regazona_ and _Lavia_, which had inadvisedly docked at Lisbon, were informed that "the king required those vessels... the commissioners reported that these ships were the finest, the best armed and manned of all that lay in Lisbon, and on no account should his Majesty let them go".(42) Vigorous diplomatic protest by Venice was of no avail, and although Philip's commissioners expressed their deep regrets to the Venetian ambassador Lippomano, they stressed that "because of the great need for big ships of the build of those two Venetians lying at Lisbon, he [the king] could not release them... the Venetian ships are so powerful that they can give battle to ten or twelve Englishmen".(43) The Levant squadron's commander, Martín de Bertendona, explained in a letter to Philip II on 27 February why he thought these massive ships would be valuable in the campaign to come. Although he admitted that their _grandeza_ (a word which implied overbearing magnificence as well as sheer size) may carry some risks - presumably in coping with the Atlantic weather - it would give them, thought Bertendona, an overwhelming tactical advantage when it came to close quarter battle.(44) His observation underlines the 'floating fortress' concept with which most Spaniards viewed naval warfare, and explains why they went to considerable lengths to acquire such ships. But within a few days of the Armada's departure from Lisbon Medina Sidonia had cause to complain about their poor sailing performance.(45) "I see plainly the truth of what you say," replied the king on 5 July, "that the Levant ships are less staunch in heavy seas than the vessels built here... but it still is the fact that they constantly sail to England. It is true that if we could have things exactly as we wished, we would rather have other vessels..." (46)

But, concluded the king, the Enterprise should not be abandoned on account of this difficulty, "which is not such a great one after all". He no doubt thought otherwise when, some months later, he reviewed the fleet's casualty figures. Of Bertendona's ten great Levanters only two had returned, a rate of loss almost three times greater than the Armada's overall thirty percent. Why, he may well have asked, had these Mediterranean great-ships fared so very badly?

Big cargo vessels had been built in the Mediterranean from Roman imperial times, when Lucian described the grain ships which plied between Alexandria and Rome in terms which suggest that their carrying capacity may have been as high as 1200 tons.(47) Ships of comparable size were common in the fifteenth century, though they became less so in the sixteenth as it became recognised that smaller craft were more adaptable and represented a smaller individual risk.(48) Only in the movement of bulky commodities such as grain along well established routes did the larger hulls continue to predominate. In requisitioning shipping for the Armada the Spaniards made particular efforts to obtain these comparatively rare bulk carriers because, they believed, such vessels would combine the strong fighting capacity which _grandeza_ imparted with an ability to carry much of the fleet's heavy and space-consuming cargo of invasion stores.

Ships of this kind were extremely broad in relation to their length. Maximum beam might be as much as half the keel length and this, coupled with the deep hull, provided them with great capacity but exacted a corresponding penalty in hydrodynamic efficiency - in other words, they were very slow and clumsy. The Venetian shipwright Pre Theodoro de Nicolo, in a treatise written about 1550, provides specifications from which the hull of a merchant ship of this type may be reconstructed (49), while a bas-relief on the tomb of Alessandro Contarini (d. 1555) in the Cathedral of St. Anthony at Padua shows such a vessel under full sail (Figure 34). The characteristic features included a high and broad hull reinforced with wales and riders; substantial castleworks fore and aft; a three-masted rig with bowsprit (this has been omitted in the Contarini relief, presumably for reasons of space and composition); and an armament designed to ward off all but the most sustained and powerful attack.

Of the five Armada wrecks examined, La Trinidad Valencera and the San Juan de Sicilia, both of the Levant squadron, were undoubtedly vessels of this kind. On the Trinidad site a considerable number of dislocated timbers, all apparently from the hull, have been identified. The greatest concentration of them occurred in the northern part of the site (Figure 10), where ten substantial pieces were found within an organic deposit. Botanical samples were taken of all the timbers found, and four of them - AAC, AAI, AAE, and AAH - were raised for detailed examination.

All the samples proved to be of oak. The raised pieces were photographed and then both faces were traced at full scale on polythene sheet. Figure 35 was prepared from these traces.

AAC appears to be a hull plank. It is 36 cm wide, 10 cm thick, and has a surviving length of 3.81 cm. One end is intact, showing a simple squared butt. 1.3 cm diameter iron fastenings have been used throughout, though in all cases these have completely corroded away, leaving only the concretion casts. On what is presumably the outer side of the plank the bolt heads, which were 2.5 cm in diameter, were countersunk flush with timber surface, no doubt to ensure a smooth underwater skin. The fastening holes are set in pairs positioned on average 20 cm apart. Except for the holes next to the butt, which are squarely opposite one another, the pairs are set obliquely, so that they would clamp the frame behind fore and aft.

The pattern of the fastenings is extremely regular in appearance, in contrast to the apparently haphazard patterning of fastenings more normal on hulls of the early modern period in northern Europe. As demonstrated by the mid-seventeenth century Dartmouth, such irregularity was clearly intentional, so as to avoid as far as possible setting up weaknesses along the line of the grain.(51) No such attempt has been made in placing the Valencera's fastenings, and the weakness thus occasioned is evident in the lines of split and breakage which have in fact occurred. The impression is one of routine mass-production rather than the intuitive work of a skilled shipwright.

AAH carries much the same pattern of fastenings as AAC, although it is considerably narrower and thicker (18 cm and 14 cm). The countersunk bolt heads suggest an outside surface, and the piece may well be part of a strengthening wale. One squared end is evident.

AAE and AAI appear to be sections of frames. Both are some 20 cm wide, which accords with the spacings indicated by the plank fastenings and suggests that the hull was solid framed (cf. the Santa María de la Rosa). On both these frame sections the inner (i.e. concave) faces show traces of pitch apparently brushed on before an inner skin of ceiling planking was placed. AAI has a butt end and three lateral fixing holes.

We may deduce from these finds that the Trinidad Valencera's hull was built entirely of oak. It was solid framed (that is, there were no gaps between the ribs), with 10 cm planking outside and ceiling planking of indeterminite thickness inside. Not much is yet known about the detailed construction of Venetian merchant ships of this period, and the exclusive use of iron in her fastenings is of particular interest. By the sixteenth century iron was only used in northern European ships at points where particular strength was required, notably on keel/frame joints and at the butt-ends of planks.(52) The remaining fastenings were made with treenails, long oak dowels whose heads were cross-wedged to ensure a tight fit. Rotten treenails could be drilled out and replaced without difficulty, but it was almost impossible to remove and replace iron bolts. A ship fastened entirely with iron, though initially stronger and tighter, therefore had a more limited life: once the bolts began to corrode the entire vessel would have to be scrapped.

Iron fastenings began to replace wood and copper ones in the Mediterranean during the late Roman period, and the change can be linked to underlying economic factors. As artisan slavery declined the cost of labour escalated, and time-consuming craft skills were abandoned in favour of quick and simple procedures which could be undertaken by unskilled workers.(53) It thus became cheaper to replace than to repair, and the widespread use of easily fitted iron fastenings ensured a strong hull which required minimal maintenance over a short but intensive working life.

There is reason to suppose that very similar considerations applied in sixteenth century Venice. F.C. Lane has shown that the life of a Venetian cargo vessel rarely exceeded ten years,(54) while Romano has pointed out that the highly organised industrial processes of Venetian commercial enterprise relied on surprisingly modern concepts of assembly-line operation.(55) It may be significant, in the context under discussion, that by the end of the sixteenth century economic recession and poor industrial relations had brought the system into decline, with work often unnecessarily spun out and sloppily done. In such circumstances iron fastenings would have offered substantial advantages over wooden ones.

It seems that Ragusan ships of the Armada period were fastened in the same way. The _San Juan de Sicilia_, wrecked in Tobermory Bay, was a Ragusan argos. Though her remains are elusive today, her hull was substantially intact in the seventeenth century, apart from the damage caused by the explosion which wrecked her. In 1677 the Ninth Earl of Argyle, in a memorandum about the wreck, pointed out that the hull was "fastened together with iron bolts, which are so rusted and worn that if any attempt were made to raise the hull, it would fall all to pieces".(56) Six years later Archibald Miller of Greenock, who had dived on the wreck and recovered, amongst other things, the ship's rudder, noted that this component was 28 feet long, an observation which suggests that her waterline draught was in the region of 20 feet. Clearly the _San Juan_ was another capacious iron-fastened Mediterranean hull.(57)

But such hulls, although capacious, were not particularly strong. For a ship rated at 1,100 toneladas _La Trinidad Valencera_ was of remarkably light construction. Her frames are less substantial, for example, than those noted on the hull of the _Dartmouth_, a mid-seventeenth century English warship only a quarter her size, and her planking is only marginally thicker.(58) This distinction between Atlantic and Mediterranean forms of construction is strikingly paralleled, at a much later date, in the proceedings of a court-martial about the loss of H.M.S.

Daedalus, a 40-gun frigate wrecked on the Little Basses, S. Ceylon, in 1813. She had been captured from the French and had been, according to her captain, "built at Venice, and perhaps never intended by the Enemy to go out of that Narrow Guelph; for when taken into dock at Deptford she was found to possess the Timbers, and the Scantlings, of an 18-gun ship... the weight of her upper works and guns, when she touched [the reef], crushed her slender Frame to pieces".(59) Such, indeed, was to be the fate of the *La Trinidad Valencera* shortly after she grounded in Kinnagoe Bay.

6. *Atlantic-built merchantmen*

Shipping provided by the maritime provinces of Biscay and Guipuzcoa accounted for almost a quarter of the Armada's total tonnage. These big merchant vessels had been constructed for the trade routes of the Atlantic, which no doubt helps to explain their relatively low casualty rate in the campaign; 30 percent against the Levant squadron's 80 percent. Little is known about the design and construction of contemporary Basque ships, although current excavations in Red Bay, Labrador, on the hull of a 400-ton Guipuzcoan whaling ship wrecked in 1560 will in due course yield a great deal of detailed technical information.(60) Some structural evidence has also been obtained from the wreck of the Guipuzcoan *almiranta Santa María de la Rosa* in Blasket Sound, and since this ship was built at San

Sebastian the year before the Armada sailed it is probable that her remains are generally representative of Basque shipbuilding techniques during the later past of the sixteenth century.(61)

The nature of this evidence has already been described. It indicates an oak-built ship with a broad and flattish bottom contructed of closely spaced frames. Unlike the Mediterranean-built _Trinidad Valencera_ and _San Juan de Sicilia_ the hull was fastened with treenails, iron having been used only at points of particular stress. But in at least one respect the _Santa María_ was very similar in construction to her Mediterranean sisters. Her individual component parts were relatively slight, and indeed her frames and planking were of much the same thicknesses as those noted on the wreck of _La Trinidad Valencera_. There are therefore no grounds for supposing that great-ships constructed on Atlantic seaboards were necessarily more solidly built than their Mediterranean counterparts, although the treenail fastenings may have made them somewhat more resilient.

Our excavations have confirmed that merchant ships of this kind had little in common with Atlantic-built galleons. On the _Santa María_ wreck site the mainmast step lay, by the line of the keelson, 11.43 m from the forward edge of the ballast, which in turn must be on or very close to the bow end of the keel. If, however, the mast step is presumed to have lain mid way between stem and sternpost, as it did on the galleon, an overall keel length of only 22.86 m is obtained. This figure is patently too short to have accommodated the Santa María's listed 945 tons. Such a presumption must therefore be wrong, and we are justified in supposing that the mainmast of this particular ship was stepped some distance forward of the central position.

This characteristic was typical of Mediterranean merchant ships. In about 1445 Giorgio Timbotta, a Venetian merchant, wrote a treatise on shipbuilding which includes the following passage: "To fix the mast step... divide the keel into five parts and leave three (less one foot) aft."(62) If this formula is applied to what we know of the Santa María, assuming the 11.43 m between the mast step and the estimated location of the stem to be two parts plus one foot (0.305 m) forward, the following calculation emerges:

$$1 \text{ part} = \frac{11.43 - 0.305}{2} = 5.56 \text{ m}$$

$$\text{Therefore keel length} = 5.56 \times 5 = 27.8 \text{ m}$$

$$\text{Keel forward of step} = 5.56 \times 2 + 0.305 = 11.43 \text{ m}$$

$$\text{Keel aft of step} = 5.56 \times 3 - 0.305 = 16.38 \text{ m}$$

If the Santa María was a broad-beamed merchant vessel, then a keel length of 27.8 m would easily have accommodated her tonnage. We can indeed extrapolate this estimated dimension with her known burden and the formula used by the Spaniards to make such calculations (see Appendix 1) to suggest a likely beam for the ship of c. 11.6 m and a depth in hold of c. 6.4 m. These figures obtain support from the character of the surviving ballast pile, which has a width at midships which co-incides with the estimated maximum beam, and a length aft of the mast step, where the ballast spilled as the stern section broke away down tide, very close to the length I have postulated for the after part of the ship (Figure 19).

In conclusion we can describe the Santa María (and, by implication, the other ships of the Biscayan and Guipuzcoan squadrons) as a ship built on lines similar to the big merchant vessels of the Mediterranean, though the method by which her hull was fastened doubtless gave it more resilience in the long Atlantic swells. The forward-placed mainmast reflected a continuation of earlier Mediterranean practice, occasioned by the need to concentrate the thrust of the sails towards the bow in order to give the beamy hull directional stability. We may fairly rate the Basque vessels which sailed with the Armada as excellent load carriers, but poor warships.

7. Baltic hulks

The Armada's supply-hulks (urcas) were distinctive craft of Baltic origin and most, if not all, came from Hanseatic ports. The pedigree of this type of ship is a long one. Its capacious hull is distinguished by the peculiar arrangement of the plank ends, which finish on a level plane above the waterline so avoiding the use of a transom at the stern or the conventional rebating of the ends into a stem post. Its name, which is derived from an old word for the husk of fruit or grain, reflects the characteristic pod-like shape of the vessel.(63) Elements of this form of construction have been identified in the eighth century Utrecht ship, and in the later mediaeval period it may frequently be recognised in heraldic form on seals. By the fifteenth century carvel planking on a pre-erected frame had replaced clinker (or reversed clinker) building in hulks, and the type had begun to supersede (or, perhaps more accurately, to merge with), its one-time rival as an economic cargo carrier, the cog.(64)

The sixteenth-century hulk generally carried a full 3- or 4-masted rig, with or without spritsail. A mid-sixteenth-century woodcut after Breughel (Figure 36) gives a general impression of the type's appearance. It shows a tubby cargo vessel designed for coastal trading which, although seaworthy, was not particularly weatherly or manoeuvreable. As a highly specialised instrument of maritime economy it was slow but reliable, and cheap to operate. It possessed few attributes desirable in a warship.

In the two years preceding the Armada, Baltic hulks had been extremely active, ferrying supplies and war materials to Spain. The importance of Hanseatic exports and shipping to the Spanish war effort can be gauged from the Elizabethan government's reaction to it in the year following the Armada, when it was stated in an Act of Privy Council that "the late great Navy of the King of Spain... could not have been prepared and furnished fit for such an exploit with ships, munition and victuals unless they had been supplied (as they certainly were) of the greatest part of their provisions, yea, of many great warlike ships furnished with men and ordnance by certain Esterlings, members of the Hanse towns..." The Act goes on to specify those classes of material of which carriage to Spain in Hanseatic ships was deemed to be a hostile act, and which would be confiscated if intercepted. This list therefore reflects the range of Baltic exports involved in the 1587-8 preparations:

	<u>munition</u>		<u>victual</u>
cables	tallow	brimstone	wheat
masts	pikestaves	saltpeter	rye
anchors	calivers	bullets	barley
cordage	muskets	copper	meal
pitch	armour	lead	beans, peason
tar	powder	match	and the like

ordnance not belonging to the ships, canvas, and
Danske Poldavyes (Danzig sailcloth)

In the muster held at Lisbon before the fleet sailed twenty-three hulks are listed, making the supply squadron, with a total burden of more than 10,000 tons, by far the largest command in the fleet. The Armada hulks were evidently hired, on a strictly commercial basis, with the full agreement of their owners. The Enterprise had an obvious appeal to the Hanse merchants both as a means of curbing the growth of Anglo-Dutch maritime power (which had already eclipsed their own) and of ending the isolation in which, as Catholic enclaves in a largely Protestant northern Europe, they now found themselves. Trade with Spain had, moreover, become a mainstay of their economic survival. In June 1586 twenty-five Baltic hulks laden with pitch, sails, and cordage, sailed from Hanseatic ports for Spain taking, for security reasons, the 'north about' route around Scotland which, two years later, the retreating Armada was to follow with such disastrous consequences.(66) A few days later nine other German hulks, out from Hamburg and similarly laden, were intercepted and captured by English ships.(67) In retaliation the city of Hamburg offered Philip II the use of its port, "which is capable of sheltering a large fleet".(68) It is clear therefore that the Hanse towns had a strong political and economic stake in the Armada, and so Philip II's edict of December 1586, under whch all foreign ships entering Spanish-controlled ports were subject to embargo, in no way deterred the Baltic hulks: within a month of its publication twenty more had docked at Lisbon and discharged cargo.(69)

These ships were not intended to be combat vessels, as the lightness of their armament indicates, and Medina Sidonia's instruction that they should be herded together in the middle of the battle formation confirms.(70) It is also noteworthy that no hulks are included in the list of merchant ships which were fitted at Lisbon with fighting superstructures to convert them into temporary warships. The twenty-three hulks sailed with the Armada solely to provide logistical support, and as well as acting as auxiliary troop transports and hospital ships they carried some of the invasion army's draught and pack animals.

Although from a strategic point of view the hulks were indispensible, from a tactical standpoint they proved a considerable liability. Shortly after the fleet left Lisbon Medina Sidonia first had cause to complain of their laggardly progress: they were slow, he said, and could not sail to windward.(71) Philip II characteristically waved these objections aside; hulks hardly went anywhere but up the Channel, he pointed out, and indeed rarely left the northern seas.(72) True - but they did not normally sail in company with a great battle fleet whose already ponderous progress they substantially reduced. On 30 July off the Lizard, the duke again vented his exasperation: "...I, in this galleon [the <u>San Martín</u>] could only sail as fast as the scurviest ship in the fleet, as I have to wait for the slowest of them - and some of them are dreadfully slow - so I was obliged, anxious as I was to get forward, thus to tarry on the way."(73)

The wreck site of _El Gran Grifón_, _capitana_ of the hulks, has yielded little evidence of the ship herself. A single wrought-iron pintle shows that her rudder was 15 cm thick, while the general absence on the site of iron hull bolts suggests, on negative evidence, that her structure was fastened with wooden treenails in the northern tradition.

8. _Light craft_

The Lisbon muster records 34 _zabras_, _pataches_, and _pinazas_ in the Armada, though the nature of their duties meant that such craft were often detached from the parent fleet, and new ones added to it. Twenty-one were allotted to António Hurtado de Mendoza's communications squadron, while the remainder were attached to the squadrons of Portugal, Biscay, Castile, Andalusia and Guipúzcoa. Their job was to provide fast communication within the fleet formation and beyond it.

Zabras were two-masted smacks, and the burden of the only two craft specifically named as such in the muster - the _Augusta_[11] and _Julia_[12] of the Portuguese squadron - was 166 tons apiece.(74) We may presume that the only three ships of comparable tonnage in the communications squadron itself were also *zabras*[102, 103, 104]. Two of these were particularly interesting vessels, for one was of English origin (the 180-ton *Caridad Inglesa*[102]), while the other was Scottish (the 150-ton *San Andrés Escocés*[103]).

The largest *patache* of the twenty-seven in the fleet was the 96-ton vessel belonging to Miguel de Suso [25], while the smallest for which a burden is given, the *San Jerónimo*[109], was 55 tons. The nineteen *pataches* from the *San Jerónimo* upwards carried small contingents of soldiers in addition to their crews (twenty troops was the usual figure), while the eight which have no recorded tonnage contained only seamen. From this it may be presumed that the smaller *pataches* were well below the 50 ton mark.

Only two *pinazas* are recorded, both of them attached to the Guipuzcoan squadron [66, 67]. No tonnage for them is given, but their 14- and 15-man crews, and the single small *esmeril* each sported, shows that they were very small vessels indeed.

Hurtado de Mendoza's *capitana*, the *Nuestra Señora del Pilar de Zaragoza*[101], presumably fell into none of the categories described above: her 300-tons suggests that she functioned as the squadron's command headquarters and was not a dispatch craft in her own right.

Most of these small communications craft were almost certainly lateen rigged, and owed more to Mediterranean and Arab influence (with the exception, of course, of the English and Scottish strays) than to the Atlantic environment in which they ultimately proved so successful. It was in ships such as these that Columbus discovered America, and both their speed and seakeeping abilities were outstanding.(75) A dispatch craft sent by Medina Sidonia from Corunna to seek out units dispersed by the storm of 19 June was off the Devon coast within three days,(76) and made the return journey in even better time. During the voyage she endured very severe weather, and used auxiliary oar-power to manoeuvre close inshore. She carried a two-masted rig, and her mainmast could be lowered to the deck to increase stability in heavy seas.

An example of the way in which such craft operated within the fleet is provided in a letter from the Prince of Ascoli to Philip II from Dunkirk on 12 August 1588. During the fireship crisis on 7 August, he writes, Medina Sidonia sent out emergency orders to the fleet, and "directed some of us who were most in his confidence to go in _zabras_ and carry instructions to the other squadrons." Small fast boats were also used to convey dispatches back to Spain, and to establish contact with the Army of Flanders.(77)

The support these small vessels gave the Armada in the Channel was one of the few unqualified successes of the campaign, and it was in a fast patache that Don Baltazar de Zúñiga brought Medina Sidonia's final gloomy dispatches from Shetland to Spain.

9. Landing craft

Galleys alone could not land an army on the beaches: complementary to them, and generally operating in conjunction with them, were flat-bottomed landing craft designed to carry troops from the fleet to a point at which they might safely wade ashore. Seven large flat-bottomed boats (barcas grandes chatas) were used at Terceira and the Marquis of Santa Cruz, in proposing a self-contained Armada in 1586, had these very boats in mind when he called for "200 barcas chatas like those used in the Terceira campaign... to disembark the army for the assault on land." These boats were to be built at Seville, at a cost of 120 ducats apiece.(78)

If we accept the evidence of the Hall of Battles fresco the barcas chatas used at Terceira were wide carvel-built open boats with transom sterns, propelled by three sweeps on either side (Frontispiece). An assessment of their size can be little more than a guess, but they seem to be around 10 metres long and probably carried about fifty standing men. This implies a payload, if we assume a soldier with his equipment and weapons to weigh something like 200 pounds, of about four tons.

No such landing craft were included in the 1588 Armada, although some of the individual ship's boats appear to have reached a comparable size. The _barcas_ belonging to the Levantine ships were described by Juan de Acuña Vela, in a letter to the king on 30 January 1588, as "the most suitable for loading the heavy artillery", which shows that they were at least capable of carrying a three-ton siege _cañón_ together with the crew and equipment necessary to handle it.(79) These large ship's boats appear, moreover, to have been strong and seaworthy vessels. Márcos de Aramburu recounts how, in Blasket Sound, the _bajel grande_ of Recalde's _San Juan de Portugal_[2] carried a party of fifty arquebusiers to attempt, in rough seas, a landing on the mainland at Dunquin.(80) The galleass _Zúñiga_[124] possessed at least two large boats, one of which came adrift and was washed ashore as she lay at anchor in Linscannor Bay, County Clare. Boetius Clancy, the Sheriff of Clare, found the boat unusual enough to include a brief description of it in his report on the incident to Sir Richard Bingham. It was, he wrote, "not like our English cockboats; it would carry twenty men at the least." He added that it, and its anchor, were painted red, and that it carried "an earthen vessel, like an oil prock".(81)

If we assume that all of the Armada's ships carried boats of roughly the same capacity proportional to their size as the 1050-ton San Juan's fifty-man craft, or the c. 800-ton Zúñiga's two twenty-man cockboats, we can estimate for the fleet as a whole a boat capacity of about 3,000 men, less than a third of the troops which the Armada itself was supposed to land. Thus, even if all of these boats had been available when the landings commenced, three round trips would have been necessary to ferry the men ashore, plus several more to bring heavy equipment, munitions, and provisions to the beach-head.

The primary responsibility of the Armada was not, however, to land the initial wave of assault troops. This was the task allocated to the duke of Parma's waterborne army, which was to cross the Channel under the Armada's protection. Once Parma's men were ashore, and thrusting inland, the fleet would dispatch a back-up force of troops and land equipment and supplies on the beaches. For this task the ships' boats might, at a pinch, have proved adequate.

But from what kind of vessels were Parma's veterans expected to storm ashore? A report on his invasion fleet's state of readiness on 30 May 1588 shows that he had, at Gravelines, Dunkirk, Niewport and Sluys, sixty small warships, thirty or forty transport hoys, three hundred flat-bottomed barges, and a 'great number' of small craft.(82) Hoys were small shallow-draft coastal craft of a kind whose workmanlike form, usually associated with a single masted rig and leeboards, underwent little change between the sixteenth and nineteenth centuries.(83) Given an appropriate escort and a fair wind they would probably have made the crossing safely enough. But the same confidence cannot be extended to the barges, and Parma himself was under no illusions about them. They were, he said, "built for the rivers and not for the seas"; they would "not stand a freshet, much less a tempest"; and they were "not fit for anything but the passage itself, as they are too small for fighting, and so low that four skiffs might send to the bottom as many as they might meet".(84)

Van Meteren's account of Parma's preparations states that seventy of the flat-bottomed boats were horse transports, each equipped with a loading ramp and able to carry thirty animals.(85) The two hundred smaller ones he mentions were, presumably, troop landing craft. A cargo of thirty horses would weigh about ten tons, and so in a troop-carrying role they would be able to accommodate some 120 armed men. Even if the smaller boats were only half this size, Parma's troop landing craft capacity would still be about 12,000 soldiers and so, if we take into account the hoys and the horse transports, he probably had on paper just sufficient capacity to bring his 17- or 18,000-strong army across the Channel.

But what of the boats themselves? Van Meteren's statement that the vessels were equipped with integral loading-ramps makes it clear that they were no more than flat-bottomed river barges, of a kind widely used as ferries and lighters along the Rhine and in its delta. These simple and functional craft were certainly in use by the Roman period, as has recently been demonstrated by the discovery of a group of massive flat-bottomed and double-ended barges of second-third century date at Zwammerdam, on the old course of the Rhine between Leiden and Utrecht.(86) Just the same kind of craft can be seen, some 1,300 years later, in Anton Woensam's composite woodcut of the Cologne waterfront in 1531 (Figure 37). Similar craft continue to ply the river today.

Excellent though they undoubtedly were for river transport, such craft were entirely unsuited to open water use. A remarkable instance of an attempt to use Rhine barges as troop transports in the North Sea is recorded by Tactitus, in his account of Germanicus's campaigns of A.D. 16. It ended in total disaster. Parma, as an educated man, doubtless knew the passage well.(87)

Chapter Seven: Shipboard artillery

Introduction

There exists, in a variety of sources, a bewildering volume of information about sixteenth century artillery in general, and on the guns carried by the Armada fleet in particular. Works by contemporary authors, mainly in Italian, Spanish, German and English, are legion.(1) Administrative documents concerning guns actually issued to Armada ships, together with equipment associated with them, are in some cases remarkably complete. Finally, many guns of the period survive to this day in various parts of the world.(2)

On the face of it, therefore, there would appear to be no great difficulty in computing, in reasonably specific terms, the nature and strength of the Armada's armament, and its probable performance in battle. This has indeed been attempted by the late Professor Michael Lewis (3) and, more recently by Dr. I.A.A. Thompson, whose discoveries at Simancas enabled him to produce a statistical estimate of the Armada's entire gun strength to which only a few points of detail can now be added (see Appendix 4).(4) Raw statistics do not, however, constitute the whole story. The design and quality of the weapons must be considered too, together with the question of how, and with what skill, they were operated. It is in these vital areas that the historical sources *per se* are the least revealing. Much of the technical material on artillery which was published in the sixteenth and seventeenth centuries is couched in highly theoretical terms, and much of the theory expounded can now be shown to be based on false premises. Caution must therefore be exercised when making use of such material, invaluable though it undoubtedly is. In particular, virtually all the figures relating to range (and, by implication, muzzle velocity) do not stand up to scientific scrutiny; while the critical relationship between calibre, shot diameter, and weight, involving as it does concepts of spherical geometry which were not generally understood in the early modern period, invariably threw the writers (and, apparently, the practicioners) into a good deal of confusion. Furthermore, it should be noted that the authors, even those who were themselves practising gunners, tended to write about their art not as it actually was, but how in ideal terms they felt it ought to be.

Less bias is to be expected from the administrative records which are, in the main, bald statements of fact presented by accountants. Here the problem lies not in the unreliability of the statements, but in their lack of detail. At best, an individual gun may be recorded by type-name, weight (but almost never dimensions), and the material and weight of the projectile it was designed to throw. At worst, a whole group of guns (the entire complement of a ship, for example), may be given as a straight total, without any indication of the types and sizes of the individual pieces which made it up.

Surviving examples of guns are, of course, useful in illustrating the physical form of the weapons described by the artillery theorists and the documents. But it should be remembered that unless these are the actual weapons involved in the campaign we are studying they may well display characteristics which were not, for good or ill, identical to those of the guns with which the Armada was equipped.

A final point must be taken into account. Gun barrels are only one element in a fairly complex assemblage of equipment, tools and instruments which together make up a working artillery system. Any study of the effectiveness of Armada weaponry must therefore take this ancillary material into account. Very little of it has survived in modern artillery collections, and although published works and manuscripts are again helpful, they cannot be relied upon to give full or unbiased descriptions of such equipment, particularly with regard to its use and performance under operational conditions. Almost nothing is therefore known of the way in which shipboard guns were mounted and worked on both the Spanish and English sides during the Armada campaign.

It is against this background that the relevance of the Armada wrecks can now be considered. Between them, the sites have yielded a number of the guns actually used by the Spanish side during the battles. Although numerically quite small (almost exactly one percent, with 24 guns out of a grand total of 2431), the sample includes most of the basic types known to have been carried by the fleet. Even accepting, as we must, the dangers inherent in drawing conclusions from a small sample, these 24 guns give us, for the first time, a working base from which to assess the Armada's armament in entirely practical terms.

This chapter is arranged in four sections. First the question of gun performance is reviewed, with particular attention to the effects of barrel length. Next the problems of gun-weight and calibre are considered. This leads to a general classification and description of types, based wherever possible on evidence, both documentary and archaeological, derived from the Armada itself. Finally, the way in which the guns were mounted aboard ship is considered.

1. The performance of smooth-bore muzzle-loading artillery

Many artillerists of the sixteenth and seventeenth centuries believed - and most modern historians have followed them - that the greater the length of the gun barrel in relation to its calibre, the greater was the muzzle velocity, range, and accuracy of the weapon. This belief was typically expressed by Robert Norton in the early seventeenth century when he wrote:

> "The longer the chase of the piece the stronger the stroke... whereby it cometh to pass that long Culverings carry further than great Cannons although with less powder: yet the force is better entertained by their greater length and better fortification to endure the full charge of powder."(5)

The second part of Norton's statement is undoubtedly true: as any plumber knows, a long small-bore tube will withstand greater pressure than a short large-bore one. But his first proposition is erroneous, and it will be as well to consider its implications before we begin our detailed examination of the guns themselves.

The problem has recently been the subject of an exhaustive study by J.F. Guilmartin, and it is only necessary to summarise his findings here.(6) There is, he points out, no valid ballistic explanation for the supposed range advantage of culverins (which we may define broadly as guns with barrels 30 times or more as long as the diameter of their bore) over cannons (25 diameters or less) which the range data contained in most published sixteenth and early seventeenth century works on artillery invariably shows. Colonel Guilmartin goes on:

> "The unreliability of sixteenth century range data was demonstrated by an analysis of the values given by Collado and by Diego Prado y Tovar, undertaken by Mr. J.W. Kochenderfer and his co-workers in the Firing Tables Branch, U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland... who determined that the maximum ranges given by Collado and all the ranges given by Prado y Tovar which were subjected to analysis would have been attainable only with muzzle velocities in the neighbourhood of 6,000 feet per second, nearly five times the speed of sound and almost three times the muzzle velocities of modern small arms.
>
> "Experimentally derived mid-nineteenth century

data, most authoritatively given in the published work of Captain Thomas Jefferson Rodman, makes it plain that any muzzle velocity for black powder artillery in excess of 2,000 feet per second must be held suspect, particularly for the larger pieces... It seems clear that to the sixteenth century gunner, long ranges in general and maximum ranges in particular were a highly theoretical proposition. We should not therefore expect too much accuracy in what he tells us about them... Most of the so-called range figures which he left us are therefore little more than educated guesses which reflect his prejudices concerning the types of gun which he felt _should_ have been able to shoot farthest and which he himself preferred when long-range fire was called for."(7)

Guilmartin next considers the question of barrel length. He points out that most modern authors have made the _a priori_ assumption that the internal ballistics of black powder cannon are the same as modern guns burning nitrocellulose-based propellants. They are not. With modern propellants, the increase of temperature and pressure within the chamber serves to increase the burning rate and hence the rate of evolution of propellant gases as the projectile moves along the barrel. Careful shaping of the propellant grains further enhances this desirable effect. Black powder, on the other hand, burns in an entirely different manner. The rate of decomposition is essentially independent of temperature and, above a quickly reached threshold of about 350 pounds per square inch, of pressure. Thereafter the rate of evolution of propellant gases within a black powder cannon is in all practical respects constant. As the ball accellerates down the barrel a point will therefore be reached beyond which the projectile will expand the volume behind it faster than the decomposition of the propellant can keep it pressurised. Extending the barrel beyond this point will thus result in a reduction of the muzzle velocity and range of the gun.(8)

In the mid-nineteenth century J.G. Benton determined experimentally that an absolute threshold of velocity was reached for a 12-pounder black powder field gun at a barrel length of about 25 calibres. His data further showed that extending the barrel length beyond 16 calibres resulted in an increase of muzzle velocity of only 5 1/2 percent while extending it beyond 12 calibres yielded only a 12 percent gain.(9) Due moreover to the effects of aerodynamic drag, which increases as a function of the velocity squared, these small variations in muzzle velocity would have had an even smaller effect on the maximum range which could be obtained.(10)

Captain Benton's figures cannot, of course, be applied without reserve to all types and sizes of sixteenth-century artillery. Powder charges used in the sixteenth century were generally larger than those used in Benton's experiments, though higher gas losses will to some extent have compensated for this. The considerable space taken up within the bore by charge, wadding, and ball must also be taken into account, nor should it be forgotten that we will be following the sixteenth century practice of relating calibre to length as measured from muzzle to base ring and not, as Benton's calculation demands, from the breech end of the bore itself. Nevertheless it is clear that the muzzle velocities of sixteenth-century guns were _not_ direct functions of the barrel lengths, in spite of the widely held belief to the contrary. Indeed, many sixteenth-century guns had barrels considerably longer than the threshold length beyond which velocity actually declined, a length which we may compute in round terms as 30 calibres, so allowing 5 calibres over a postulated maximum of 25 to accommodate charge space and the distance between the base ring and the true breech.(11)

In fairness it should be pointed out that some contemporary gunners had come to suspect, on empirical grounds, that shorter bores did not reduce a gun's efficiency. There was in any case good reason for attempting to shorten guns intended for shipboard use, a point to which we will return in due course. William Bourne, writing in England shortly before the Armada campaign, touches the heart of the matter when he noted that "...for divers causes, and especially for the Queen's Navie, they have decided to make their ordnance shorter than the accustomed manner, and so by that means they are lighter than the pieces before time made, and yet as servicable as the longer..."(12) Exactly the same reasoning is reflected on the Spanish side in a scale drawing sent by Don Juan de Acuña Vela to Philip II on 25 July 1587 (Figure 38). The drawing shows three different types of 12-lbr medias culebrinas, one of which is a 'standard' 33-calibre model cut down to a much more manageable 25-calibres. This version is described, significantly enough, as "muy buena para la mar".(13)

We have already seen that the maximum range obtained by smooth-bored black powder guns was a highly theoretical proposition. Contemporary artillery writers frequently mention, however, another more relevant concept, that of "point-blank" range (from the Spanish punto de blanco, pointed at the target; i.e. without elevation). In practical terms this distance was determined by two factors, namely hitting-power and accuracy.

A solid mass of metal leaving a gun barrel at upwards of 1,000 feet per second obviously possesses considerable destructive energy. The practical effects of this were graphically demonstrated by John Greaves, Professor of Geometry at Gresham College, with a series of test firings which he carried out at Woolwich in 1651.(14) Iron balls ranging in weight from 9 to 32 pounds were fired from several types of gun at point-blank range (the exact distance, unfortunately, is not given) into composite butts of oak and elm. Three butts were set up, each 19 inches thick. The distance between the front and middle butts was 42 feet, and between the middle and rear 24 feet. All the guns pierced the front and middle butts, while most of the "cannon" types (i.e. the shorter pieces) struck the rear one, though none penetrated it. It is noteworthy that the longer-barreled "culverin" types consistently failed to strike the third butt, although the difference in performance was admittedly slight: the important point is that all of the guns were capable, at very close range, of smashing their way through 38 inches of solid woodwork.

This formidable destructive power, however, diminished rapidly as the range was increased. Aerodynamic efficiency of a spherical body is very low. Its drag amounts to nearly 60 percent of that offered by a flat plate of the same frontal area, whereas a modern rifled shell is penalised by a drag coefficient of only about 5 percent.(15) The relatively high velocity with which a spherical projectile left its barrel was thus quickly lost to drag, and most of its effective hitting power - its capacity to batter a wall or inflict structural damage to a ship's hull - died with it. In practice, therefore, point-blank range in terms of destructive effect was very short. For battery work - the breaching of walls by sustained gunfire - a contemporary authority, Luis Collado, recommended 80 paces (about 55 m) as the optimum distance.(16) We are not likely to be far wrong if we regard the same figure as the maximum range at which really effective damage could be done to a great-ship's hull.

Roundshot fired at much greater ranges was still, of course, capable of inflicting damage: a solid mass of iron weighing up to 50 pounds, even in the dying moments of its flight, is obviously a force to be reckoned with. It will damage spars and tackle, and kill men if it hits them. On this basis a roundshot's range is to be reckoned in thousands rather than hundreds of yards. But long-range capability is only effective if, as with modern rifled weapons, the projectile can be despatched with sufficient accuracy to find its target, at least upon occasion. Roundshot fired from a smooth bore gun, however, followed an entirely unpredictable trajetory. There are two reasons for this. First, the ball was made to fit very loosely in the barrel in order to compensate for variations in projectile shape, for bores which were bumpy or out of true, and for the layer of chemical residue which built up on the inside of the bore during firing. This allowance, or "windage" as it is called, usually amounted to some 5 percent of the bore diameter. In its progress along the bore the loosely fitting projectile rattled from one side of the barrel to the other, and so left the muzzle at a haphazard angle to the centreline, dependent upon its last point of contact. This erratic progress from breech to muzzle induced a second source of inaccuracy. As it dragged against the walls of the barrel the ball acquired an indeterminite degree and direction of spin, which in flight manifested itself aerodynamically as the so-called Magnus effect (well known, in its consequences at least, to golfers) whereby the advancing side of the spinning ball generated more boundary layer drag than the retreating side, causing the projectile to slice.

It is thus apparent that the concept of "random" range in terms of how far a ball would actually fly has little or no validity, especialy when applied to warfare at sea. What matters is the range within which there is at least some chance of hitting the target. While the number of variables posed by the individual gunner, gun, and target, and operational circumstances on any particular occasion, render it impossible to lay down hard and fast figures, it is probably true to say that in sixteenth-century sea fighting very little damage was ever caused by gunfire at ranges beyond 500 yards, and that the chances of regularly hitting even a large target such as a ship beyond 200 yards were fairly remote.

2. Gun weights and calibres

Most gun weights in the sixteenth century were cut as figures on the gun itself, and such figures are also encountered in the documentary sources. These marks were placed on the piece concerned when it was officially weighed after casting; and, while they would clearly have been of value to anyone who subsequently had to operate, identify, or otherwise assess the weapon, their primary function was one of accountancy. A balance had to be struck between the metal issued to the gunfounder and the weight of the finished product, since the high value of tin and copper - the main constituents of gun metal - made fraud an attractive proposition. Benvenuto Cellini suspected that he had been so cheated on one famous occasion, thereby incurring considerable technical difficulties in casting his reknowned Perseus.(17) The weighing was therefore carried out as precisely as possible - the results were normally expressed to the nearest digit - and since a well calibrated beam balance is capable of fine adjustment we may be reasonably confident that the recorded weights are accurate, particularly in respect of guns which come from big state-controlled foundries such as those of Venice or Malines.

The bore or calibre of sixteenth-century guns was always expressed as the weight of a ball, of the appropriate material, which would exactly fit it. The word calibre, indeed, is probably derived from the latin _qua libre_. There is, of course, a distinction between the "calibre" weight of a gun's bore and the weight of shot it actually fired, since allowance had to be made for windage, but in most practical instances calibre is given as the weight of the projectile actually fired, the necessary adjustment being assumed. As we shall see, however, variables introduced by specific gravity, by the bewildering diversity of weight units involved, and by the general muddle of sixteenth-century arithmetic, reduced this essentially simple concept to a morass of confusion.

Some years ago Professor Lewis demonstrated that the master unit of weight used in the Armada preparations was the Castilian _libra_ of 460 grams, and most of the documentary evidence which has been studied since he wrote supports this conclusion.(18) Where a different unit was involved, this was specified. Lewis himself cites the use of the Neapolitan _rotolo_ (of _c_. 891 grams) in respect of commodities which were to come from Naples, while a listing of the guns on board five ships of the Levant squadron in 1587 notes that their shot weights, which are not expressed individually but as a range for each group of types, are in _pesos de Italia_.(19)

In seeking to establish the value of the sixteenth-century Castilian *libra* Lewis was able to show that the 460 gram unit was in use by the mid-eighteenth century, and he assumed (with some circumstantial supporting evidence) that it had not materially changed in the course of the preceding 200 years.(20) We can now confirm his assumption by practical experiment. The value of weight unit cut as a figure of 5316 on the better preserved of the two Spanish *cañones de batir* from *La Trinidad Valencera* can be calculated with reference to the gun's present weight, for it is evident that loss from wear and chemical action since its manufacture is negligible. The piece actually weighs 5429 pounds (2463 kgs), from which we may deduce that the figure marked on the gun is in units of 463 grams, plus or minus three. From this it appears that the unit involved is for all practical purposes identical to the modern Castilian *libra*.(21)

The long Venetian *sacre* from *La Trinidad Valencera*, which carries a weight mark of 2529 and is also little affected by wear or corrosion, was also weighed. It gave a reading of 2632 pounds (1194 kgs), from which the unit emerged with a value of 472 grams. This, to within 0.25 gram, is the "gross" Venetian pound of 471.75 grams, although an error factor of up to plus or minus 7 grams should, admittedly, be taken into account.(22) But it seems unlikely to be coincidence that our physical calculation should produce, with such a remarkable degree of precision, so suitable a weight unit for this particular gun. The implication is, surely, that both the Londonderry Port and Harbour Commissioners and the sixteenth-century Venetian weighing authorities are to be credited with a much higher standard of accuracy than we have assumed.

Most of the contemporary artillery theorists who wrote in English (Bourne, Lucar, and Norton are the best known) specify a quarter of an inch as a standard windage for all bores, and this simple formula has been accepted by most modern authorities - who themselves have mainly been English. From a practical point of view this is illogical: common sense dictates that windage should be proportional, increasing with the size of shot. Most of the Continental authorities confirm that this indeed was so. Collado recommended that one-tenth should be deducted from the _boca_ (the bore calibre expressed in _libras_) to determine the appropriate weight of shot for the piece.(23) Converted into linear measurement, this involves a reduction of about one-twentieth, or 5 percent. This figure is confirmed, in the later seventeenth century, by Thomas Binning who, after some extremely complex (and largely spurious) geometry, concluded that the ideal windage was $\frac{1}{20\frac{42}{100}}$.(24) This proportion remained constant until the end of the smooth-bore era, 5 percent being the figure recommended in an early ninteenth century gunnery manual.(25)

A manuscript diagram prepared in the ordnance office of Philip II's Captain-General of Artillery, Don Juan de Acuña Vela, in January 1590, shows at full scale four sizes of iron roundshot each sitting inside its appropriate bore (Figure 39).(26) Bores and shot-weights are expressed in Castilian <u>libras</u>, and physical measurement of the windage shows, in every case, that (subject to the limitations of accuracy imposed by the Spanish clerk's drawing instruments and my ruler) it is almost exactly 5 percent.

Acuña Vela's windage diagram is invaluable in another connection. The specific gravities of modern grades of cast iron range from 7.0 to 7.4 (pure iron being 7.86), the lower values being due to an increasing presence of low density impurities, particularly graphite: the lower the specific gravity, the lower the grade of iron.(27) Although it has been impossible to calculate original specific gravities for the large number of iron balls recovered from the wrecks because of the chemical reduction which cast iron undergoes in sea water, exact values can be worked out from the information contained in Acuña Vela's drawing. His data may be tabulated as shown in the table overleaf.

The fact that the calculated specific gravities fall within the known range for cast iron but vary from shot to shot suggests that the figures were derived not from some theoretical formula but from the weighing of samples. The

Calibre (in <u>libras</u>)	Shot weight (<u>libras</u>)	Bore diameter (cms)	Shot diameter (cms)	Windage (cms)	Windage/ bore	Shot weight (grams)	Specific gravity
3 lbs 6 oz	3	7.40	7.05	0.35	1/21	1380	7.52
8 lbs	7	9.95	9.45	0.50	1/20	3220	7.29
13 lbs 8 oz	12	12.00	11.40	0.60	1/20	5520	7.12
18 lbs	16	13.25	12.55	0.70	1/19	7360	7.11

steady decrease in specific gravity as the shot sizes increase is of particular note, since large-volume castings tend to contain a greater proportion of impurities than small ones. It therefore seems likely that shot of larger diameters than those tabulated had even lower densities than that of the 16-lbr ball, with its specific gravity of 7.11 - the lowest grade of cast iron recognised by modern metallurgy. This observation lends support to Sydney Wignall's contention that Spanish iron shot, particularly in the larger calibres, was cast from extremely poor metal.(28)

3. Classification and Description of gun types.

Classification

Any attempt to classify sixteenth-century gun types carries with it the danger of implying that some kind of general specification for each type was widely accepted. It was not. In spite of various attempts to impose local standards - that by Charles V in 1549 is the best known - sixteenth-century guns are in the main remarkable for their individuality and profusion of forms.(29) This can be attributed to several causes. First, the craftsmen who created them were technical innovators, usually of forceful and opinionated character, who were generally competent (sometimes outstandingly so) but always intensely individualistic. As masters of an art which was (and to some extent still is) empirical rather than scientific, each held his own views on how to approach gun design and manufacture, and jealously guarded his technical secrets. Guns therefore tended to reflect the individuality, and sometimes the prejudice, of their creators. This lack of a common standard was compounded by the immensely confusing range of weights and measures Europe had inherited from the mediaeval period, some of the manifestations of which we have already discussed. Finally, each gun was individual in the sense that a fresh pattern and mould had to be made up for each casting, since both pattern and mould were destroyed in the manufacturing process.(30) This, in an age before mass-production and the concepts of conformity it engenders, further militated against standardisation. All that can be said of gun design is that it was largely a matter of trial, error, and personal idiosyncrasy in which a range of successful forms emerged, and less successful ones were abandoned, in an almost Darwinian process of evolution.

Even contemporaries were dismayed by the lack of ordered classification which resulted. "Through an intolerable fault," wrote Cyprian Lucar in 1587, "all our great pieces of one name are not of one length, nor of one weight, nor of one height in their mouths: and therefore the gunners' books which do show that all of our pieces of one name are of an equal length, and of an equal weight and of an equal height, are erroneous."(31) This difficulty was echoed by Luis Collado (1592) who noted that in the Castle of Milan more than two hundred different sizes of charging implements were needed when eleven would have served had the guns been properly standardised. The problem created by unstandardised shot, he added, was just as serious.(32)

In spite of the almost limitless variety of detailed specification which was thus possible, sixteenth-century gunners usually applied quite specific names to particular types of gun. These names should not, however, be regarded as implying something definitive, for as we have seen no such definition existed. The important factors are the weight and type of metal of which the gun was composed; the material and weight of the projectile it fired; and the length of the weapon expressed in relation to its calibre. Since, in our assessment of the Armada's artillery, we are able in some cases to examine at first hand the weapons themselves, we can often consider these practical factors without becoming lost in the confusing and often irresolvable byways of renaissance artillery nomenclature. As one of the wisest of the sixteenth-century technical authors, himself a gunfounder, put it: "It does not matter what their names may be, except to know their sorts and kinds."(33)

An attempt must nevertheless be made, for descriptive convenience if nothing else, to group the various sorts and kinds into named families. Fortunately we can, from the Armada documents themselves, extract enough information to be tolerably certain of the general parameters of classification for each named type as they were understood at the time by those responsible for planning the Armada. It should be stressed that these parameters do not necessarily apply in other contexts, especially when translating gun names into another language (see Appendix 3).

The groupings are set out in the table below as a preliminary to more detailed consideration of the guns. The range of shot-weights in each group is taken from maximum and minimum figures specified for the guns allotted to that group within the fleet. Corroborative evidence, from the classification set out by Diego Prado y Tovar (1603), is included in the right hand column.(34) The groups are themselves allocated to particular families, which follow sixteenth-century practice and are self-explanatory.

FAMILY	TYPE NAME	SHOT-WEIGHT Armada documents	SHOT-WEIGHT Prado y Tovar
Cañones	Cañón de batir	40-50 lbr	30-50 lbr
	Cañón	28-35 lbr	
	Medio cañón	15-27 lbr	12-25 lbr
	Tercio cañón	10-14 lbr	
	Quarto cañón	9-12 lbr	12 lbr
	Cañoncete	10 lbr	
Pedreros	Cañón pedrero	12-20 lbr	
	Medio cañón pedrero	10-12 lbr	not
	other pedreros	4-12 lbr	classified
Culebrinas	Culebrina	16-21 lbr	15-22 lbr
	Media culebrina	7 1/2-14 lbr	8-12 lbr
	Sacre	5-8 lbr	6 lbr
	Media sacre	3-4 lbr	
	Falconete	2-4 lbr	
	Media falconete	1-1 1/2 lbr	
	Falcones	1 1/2-3 lbr	
Swivel guns (Man-killers)	Falcones pedreros	3-6 lbr	
	Esmeriles dobles	12 oza	not
	Esmeriles	6-8 oza	classified
	Versos	1-3 lbr	
Obsolescent	Pasamuros	1-2 lbr	not
	Lombardas	4 1/2-7 lbr	classified

Descriptive catalogue

i) Cañones de batir (Figure 40)

The heaviest shotted gun carried on either side in the campaign was the 40-50 lbr full cañón, or cañón de batir as the Spaniards almost invariably called it. Two fine examples of this weapon have been recovered from the wreck of La Trinidad Valencera, and these are described below along with a discussion of their historical background.

The Valencera cañones de batir are a matching pair, cast in bronze. They bear the Spanish royal escutcheon, and without doubt they are two of the three cañones de batir loaded aboard the ship at Lisbon in May 1588. Documentary descriptions tally precisely with the two guns recovered, while Baltasar Lopez del Arbol confirms that the cañones aboard the ship belonged to the king.(35) The guns are in all practical respects identical, and have been cast in the traditional way. A simple four-pinned iron chaplet had been used to secure the barrel core to the mould.(36)

Specifications for both pieces are as follows:

Bore	18.4 cm
Shot diameter (5 percent windage)	17.5
Shot weight (by estimation)	44 libras
Overall length	2.92 m
Muzzle to breech ring	2.68 m

Calibre/length	1/14.5
Weight mark	5316 (No. 1);
	5260 (No. 2)
Weight by weighbridge (No. 1)	2463 kg
Shot/gun-weight	1/121

The guns are well cast, with little indication of the common fault of aeration in the metal. Their barrels are smooth and true. Decoration is finely and tastefully executed, with additional detail chased on after casting. The lifting and breech dolphins are ornate and display considerable artistic feeling, combining strength with a fluid sense of movement. When slung by the lifting dolphins, with a restraining strop at the breech, the guns hang level.

The triple-moulded base-ring bears this incription:

IOANES . MA[N]RICUS . A . LARA . FIERI . CURAVIT

OPUS . REMIGY . DE . HALUT

ANNO 1556

The first reinforce bears a crowned shield in relief, encircled with a chain of firestones and rays from which is suspended the insignia of the Golden Fleece. The escutcheon shows the arms of Spain impaling those of England, reflecting Philip's consortship with Mary Tudor. Below it the words PHILIPPUS REX are contained within a rectangular cartouche. On the reinforce mounding the weight figures 5316 (No. 1) and 5260 (No. 2) have been cut subsequent to casting.

The vent pan is set in a transverse oblong block, at each end of which is an upstanding lug. The left hand lug (as viewed from the breech) is the shorter, and is set over a curving recess so that it can act as a hinge pivot. A plain bronze vent cover found close to No. 2 clearly belongs to this gun; it fits snugly over the hinge lug, and the drillings line up, while a slot at its other end mates with the taller lug so that the hole stands proud to take a locking pin. A decorated but otherwise similar cover was found within a few feet of No. 1 (Figure 41). A concavity on the underside of both covers fits over the rimmed vent pans of the guns, so that the arrangement provides a secure but easily opened apron which would have allowed the guns to be kept primed under wet or windy conditions. The locking pins were evidently secured to the vent covers with a length of fine chain, the dovetailed attachment for which can be seen on No. 1's vent cover.

On No. 1 a flaw in the face of the muzzle, perhaps caused when the gun-head was sawn off, has been repaired with a rectangular insert, filed flush.(37) Muzzle wear suggests that No. 2 had been fired fairly frequently, and No. 1 scarcely at all. Chafing at the sides of the breeches, particularly on No. 2, indicates the use of a breeching rope. Neither gun was loaded when found, although a quantity of black powder sludge was noted in the barrel of No. 1.

These guns are complemented by a set of drawings which have survived at Simancas. The drawings originated from the office of the Captain-General of Artillery, Don Juan de Acuña Vela, and are accurate, detailed, and to scale (Figure 42).(38) They represent an unusually fine example of early technical draughtsmanship. Three _cañones de batir_ are shown, and the lower example is in all practical respects identical to the _Valencera_ pair; indeed there are grounds for supposing that the very gun depicted in the drawing is the third and as yet undiscovered Remigy _cañón de batir_ carried by the ship.(39) The drawing is captioned: "This _cañón_ is one from the foundry of Remigy, weighing 5286 _libras_ and throwing a 40-_lbr._ shot. It is fifteen diameters of its calibre in length."

The middle _cañón_ illustrated bears the arms of Charles V and was cast by Gregorio Loefer of Augsburg. It too is a 40-_lbr._, and is rather more thinly metalled than the Remigy piece, being somewhat longer (17 3/4 calibres) and weighing slightly less (5230 _libras_). It seems likely that the Remigy and Loefer _cañones_ were the standard heavy siege weapons then in the service of the Spanish crown. Both, however, were rather old, and Acuña Vela's third drawing shows a design specification for a replacement model. It would, so its caption informs us, have "the same reinforcement and ball as that of Remigy, and be three-quarters of its mouth shorter than that of Gregorio Loefer." Its weight was to be 5500 libras.

The two Valencera guns were cast in the Malines foundry of Remigy de Halut, in the first year of Philip II's reign. Along with the rather earlier Augsburg cañones of Gregorio, they are to be associated with the Hispano-French wars which ended with the Treaty of Cateau-Cambrésis in 1559, and they will undoubtedly have been part of the great siege train which was built up in the Low Countries during the second and early third quarters of the sixteenth century by Charles V and his son. Such weapons demonstrate the growing need of field armies for mobile battery artillery to counter the development of scientific fortification. Don Juan Manrique de Lara, whose name appears on the Valencera guns as the man under whose auspices they were cast (and who, presumably, was responsible for laying down their specifications), was Captain-General of Artillery from 1551 to 1574. The main artillery base in the Low Countries was at Malines, where in 1551 Charles V established an arsenal. Garrison troops and associated specialists were stationed there under the command of a Grand Master, who between 1550 and 1564 was Philippe de Stavele, lord of Glajon and knight of the Golden Fleece.(40)

Malines had been a noted bell foundry since the early fifteenth century and in the 1480s Hans Poppenruyter, the most famous of the city's master-founders, began producing high quality bronze ordnance. During the first two decades of the sixteenth century Poppenruyter cast more than 144 guns for Henry VIII of England. Work for England was suspended in 1526 because of difficulties over payment, but production in no way declined for in 1520 Charles V had established Malines as his own gunfoundry, with Poppenruyter assuming the title of _fondeur royale_. In 1526 Poppenruyter married Hedwige van den Nieuwenhuisen, and when he died in 1534, leaving no heir, Hedwige - who appears to have been an enterprising lady - sought a mate who could fill the dual role of husband and foundry-master. She chose Remigy de Halut, who had served as an artilleryman under Philippe de Montmorency, and married him in 1536. Shortly afterwards Charles V confirmed Remigy's appointment as _fondeur royale_ in succession to Hans Poppenruyter.

Hedwige died in 1562, Remigy in 1568, by which time the foundry had fallen into a decline occasioned both by the effects of the Dutch Revolt (Malines was sacked in 1566, 1572, and 1580) and by a shift in the strategic positioning of the king's heavy artillery following Cateau-Cambrésis. Most of the guns were shipped to garrisons in Spain and Italy, where they were still stationed in 1586 when the marquis of Santa Cruz noted their availability for the projected Armada. His breakdown of the whereabouts of these guns, all described as 40-*lbr* *cañones refozados* weighing on average 5500 *libras* apiece, shows that twelve were in Sicily, seventeen at Naples, and twenty-five dispersed between Cartagena, Málaga, and Lisbon.(41) The marquis earmarked these guns specifically for land service in support of the invading army, and they were to be organised into four batteries of twelve guns apiece, with six held in reserve.

The Lisbon muster of 9 May 1588 records that only twelve such guns - a single battery, presumably - were actually shipped. The probability is that all or most of them were from the foundries of Augsburg and Malines, and that all or most of them had been cast before 1559. The Malines guns, at 15 calibres, were rather stubbier than the Augsburg pieces, at 17 3/4; both, however, appear to have been highly standardised weapons with a virtually identical weight and a common bore.

This impression is confirmed by a summary of the technical evidence. First, there are the two *Valencera* guns with their respective weights of 5316 and 5260 *libras* and their bore diameters of 18.4 cm. To these we may add the other six (presumably similar) *cañones de batir* throwing 40-*lbr* shot known to have been issued to the Levant squadron.(42) Next we have the two guns captured aboard the *San Salvador* of Guipúzcoa, described by the English inventorist in 1588 as cannons weighing "by the Spanish mark" 5222 and 5329 _libras_ respectively.(43) These must be the 50-_lbr_ _cañones_ listed among the ship's armament in Spanish sources.(44) The 10-_lbr_ increase in shot size does not necessarily imply a larger calibre, since most of the artillery theorists allocate a 50-pound ball to a battery cannon, although in practice Spanish _cañones_ threw a rather lighter projectile.

Yet more evidence can be gleaned from the wrecks. At "Borreis", a place in County Mayo which cannot now be identified, a great ship (perhaps _El Gran Grin_[14], of Biscay) was wrecked with "50 great pieces of brass, besides four great cannon" aboard her.(45) From a wreck off Clare, which may have been that of the Guipuzcoan _San Esteban_[57], Sir George Carew attempted in the summer of 1589 to raise "a cannon of battery or basalyke, as we suppose by the length... which was so huge that it break our cables". He added: "Our diver was nearly drowned, but Irish _aqua vitae_ hath such virtues as I hope of his recovery."(46) Sir George doubtless knew his artillery as well as he knew his whisky, and since he described in precise terms the types and sizes of the guns he successfuly raised, he is unlikely to have been mistaken about the lost piece.

Confirmation of the two *cañones de batir* recorded in Spanish sources aboard the Levanter *San Juan de Sicilia*[71] comes from her wreck in Tobermory Bay, which yielded to seventeenth-century salvors "one great gun... which would carry a 48-pound ball" and another which was "eleven feet in length, and seven inches and one fourth part of measure in the bore."(47)

Finally, we should take into account the specifications of similar pieces which appear in documentary sources not directly connected with the Armada. As we have seen, the Remigy and Loefer guns illustrated by Acuña Vela bear marks of 5186 and 5230 respectively, while four *"cañones de metal de los de la fundición de flandes"*, which were on the walls of Málaga in 1587 (and which therefore almost certainly sailed with the Armada in 1588) carried weight marks of 5260 (twice), 5170 and 5185.(48) Between them, all of these presumed Remigy and Gregorio *cañones de batir* have an average weight of 5252 *libras*, which is within 82 *libras* of the lightest and 77 *libras* of the heaviest. By any reckoning these figures are close for big bronze castings: by sixteenth-century standards they are little short of miraculous.(49) Beyond question, then, the Spanish crown's siege train, dispersed after 1559, and partially brought together at Lisbon for the 1588 Armada, was equipped with good quality weapons of a highly standardised type and calibre.

ii) _Other cañones_

In addition to the standardised _cañones de batir_ a number of guns described simply as _cañones_ were present in the fleet. These were evidently much more of a mixed bag. The four galleasses carried eight _cañones_ of 30 to 35-_lbr_ calibre, while the Andalusian squadron was credited with nine _cañones_ of 34 to 45-_lbr_ calibre.(50) The two aboard the squadron _capitana Nuestra Señora del Rosario_[43] threw a 28-_lbr_ and 35-_lbr_ shot.(51) These figures agree broadly with Prado y Tovar's classification of _cañones_ as guns firing 30 to 50-_lbr_ iron shot.

Although 50 _libras_ generally speaking represents the upper limit of Armada shot weights, there may have been a few "super-_cañones_" aboard the fleet. Such may have been the two "_piezas grandes_" on the Andalusian _almiranta San Francisco_[44], whose shot sizes are not specified but whose gun weights were 65 and 75 _qtx_.(52)

iii) _Medios cañones_

The documents show a considerable weight range for this type of gun, from a 15-_lbr_ aboard the _Nuestra Señora del Rosario_[43] to the 19-, 25- to 27-_lbr_ _medios cañones_ distributed among the four galleasses.(53) Prado y Tovar is in fairly close agreement, allocating a weight range of 12-

to 25-_libras_ for _medios cañón_ shot. A pair of "typical" Spanish guns in this category are illustrated in a contemporary document from Simancas. Both are 20-_lbrs_, weighing between 3500 and 3600 _libras_: one is nineteen calibres long, the other twenty (Figure 43).(54)

Two guns from the wrecks can be included in this category. The first, which is said to have been raised from the Tobermory ship in 1740, is now at Inverary Castle, and I am indebted to his Grace the Duke of Argyll for allowing me to examine it (Figure 44). The piece is an extremely fine bronze gun of French origin, and it bears the attributes of Francis I. Its specifications are:

Bore	14.8 cm
Shot diameter (5 percent windage)	14.1 cm
Shot weight (by estimation)	23 _libras_
Overall length	3.11 m
Muzzle to base ring	2.86 m
Calibre/length	1/19
Weight mark	3253
Weight (by estimation)	3154 _libras_ (1451 kg)
Shot/gun-weight	1/137

The gun has mid-set trunnions and no dolphins. Its cascabel terminates in a stylised pomegranate, while its breech carries the salamander device of Francis I set within a decorative oval. The chase is covered with an alternating pattern of _fleurs de lys_ and the king's monogram. A letter

B with a hooked stroke above it surrounds the touch hole. The claim that this is the mark of Benvenuto Cellini has little to commend it, though the actual founder remains unknown.(55)

A simple four-armed chaplet has been used to hold the mould core in the breech, while two iron-filled holes 2 cm square (the metal has all but disappeared) are located on top of the base ring, set symmetrically on either side of the centre line and 9.6 cm apart. These holes may perhaps have been connected with the mounting of some kind of sighting instrument.

Why a French royal gun should have been carried aboard an Armada ship is a question of some interest. A possible explanation is that the gun fell into Spanish hands during the Hispano-French wars prior to 1559, perhaps in the aftermath of the battle of Pavia, when Francis himself was captured. Several trophies taken after this action, including the French king's armour and campaign tent, are still in the _Armería Real_ of the Royal Palace at Madrid.(56) Another possible source for such a gun would be Strozzi's defeat by Santa Cruz off the Azores in 1582. Other French guns aboard Spanish ships are known from documentary sources.(57)

The second _medio cañón_ comes from _La Trinidad Valencera_ (Figure 44). Its specifications are:

Bore	12.4 cm
Shot diameter (5 percent windage)	11.8 cm
Shot weight (by estimation)	13.6 _libras_
Overall length	3.25 m
Muzzle to base ring	3.10 m
Calibre/length	1/25
Weight mark	2950
Estimated weight	3025 _libras_ (1392 kg)
Shot/gun-weight	1/222

With a shot weight of 13 1/2 _libras_ this gun is, by the criteria of the Armada documents, too light by 1 1/2 _libras_ to classify as a _medio cañón_. But there is evidence to show that this very gun was classed as such by the Spanish inventorist who listed the guns aboard the five Levantine ships, since he was working, as we have seen, in rough-and-ready _pesos de Italia_ with a value of about 340 grams.(58) On this basis our piece would have been an 18 1/2-pounder, taking it into the upper bracket of _medios cañones_ as they were defined aboard these five ships (16 to 19-pounders). These observations should remind us of the general muddle which pervaded gun nomenclature and classification at this period, particularly where the types, names, and weights of different countries were involved.

The gun itself is well cast, although the bore at the muzzle appears to be slightly out of true (cf. the much worse case of the _media culebrina_ from _El Gran Grifón_). There are no dolphins. The trunnions are low set, and the piece has a plain cylindrical cascabel. A small notch has been filed at the top of the muzzle, doubtless for fixing a dispart sight. The iron chaplet which held the barrel core in place during casting is of the type described by Biringuccio as "castillated": that is, it consists of two arched irons to which was welded a supporting "castle" to hold the end of the core.(59)

The piece is unmistakably Italian, the rosetted founder's initials N D C and the decoration on the chase being particularly characteristic features. So far the maker has not been identified although he may have been one of the Conti family which, like the Alberghettis, practised gunfounding in Venice for many generations.(60) The gun's crest consists of crossed olive and palm branches with the (presumably mis-spelt) motto SENPER set in a scrolled cartouche. Traces of a similar crest, apparently in association with the same founder's initials, were noted on a badly abraded _media sacre_ from the same wreck).

In calculating the weight of the gun it has been assumed that the figure on the breech refers, like the mark on the Venetian _sacre_ by Zuanne Alberghetti, to its weight in Venetian gross pounds of 471.75 grams. The resultant figure agrees closely with an estimate based on Brigadier Hogg's formula.(61)

iv) _Minor cañones_

A number of small _cañón_-types are mentioned in the inventories. These include the _tercio cañón_, throwing an iron shot of 10-12 _libras_, the _quarto cañón_ of 9-12 _libras_, and the _cañoncete_ of 10 _libras_. There seems to be little to distinguish these guns from _medias culebrinas_ except, presumably, their shorter length.

v) _Cañones pedreros_

Cañones pedreros, as their name implies, were stone-shotted guns, for which the Armada lists show a calibre range of 8- 14-_lbr_. Most of them were bronze pieces, although ten _pedreros_ of wrought iron (_hierro de martillo_) are recorded aboard two Guipuzcoan ships, the _Santa Marta_[58] and the _San_ Esteban[57].(62)

The *pedrero* was a short muzzle-loading gun with a restricted chamber to carry the smaller charge demanded by its less dense projectile. These guns were, in consequence, much more lightly metalled than iron-shotted pieces of similar calibres. The *Nuestra Señora del Rosario's* six *pedreros* ranged in weight from 2566 to 3032 *libras*, while the English inventorist who listed the captured *San Salvador's* guns recorded the marks on her four *pedreros* (which he called "cannons pedro") as lying between 2019 and 2572 (see Appendix 3).(63) The bore of a 14-*lbr cañón pedrero* would have been about the same as that of a 40-*lbr* iron-throwing *cañón de batir*. Though no example of such a gun has been recovered from the wrecks, an illustration of one from Luis Collado's *Plática Manual* is shown in Figure 45.

Some *cañones pedreros* may have been breech-loaders. A large wrought-iron breech-block was found on the wreck of *La Trinidad Valencera* (Figure 46) and, since we have reason to believe that all of this ships's guns were bronze, its missing barrel was probably of that metal too. The breech-block is 61 cm long with a chamber bore of 7.5 cm, so in its original state it would have weighed some 100 kg. The bore of the gun it served, indicated by the diameter of its shouldering, was about 15 cm, which suggests a stone projectile of about 8 Castilian *libras*. This would place it at the lower end of the *cañón pedrero* scale. It may be significant that a number of bronze guns described by an English inventorist as "great bases" - by which he certainly meant breech-loaders - aboard the *Nuestra Señora del Rosario* were itemised in a list which included ten otherwise unspecified "iron chambers".(64) The Spanish gun inventory of the same ship included three bronze *falcones pedreros* which fired stone balls of 5 and 6 *libras*, and it is reasonable to suppose that these are the great bases of the English list, each recorded as weighing "by the Spanish mark" between 700 and 800 *libras*.(65) We may suppose that an 8-*lbr* in the same category would have been proportionally heavier - say somewhere in the region of 1000 *libras*.

At the time of the Armada, the *cañón pedrero* was much favoured by the Spaniards, and to a lesser extent by the English, as a short-range battery piece for shipboard use. At close range the hitting power and fragmentation effect produced by its large diameter stone ball was considerable. That it was soon afterwards to fall out of use was due not to its shortcomings as a naval gun - in many respects it foreshadowed the highly successful carronade of the late eighteenth century - but because stone projectiles took a great deal of time and skill to produce, which at a time of escalating labour costs rendered them prohibitatively expensive.(66)

vi) _Culebrinas_

Relatively few _culebrinas_ appear to have been carried by the Armada, and no example has been recovered from the wrecks. The five Levantine ships mounted between them seven 18- to 21-pounder _culebrinas_ (rated at Italian weights), which if translated into Castilian become, approximately, 13 1/2- to 15 1/2-_lbrs_, while the Andalusian squadron also carried seven _culebrinas_ throwing 18 to 21-_libra_ shot.(67) In the 1591 listing of her 1588 armament the _San Juan de Portugal_[2] is credited with a number of 16 to 20-_lbr_ _espheras_, a name which appears to have been synonymous with _culebrina_, while the _Nuestra Señora del Rosario_ in the same list is given two _culebrinas_ of 19 and 20-_lbr_.(68) Prado y Tovar gives his _culebrinas_ a shot-weight range of 15 to 22 _libras_.

A true _culebrina_ at the upper end of the shot-weight scale was a gun of very considerable length and weight. In Simancas there is a casting specification for a set of four matching _culebrinas_, which includes a scale drawing (Figure 47).(69) The document is dated 25 July 1587, and the casting was to be carried out at Seville. These guns were clearly intended for fortress use, since they were destined for the Canary Islands. The specification calls for a shot-weight of 18 _libras_, a length of thirty calibres, and a gun-weight of 6000 _libras_.

Santa Cruz's planning document of 1586 includes 16 _culebrinas_ of 6000 _libras_ apiece, firing 25-_lbr_ shot.(70) These "super" _culebrinas_ were intended to neutralise enemy strongpoints on land ("_deshacer los traverses_"), and here Santa Cruz is clearly envisaging them in a classic counter-battery role on land, in which their (supposed) advantage of range and accuracy would be used to prevent an enemy from bringing his own heavy batteries into effective range. There is no evidence to suggest that counter-battery _culebrinas_ of this kind were actually included among the field artillery which sailed in 1588.

vii) _Medias culebrinas_

The Armada documents give a shot-weight bracket for this class of gun of 7 1/2 to 14 _libras_, which is reasonably close to Prado y Tovar's 8 to 12 _libras_, especially since at least some of the Armada's 14-pounders - those aboard the five Levantine ships - were rated in '_pesos de Italia_', which would reduce their value in _libras_ to about 10 1/2.

A particularly informative example of a _media culebrina_ has been recovered from the wreck of _El Gran Grifón_. The gun was found in two pieces: its broken-off muzzle end, 66 cm long, was discovered in 1970, while the remainder of the weapon was located, together with one of its slab-sided dolphins, in 1977 (Figure 48). The piece has a simple button cascabel, and its specifications are:

Bore	10.8 cm
Shot diameter (5 percent windage)	10.25 cm
Shot weight (by estimation)	8.9 _libras_
Overall length	3.71 m
Muzzle to base ring	3.54 m
Calibre/length	1/33
Weight (by estimation)	2426 _libras_
Shot/gun-weight	1/273

This gun must be one of the four bronze _medias culebrinas_ of "_la nueva fundición_" with which the ship was credited in a document of 14 May 1588.(71) The "new founding" refers to a crash programme of gun manufacture at the Lisbon foundry, carried out under the supervision of Don Juan de Acuña Vela, Captain-General of Artillery, which was intended to boost the Armada's armament strength right up to the moment of departure. The piece under discussion is remarkable in several respects. First, it bears no escutcheon or inscription, an omission which, for the product of a sixteenth-century royal gunfoundry, is virtually without parallel. This in itself suggests hurried production since, although the work involved in setting decoration on a basic gun pattern required time and skill, the placing of arms was regarded as an indispensible symbol of the authority and power which such weapons represented.(72) So radical a departure from tradition evidently required the express permission of the king and indeed we find, on 10 April 1588, the harassed Acuña Vela writing to Philip II upon this very matter.(73) The king evidently acquiesced, and so these last-minute products of the Lisbon foundry, by extraordinary royal assent, carried no arms or decoration whatsoever.

Such an omission would, of course, in no way affect a gun's performance. But the Grifón's media culebrina demonstrated practical disabilities which must have rendered it all but unserviceable. When its broken end was found it was observed that the barrel was bubbled with numerous gas voids throughout the metal. Apart from making the gun weak and brittle such voids, where they touched the bore itself, might easily trap hot debris which could prematurely - and perhaps disastrously - ignite the succeeding charge during loading.(74) Worse still, the bore at the break, a clean fracture 66 cm from the muzzle, is woefully off-centre. Its thick wall measures 7.1 cm, while the thin one is only 3.5 cm. In this short length, therefore, the bore has diverged 1.8 cm from the centreline. Because it would entail the damaging process of drilling into the breech it has not been possible to determine the degree of error there, but by projecting the angle of divergence indicated by the broken muzzle segment (about 1 degree) and by assuming that the bore is straight (if it is not, matters are even worse) we find that the opposing walls would measure, at their points of extreme difference, 14.7 cm and 6 cm. This represents an appalling weakness. Even a small error of this kind would have a significant effect on the bursting pressure of the gun: one of such magnitude would have rendered it, in all probability, quite unserviceable.

The possibility that the muzzle had actually blown off during firing was considered but discounted, since a cork tampion was found in position 45 cm from the end of the bore. For it to have been pushed so far down the barrel would have required pressure exerted from <u>outside</u> the gun, and such a pressure differential could only have been set up had the gun been an intact cylinder when it sank to the bottom. Possibly it broke when it hit the sea bed, or perhaps it was damaged by the eighteenth-century salvors in an attempt to recover it.

The fault in the bore was due, no doubt, to incorrect positioning of the central core during casting. Robert Norton may have been exaggerating the incompetence of continental gun manufacture in order to stress the excellence of English foundries when he wrote the following, but even so his comments are significant:

> "If we shall examine the most used foundings in Europe: namely that of Lisbon, Málaga, Barcelona, Naples, Sicily, Cremona, Milan, Genoa, Venice, Malines and Utrecht: in which by reason of their continual practice they might easily become excellent and expert, yet whether it be by ignorance, negligence, or else by too much haste

of those that have charge and command of those foundings, it is apparent that they commit great and absurd faults therein. Some of their pieces (and not a few) are bored awry, their soule not lying in the width of the body of the metal; some are crooked in their chase, other of unequal bores; some too light in the breech turn their mouths downwards, and so endanger their own vamures and defences... others are too heavy also in their breech... some and a great many are come forth of the furnace spoongy, or full of honeycombs and flaws, by reason that the metal runneth not fine, or that their moulds are not throughly dried, or well nealed... when such gunners load them, as are either ignorant or negligent in examining their defects, they will either break, split, or blowingly spring their metals and (besides that mischief they do) they will be utterly unserviceable ever after... yet this much I dare say to the due commendations of our English gunfounders, that the ordnance which they of late years hath cast, as well for neatness, as also for reasonable bestowing and disposing of the metal, they have excelled all the former or foreigners..."(75)

These observations might have been applied specifically to the Grifón's media culebrina.

In fairness, it should be pointed out that even English guns were not above suspicion in these respects. William Bourne writing in the late sixteenth century recognised the existence of the problem of off-centre bores and prescribed some remedies: "...for though at the mouth of the piece the metal may be one like thickness, yet at the breech of the piece the metal may be thicker on the one side, and the piece will never shoot right upon the mark: and also, this piece is very dangerous to shoot in for fear of breaking."(76) He goes on to demonstrate practical tests for testing the trueness of the bore, pointing out that each gunner must determine the allowance necessary to correct any off-centre throw shown by his particular piece, and the maximum charge he may safely put in it.

But even had it been bored clean and true, the *Grifón*'s *media culebrina* would still be open to criticism. It is, for its length, a very lightly metalled piece. With a length of 33 calibres and a shot to gun-weight ratio of 1:273 it is remarkably similar to the weakest of three 12-*lbr* *medias culebrinas* illustrated in a Spanish document which just pre-dates the Armada (Figure).(77) This gun is 33 calibres long and, with a weight of 34 *qtx*, has a shot to gun-weight ration of 1:283 - marginally better than the *Grifón's*. It is included in the drawings for the purpose of demonstrating its unsatisfactory design, which is considered too lightly metalled to be servicable, and, very significantly, it is pointed out that this design is one approved by the marquis of Santa Cruz. Since the marquis was in charge of the Armada's preparations up to his death in February 1588 it seems likely that this discredited specification was the very one to which the *Grifón media culebrina* was cast.

The suggested improvements are of considerable interest. The lower gun in the drawing is basically a "beefed-up" version of the "Santa Cruz" type: it is another 33-calibre 12-*lbr*, in which the weight of metal has been increased from 34 to 44 *qtx*, giving a shot to gun-weight ratio of 1:367. These proportions, according to the caption, are based on the *medias culebrinas* of Gregorio Lefer, cast at Augsburg earlier in the century. But while the result was clearly a strong and servicable weapon it was, so its caption-writer tells us, "too big for use at sea".

The problem presented by the other two are resolved by the middle gun in the drawing, which is presented as an ideal form of *media culebrina* for the future. Though it is still as light as the discredited "Santa Cruz" type - 34 *qtx* - it is as thickly metalled as the strong but over-long "Gregorio" type. This is achieved by the simple expedient of shortening the piece from 33 to 25 calibres and thickening the metal accordingly, to make it, as the caption says, "*muy buena para la mar*". In every respect this is indeed the best gun of the three: not only is it strong, and short enough for good management afloat, but it is very close to the calibre:length ratio which would give it the best possible muzzle velocity.

This workmanlike piece of artillery contrasts strikingly with the Grifón example. Quite apart from the gross defect in the alignment of its bore, and the spongy metal of which it is made, the latter is built to proportions which experience had already shown to be too slender for safety and too long for efficient handling at sea. We cannot, of course, argue from the shortcomings of a single media culebrina that the same deficiencies hold true for every comparable gun in the fleet, but that one so demonstrably bad was actually passed for service must surely be significant. The Grifón media culebrina was one of many similar cast at Lisbon specifically for the Armada, and its proportions reflect those favoured by the marquis of Santa Cruz, whose influence on Spanish naval affairs from the 1550s to 1588 - a date-bracket within which most of the Spanish guns carried aboard the Armada will have been manufactured - was immense. His views doubtless had a profound effect on the kind of guns with which ships in the service of the crown were equipped.

Fundamental defects in design and manufacture, such as those evidenced so strikingly in the *Grifón* example, must have greatly reduced the effectiveness of these guns in action, and perhaps in some cases rendered them wholly unserviceable. In support of this conclusion we have the corroborative evidence to suggest that the *Grifón's* four *medias culebrinas* - the only real ship-killers she possessed - were, at best, grossly under-used during the fighting (Figure 49).

viii) *sacres*

Apart for a few anomalies, guns of this name listed in the Armada documents show a shot-weight range of 5-9 *lbr*, which slightly overlaps with the most lightly shotted *medias culebrinas*. Most, however, are 5- or 6-*lbr*, thus conforming closely to Prado y Tovar's prescribed 6 *libras* for *sacre* shot. A serious anomaly, however, is to be found among the guns of the five Sicilian ships, whose 29 *sacres* are classed as 7- to 12-pounders.(78) But, as we have seen, these weights are expressed in *pesos de Italia* which, if converted into Castilian weights, gives us the more reasonable figure of *c*. 5- to 8 1/4-*lbrs*. A remaining discrepency, and one less easy to dismiss, is to be found among the 1591 listings of the armament mounted on the *San Juan de Portugal*[2] at the time of the Armada, in which *sacres* firing 9- and 10-*lbr* shot are mentioned.(79) If these weights are in full

Castilian *libras* (and there is no reason to suppose otherwise), the guns concerned cannot be true *sacres*: by every criterion we can find, they are *medias culebrinas*.

One of the Italian bronze guns recovered from *La Trinidad Valencera* demonstrates the typical characteristics of a *sacre*, and must be one of the very guns listed under that name in Sicilian ship summary noted above (Figure 44). Its specifications are:

Bore	9.5 cm
Shot diameter (5 percent windage)	9.0 cm
Shot weight (by estimation)	6.0
Overall length	3.45 m
Muzzle to base ring	3.27 m
Calibre/length	1/34.4
Weight mark (cut on base ring)	2529
Weight by weigh-bridge	1194 kg
Shot/gun-weight	1/433

The casting is a good one, although its surface shows evidence of a cracked mould which has been replastered in the way Biringuccio prescribes.(80) A castillated iron chaplet has been used to hold the core mould in the breech.(81)

There are no dolphins, and the cascabel is a simple turned moulding ending in a button. A motif of swans and crustacea supporting a vase emitting flames is moulded in relief on the breech. Towards the muzzle end of the chase there is a decorated shield, with no internal device, below which the letters Z A appear within a line of rosettes. There can be no doubt that these are the initials of Zuanne Alberghetti, who is known to have founded guns in Venice and Tuscany during the second half of the sixteenth century.(82) A remarkably similar gun bearing the initials Z A and the date 1582 has recently been recovered from a Venetian wreck off Dalmatia,(83) while another gun of the same size, proportions, mouldings and decorative style has been brought up off Teignmouth, Devon,from what appears to have been the wreck of a late sixteenth-century galley.(84)

Though the _Trinidad Valencera sacre_ is technically well made, it is considerably longer than ballistic efficiency dictates, and it is certainly too long for comfortable handling aboard ship. It is, moreover, excessively heavy for the weight of shot thrown. It would have served, no doubt, well enough to deter an attack by commerce-raiding galleys or small craft on the sea lanes of the Adriatic, but as part of a great-ship's broadside in close action against Atlantic-built galleons its defects must have appeared only too obvious.

We turn now to a very different group of _sacres_, from _El Gran Grifón_. They are not, strictly speaking, _sacres_ at all: with a shot weight of _c_. 4.4 _libras_ they fall just below the limit we have established for this class of gun, although they are just above the 4-_lbr_ ceiling imposed on the next class down, the _medias sacres_. We will therefore consider them to be light _sacres_ - the distinction is, in any case, an academic one.

There are four guns in the group. All are of cast iron, and each has a bore of 8.5 cm. This regularity of bore is in itself cause for comment, especially since the guns' overall appearance is one of closely similar proportion and design. Two, admittedly, have been heavily reduced by the effects of abrasion while a third still retains a covering of concretion which obscures its surface detail. Only the fourth, the profile of which was recorded in sectional form within a concreted deposit (Grid 2717 in Figure 25; see also Figure 26) can be reconstructed in full (Figure 50). Its specifications are noted below, followed by a discussion on the similarities between it and the other three pieces.

Bore	8.5 cm
Shot diameter (5 percent windage)	8.1 cm
Shot weight (by estimation)	4.4 _libras_ (iron)
Overall length	2.44 m
Muzzle to breech ring	2.20 m
Calibre/length	1/26

Weight (by estimation)	1565 libras (720 kg)
Shot/gun-weight	1/356

As far as can be ascertained from measurement over the concretion, with due allowance made for the thickness of the crust, the specifications for the gun at Grid 3103 are essentially the same as those detailed for the first. Of the two badly abraded guns the trunnion locations on the example at Grid 2117, indicated by the vestigial bumps, suggest that it too was of very similar proportions, while it is a fair guess that the one at Grid 3217, with exactly the same bore as the other three, was yet another member of what appears to be a virtually identical group. This example was loaded with a 8.1 cm ball when found.

Two other fragments, at Grids 3705 and 3408, appear to come from similar guns. We know that when the ship arrived from the Baltic in 1587 she had on board 27 guns of her own, all of iron.(85) Eight bronze pieces were added at Lisbon, and she was credited finally with 38 guns, leaving three for which we cannot account.(86) But since the four cast iron 4.4-lbrs are all so clearly of a kind, none is likely to be one of the three missing guns; in consequence all must have been part of the ship's own armament as a Rostock-based hulk. They must therefore be of northern European origin.

It is unusual, and valuable, to identify examples of cast iron ordnance from the Baltic region at so early a date. The guns were probably manufactured in Sweden, a country well endowed with iron ore and charcoal-producing forests.(87) Professor Cipolla notes that the production of cast iron artillery did not start there until the decade 1571-80, when one factory was in operation; by the following decade (during which, no doubt, our guns were cast), three foundries were working.(88) Cast iron guns were not evidently produced in Germany itself until about the turn of the century.(89)

Let us first examine the design of these guns, and then consider their technical merits. Their resemblance to later guns from this region, which was to become the focus of northern Europe's armaments industry during the following two centuries, is striking. The multiple barrel-rings and fillets are characteristic features of the so-called "Finbankers" (a name apparently derived from the foundry at Finspong in Sweden) which were widely exported, particularly to Holland, in the seventeenth and eighteenth centuries. Such guns are common finds on the wrecks of East Indiamen.(90)

Professor Cipolla has thrown some doubt on the quality of early Swedish cast-iron guns, citing in particular an English report of 1623 concerning Swedish ordnance which claimed that "...these pieces in the proving brake most of them".(91) But it would be altogether unwise to condemn an entire gun-founding industry, the technical excellence of which at a later date is beyond question, on the evidence of a single, possibly biased, English critic. It is just as reasonable to suppose that the product, from the start, was a sound one, and a close examination of the four Grifón examples suggest that they, at least, were well designed and competently manufactured. This conclusion is supported by the relative dearth of ammunition of the right calibre for them recovered from the wreck: unlike the under-used medias culebrinas, a good proportion of the roundshot allocated to the sacres was evidently fired off in action (see Figure 49).

In terms of design the guns are clean and workmanlike. Weight has been saved from the chase, where the pressure stresses were lowest, by stepping down the diameter of the barrel just forward of the trunnions, while the thickened base ring reinforced the point at which the main stress occurs. The barrel length, at 26 calibres, would have yielded an optimum muzzle velocity, while the piece is short enough for convenient handling at sea. Its relatively high shot to gun-weight ratio would have given it the intertia to absorb much of the recoil, further enhancing its suitability for shipboard use. Finally we have the evidence of the sectioned breech on the gun from Grid 3217 (Figure 51) to show how smooth and true is the bore, and how sound the quality of the metal casting. No trace of voids or irregularities can be detected in the sectioned area, and there is no sign of pitting in the surface of the bore. All in all, these early examples of northern European cast-iron guns appear to be well designed and competently made. There is every reason to suppose that, at sea, they would have been effective and easily handled weapons.

That at least four guns from the same ship, moreover, should be so alike, and of identical bores, suggests an element of standardisation in the make-up of her armament. This reflects credit not, of course, upon the Armada planners, but on the north German merchants who owned and equipped her. We may perhaps detect here an early glimpse of the standardised production of cheap cast-iron artillery which, in the course of the following century, was to revolutionise both naval and merchant ship armament throughout Europe.(92)

ix) _Medias sacres_

The only _medias sacres_ for which shot weights are recorded in the Armada documents are two on board the galleasses and 22 distributed among the Andalusian ships mustered at San Lúcar on 26 October 1587.(96) All of them are described as 3- to 4-lbr bronze pieces. A good example of such a gun has been recovered from *El Gran Grifón* (Figure 48). It is one of the four bronze *medias sacres* from the Lisbon foundry which we know to have been issued to the ship, along with four *medias culebrinas* from the same source, shortly before she sailed.(93)

The specifications of this *media sacre* are:

Bore	7.4 cm
Shot diameter (5 percent windage)	7.0 cm
Shot weight (by estimation)	2.8 *libras*
Overall length	2.43 m
Muzzle to base ring	2.28 m
Calibre/length	1/31
Weight (by estimation)	800 *libras* (368 kg)
Shot/gun-weight	1/286

Our calculated shot weight is marginally under the *media sacre's* lower limit, but it is close enough; a Spaniard certainly would have referred to the piece as a 3-*lbr*, and we need not quibble over the difference here. This very gun, it should be remembered, was actually listed in the Spanish documents as a *media sacre*.

The piece bears a strong family resemblance to the _media culebrina_ from the _Grifón_, described above. It, too, carries no royal arms or other markings, while its mouldings, slab-sided dolphins, and simple button cascabel, are plain to the point of austerity. It is clearly another product of Don Juan de Acuña Vela's utility gun-founding programme which was rushed through at Lisbon in the hectic weeks before the fleet sailed. Whether it has the same fundamental flaws as we have detected in the _media culebrina_ we cannot tell from surface indications alone. Its specifications, however, show it to have been almost as lightly metalled as its larger sister although, being marginally shorter (31 calibres against 33), it would have been slightly stronger.

A rather similar bronze _media sacre_ has been recovered by Dr. Sténuit from the _Girona_ wreck, and the specifications listed below are based on his drawing of the piece: (94)

Bore	7.6 cm
Shot diameter (5 percent windage)	7.2 cm
Shot weight (by estimation	3.1 _libras_
Overall length	2.34 m
Muzzle to base ring	2.22 m
Calibre/length	1/29
Weight (by estimation)	800 _libras_ (368 kg)
Shot/gun-weight	1/258

This gun bears a heavily abraded escutcheon on the breech which cannot be identified with certainty, although it may perhaps be Philip II's arms.

An Italian bronze gun from La Trinidad Valencera should also be classified as a media sacre, though in every respect except for the bore it is a much more massive piece (Figure 44). It had lain exposed on a rock outcrop, and in consequence has suffered from fairly severe abrasion and pitting, particularly on its left-hand side, which faced uppermost.

Its specifications are:

Bore	7.6 cm
Shot diameter (5 percent windage)	7.2 cm
Shot weight (by estimation)	3.1 libras
Overall length	2.92 m
Muzzle to base ring	2.77 m
Calibre/length	1/36
Weight (by estimation)	1900 libras (862 kg)
Shot/gun-weight	1/613

The gun is very similar in proportion to the N D C media cañón from the same wreck, and the much abraded traces of a similar escutcheon on the chase, together with the letter C, suggest that it may indeed by a smaller version of that piece, to the same general design and from the same foundry.

The final _media sacre_ identified on the wrecks is an eroded iron gun recorded in a partly sectioned state on the _Gran Grifón_ site (Figure 50). Because of this gun's condition its specifications can only be approximate, except for the shot diameter, which was obtained by measuring the well-preserved ball which still lay in its breech.

Bore (by estimation)	8 cm
Shot diameter (actual)	7.6 cm
Shot weight (by estimation)	3.6 _libras_ (iron)
Overall length	2.9 m (approx)
Muzzle to base ring	2.7 m (approx)
Calibre/length	1/34
Weight (by estimation)	2000 _libras_ (920 kg)
Shot/gun-weight	1/526

This long, heavy, and lightly shotted gun cannot have been particularly suited to shipboard operation although its location at the landward end of the wreck site suggests that it may have served as one of the _Grifón's_ bow chasers, where more room to work it would have been available. It seems probable that this gun, like the four short 4.4-_lbr_ cast iron _sacres_ from the same ship, came from a Swedish foundry. If so, it demonstrates that the Swedish gunfounders, whatever technical skills they may have possessed in other directions, were not immune from the sixteenth-century misconception that long guns threw shot further.

x) Falconetes

In the context of the Armada these guns are rather a shadowy class of ordnance, and examples attested in the documents range in weight of shot from 1 1/2- to 4-lbr. Medias falconetes are 1- to 2-lbr.(95) There are versions in bronze and in iron, and both stone- and iron-throwers are mentioned. Some appear to have been swivel guns, and some may have been breech-loaders. I suspect that as a group they are little more than a rag-bag at the tail end of the gun lists which the Armada planners did not feel was worth breaking down into more specific categories. We have no choice but to follow them.

No examples are known from the wrecks.

xi) Swivel guns

Breech-loading guns mounted on swivels were the quick-firers of their time, and Norton claims that one type, the harquebus-à-crock, could be discharged up to 300 times a day which, assuming a working period of ten hours, gives an average of once every two minutes.(96) Since he was speaking of the gun's endurance, and not of its extreme rate of fire, it is probable that for short periods it could be fired even more rapidly. Guns of this kind were common in the sixteenth and early seventeenth centuries, and are described by various contemporary writers. They were mounted, Norton tells us, "upon a forked prop or pintle upon which the ends of the trunnions rest," and they were aimed "with a long stern handle of iron" which extended from the butt-end of the breech.(97)

The inability of a fixed pintle mounting to absorb recoil limited the size of such guns, but their quick-firing capability and the ease with which they could be elevated and traversed to extreme angles made them especially valuable for close fighting. They were essentially anti-personnel pieces, and might equally well have been found aboard small craft as among the armament of high-charged warships, with their tactical emphasis on close-quarter, man-to-man fight. Swivel guns might be used in attack for breaking up an enemy's "chiefest fight", or main troop concentrations on deck, while mounted on the castleworks fore and aft they could be applied in a defensive role by bringing enfilading fire down on boarders crowded in the ship's own waist.(98) The unsuitability of the new flush-decked galleons of Elizabeth's navy for such armament, because of their lack of castleworks, was considered by some to be a major disadvantage. Sir William Monson, and English officer who had taken part in the Armada campaign, may have been out of tune with his more illustrious contemporaries when he wrote:

> "Such a ship that hath neither fore-castle, copperage head, nor any other manner of defence, hath no fowlers, which are pieces of great importance, after a ship is boarded and entered, or lieth board and board; for the main ordnance stands her in little stead... but a murderer or fowler being shot out of their own ship, laden with dice shot, will scour the deck of an enemy..."

but he was nonetheless expressing a belief still held by many of the English as well as Spanish naval commanders until beyond the turn of the century.(99) The views of Sir Richard Hawkins, veteran of a notable close action with two Spanish ships in 1593, were considerably more conservative than those of his more famous father who, more than anyone, had been responsible for creating Elizabeth's flush-decked warships a generation before: "I hold nothing more convenient in ships of war," wrote Sir Richard, "than fowlers and great bases in the cage works and murderers in the cobridge heads, for that their execution and speedy charging and discharging is of great moment."(100)

Although breech-loading swivel guns remained in use on merchant ships long after the Armada period, they largely disappeared from European warships with the widespread introduction of flush-decked galleons at the beginning of the seventeenth century. Their apologist, Richard Hawkins, ruefully admits their demise along with other obsolescent close-quarter weapons: "many I know have left the use of them and sundry other preventions as of shear-hooks and stones in the tops."(101) Norton tells us that by his time (1628) their use was chiefly restricted to small vessels.(102)

We cannot estimate with any confidence the total number of swivel guns with which the Armada was equipped. Breech-loading itself is not the sole criterion; some types of _pedreros_, and apparently some (if not all) of the _falconetes_ were breech-loaders too, while it must always be borne in mind that guns suitable for swivel mounting might equally well have been mounted on light carriages. Only very rarely, as in the case of the 1 1/2-_lbr_ _falcon_ and the 6-_oz_ _esmeril_ on board the _Santa María de la Rosa_, are swivels (_horquillas_) specifically mentioned in association with the guns(103); while only one of the four guns of this type recovered from the wrecks - that from _La Trinidad Valencera_ - retains the unequivocal evidence of its intact swivel mounting. Nonetheless it is reasonable to suppose that the guns described in the documents as _falcones pedreros_, _esmeriles_, and _versos_, were almost invariably mounted on swivels, while some of the lighter _falcones_ and _falconetes_ might well have been mounted in this way too. Many such pieces were evidently distributed amongst the fleet. The four galleasses [123-126], for instance, sported 20 _esmeriles_ apiece(104), while the well-gunned _Nuestra Señora del Rosario_[43] carried 15 _esmeriles de cámara dobles_ and four *falcones pedreros*.(105) Five ships of the Levant squadron mounted between them 31 *falcones pedreros* and 18 *versos*,(106) while 14 *falcones pedreros* and 10 *versos* account for almost half the 50-gun armament of the fleet's vice-flagship *San Juan de Portugal*[2], a powerful galleon commanded by the Armada's most experienced and capable officer, Don Juan Martínez de Recalde.(107)

These gun-types crop up in the documents aboard ships of all sizes, while more are doubtless lost in the blanket figures which obscure many of the lighter-shotted categories. Some of the 257 iron pieces classed simply as 1- to 6-*lbrs* aboard the *urcas* were certainly swivel types (108) - a minimum of three have been identified on the wreck of their flagship, *El Gran Grifón* - while the 61 guns belonging to the same squadron which threw shot of 4- to 6-*onzas* were probably similarly mounted.

In conclusion, we may guess that a gun-weight of about 5 *qtx* sets a practical upper limit to effective mounting on a swivel, although most such pieces were probably a good deal lighter than this.

xii) *Falcones pedreros*

These guns were light stone-throwing breech-loaders, usually if not always mounted on swivels. The weight of shot fired ranged typically between 1 1/2- and 4-_libras_, although a 1-_lbr_ piece is recorded aboard the _San Medel y Celedón_[35] (109) while 5- and 6-_lbr_ versions are credited to the _Nuestra Señora del Rosario_[43].(110) Most pieces were bronze though some, as we shall see, were fitted with an iron breech construction. Only one _falcón pedrero_ recorded in the documents as issued to the Armada - the _Rosario's_ 5-_lbr_ - is specifically described as an all-iron gun,(111) although another has been identified on the wreck of _El Gran Grifón_. The two _falcones pedreros_ listed aboard the _Nuestra Señora de Guadalupe_[112] are associated with 4 _cuñas_ (wedges) and 4 _cámaras_ (breech-blocks), thus establishing the breech-loading character of the group as a whole.(112)

A fine example of a _falcón pedrero_ has been recovered from the wreck of _La Trinidad Valencera_ (Figure 52). The barrel is a single bronze casting which bears a weight mark of 125 on the breech, but all of the gun's other fittings, including breech stirrup, block, tiller, wedge with attachment chain, and swivel, are of wrought iron. The iron is exceptionally well preserved, and most of its surface remains intact. The whole weapon weighs by estimation 3 _qtx_, which suggests that the mark on the barrel refers to the bronze casting only.

The gun's specifications are:

Bore	8.6 cm
Shot diameter (5 percent windage)	8.2 cm
Shot weight (sp. gr 2.6)	1.7 libras
Overall length (including tiller)	1.73 m
Barrel length (excluding máscolo)	0.88 m
Calibre/length	1/10
Weight mark (barrel only)	125
Weight (by estimation)	300 libras (158 kg)
Shot/gun-weight	1/176

Since this gun must have been part of the ship's pre-Armada armament of 28 pieces, we can confidently assume that it is of Italian, and probably Venetian, manufacture. Close parallels to it have been recovered from the wreck of a late sixteenth century merchant ship, almost certainly Venetian, in the Adriatic, and from what appears to be the wreck of a galley (perhaps Venetian also) off Teignmouth in Devon.(113) Such guns are described by contemporary Italian writers, notably Capo Bianco (114) and Moretti.(115) Moretti calls the piece a petriero a braga, and describes it as follows:

> "...they have their chamber separated, which is called the Mascolo, Servitore, and Covetta, and so they are loaded behind; they are servicable upon galleys, vessels, towers, and other narrow

places, where the piece cannot reverse; they are either of beaten iron or brass, as also the servitore or máscolo; the braga is of iron. They have their chase long from 10 to 12 calibres, and no more... betwixt the trunnions and the end... there are placed two wings, to fasten the braga... the braga is of iron, ordinarily fastened straight to the wings; it is prolonged within that it may be capable of the length of the máscolo, and its coine [wedge] behind, which makes it firm; and in the end hath a long trail or train... [which] serves to manage the petriero: across the braga underneath, is a place to sustain the máscolo. The wedge is of iron... one may also have more wedges to keep the máscolo or chamber joined to the bore."

Moretti's drawings include names for two more of the weapon's component parts: the forcone, or swivel, and the cuneo, or wedge.

This description might be applied, without modification, to the falcón pedrero from the Valencera. We can, however, add some technical details. The braga is a stout stirrup of wrought iron fixed to the gun by means of two cheek pieces (Moretti's "wings") which enfold the bronze barrel on either side and are attached to it over two lugs cast close to the breech. Hammer marks on the braga suggest that this operation had been carried out while the iron was still in a malleable state, to ensure a tight-shrunk fit. An iron cradle is welded under the breech end of the braga, just as Moretti prescribes, to prevent the máscolo from dropping out.

The locking wedge on the Valencera gun, like Moretti's cuneo, was secured to the head of the tiller by a short length of twisted chain, portions of which survive as concretion casts. It has a V-shaped slot cut in the top for sighting. The flaring ends which rise on either side of this cut were intended, no doubt, to shield the gunner's eyes from blowback caused by the notoriously imperfect seal at the breech: "...they will scale extremely... I have known divers hurt with shooting them off," wrote an early seventeenth-century authority on naval warfare.(116) A pad of folded leather has been inserted behind the wedge of the Valencera gun, recalling Cataneo's instruction that "between the chamber and the wedge should be placed a pad of lead or a piece of old boot, because this will lessen the shock of the recoil."(117)

These arrangements imply a well-organized firing drill, and some features of its procedure can be deduced from the Valencera example, which survives just as its gun-captain left it in 1588. It is fully loaded, with a stone ball in the breech, powder in the chamber, and a twist of hemp in the touch-hole to keep the priming dry. Marks on the left-hand edge of the wedge (as viewed from the breech) suggest that it was normally struck free after discharge by the gunner using a hammer held in his left hand (no doubt it would have been looped with a thong around his wrist). The gunner's right hand would thus have been free for laying the piece. But in the aiming position, with the tiller held at arm's length to put the maximum practicable distance between the breech seal and his eyes, and with the rising sides of the wedge blocking his access to the touch-hole, the gunner would have been unable to ignite the priming. We may presume therefore that this was done on his word of command by an assistant facing the gun on its right hand side, doubtless by means of a linstock of the kind illustrated in Figure 77. This assistant would have been well placed to extract the spent block after the gunner had struck out the wedge, and inserted a loaded one after a fresh projectile had been placed in the breech. For rapid fire a third member would, one imagines, have been needed to sponge out and recharge the spent _máscolos_.

Nine small dots are punched on the top of the _Valencera máscolo_ at its front end, and nine similar marks are visible on the side of the _braga_. These are clearly intended to match the one to the other, in the same way that a modern rifle bolt carries the serial number of the weapon for which it was machined. With so wide a variance between individual guns and breech blocks such a precaution would have been essential.

A wrought iron gun barrel recovered from the wreck of _El Gran Grifón_ may also be identified as part of a _falcón pedrero_ (Figure 53). The barrel is composed of an inner and an outer sleeve, each of which has been formed by wrapping a sheet of hammered iron around a mandrel and lap-welding it along the seam. The outer sleeve has then been passed over the inner one while the former was still hot, the seams being positioned opposite one another to ensure maximum overlap. On cooling, the outer sleeve would have shrunk tightly onto the inner one to form a strong and serviceable gun barrel. Reinforcement at the breech and muzzle has been obtained by adding further short sleeves, while a ring clamped around the muzzle had secured the trunnions, of which only vestigial traces now survive. No evidence of the breech mechanism was found, although a handled breech block with a chamber bore of 5 cm and a shoulder diameter of 8.3 cm, which was found less than 2 metres away from it, would have fitted well. The barrel bore is 8.5 cm, and its length 87 cm. If the gun had been an iron-shotted piece it would have thrown a 4 1/2-_lbr_ ball, which is patently too heavy for so light a weapon. But as a stone-thrower, firing a ball of _c._ 1.7 _libras_, it would closely match the _Valencera's falcón pedrero_ of the same calibre, and as such we will identify it. This conclusion is given strength by the discovery, elsewhere on the _Grifón_ wreck site, of two abraded stone balls of the appropriate size.

The gun, we may presume, will have been part of the ship's original armament, and is therefore probably of north German or Scandinavian manufacture.

xiii) Esmeriles and versos

If there is a clear distinction to be drawn between these two names I have been unable to find it. The Armada documents show that *esmeriles*, which were normally made of bronze, threw an iron shot of 6- 30 *onzas*: the only iron peices referred to by this name, four guns aboard the *patax San Bernabé*[65] which threw 1 1/2-*lbr* stone shot, we will dismiss as suspected *falconès pedreros*.(118) *Versos* apparently show a rather wider range of shot weights, from the 2-*onza* balls of those on board the *San Buenaventura*[60] and *patax La Asunción*[64] (119) to the 3-pdr shot of the six *versos* belonging to the five members of the Levant squadron for which we possess detailed information.(120) But perhaps these latter guns are incorrectly identified, for it is difficult to see how 2-*onza* and 3-pdr shot could possibly fall within even the most loosely defined single category - even a sixteenth-century one - and it may be safer to reject them. The *verso* appears to be the lightest category of ship-mounted weapon, and we may guess that it threw an iron or lead bullet from 2-*onzas* (about the weight of a musket ball) up to, say, 1-*libra*. On this assumption the *verso* shot-weights overlap the weights we have allocated to the _esmeriles_, and so any distinction there may be is, from our point of view, entirely academic. As we already have cause to suspect, guns of this kind, whether of bronze of wrought iron, evidently came in a wide variety of sizes, proportions, designs and countries of origin.

What undoubtedly is an Armada _esmeril_ was recovered from the wreck of the galleass _Girona_[125] by Dr Robert Sténuit in 1968.(121) This piece is one of the 20 _esmeriles_, each equipped with two _máscolos_, with which the ship was credited on 9 July 1587.(122) The ammunition provided for the 80 _esmeriles_ aboard all four galleasses ranged from 10- to 30-_onza_ iron balls.(123)

The _Girona_ _esmeril_ is a single bronze casting, with an open box-like breech extending rearwards from an octagonal barrel to accommodate a bronze _máscolo_ which could be locked in position through a pair of wedge slots at the back. A further slot was provided in the base for drainage or, perhaps, for knocking out stubborn _máscolos_. There is a hole in the rear for the iron tiller. The surface of the bronze is much worn, but an escutcheon on top of the barrel is still recognisable as the arms of Philip II.

Several bronze _máscolos_ of appropriate size were found in association with this _esmeril_. Each was loaded with a powder charge sealed with a wooden stopper. There were also several larger _máscolos_ or similar pattern, presumably for the 30-onza "super" esmeriles which the galleasses carried.

The specifications of the Girona esmeril are:

Bore	6.4 cm
Shot diameter (5 percent windage)	6.1 cm
Shot weight	1.9 libras
Overall length (excluding tiller)	1.63 m
Barrel length (excluding máscolo)	1.17 m
Calibre/length	1/18
Weight (by estimation)	200 libras (92 kg)
Shot/gun-weight	1/105

In 1905 a similar but rather shorter and lighter bronze esmeril was recovered with its máscolo in place from the wreck of the San Juan de Sicilia[71] in Tobermory Bay (Figure 55).(124) Its specifications are:

Bore	4.5 cm
Shot diameter (5 percent windage)	4.3 cm
Shot weight (by estimation)	0.65 libras
Overall length (excluding tiller)	1.38 m
Barrel length (excluding máscolo)	1.16 m
Calibre/length	1/26
Weight (by estimation)	150 libras (69 kg)
Shot/gun-weight	1/230

The gun has a weight mark of 163 set in a rectangular cartouche at the breech, while an angular shield in relief on top of the barrel contains a chiseled device more like a merchant's mark than a formal escutcheon. The same device, without the enclosing shield, appears on the *máscolo*.

Three wrought iron breech blocks from the wreck of *El Gran Grifón* suggest the presence of at least two more *esmeriles/versos* aboard that ship. They are 37 cm long, with chamber bores and shoulderings of 4.2 cm and 7.0 cm respectively, from which we can postulate iron shot of *c.* 1 1/2- to 2-*libras* (Figure 53).

xiv) *Obsolescent types*

Quite a large proportion of the Armada's numerical gun-strength was made up of light wrought-iron breechloaders. Little detail of them has survived in the documents, for they were rarely considered important enough to merit individual descriptions. A few examples can be found in the detailed gun lists of the Guipuzcoan squadron. The *Santa María de la Rosa*[55], for instance, carried two iron *lombardas* throwing stone shot of 4 1/2- and 7-*lbr* calibre, while the *Santa Bárbara*[59] had six iron *passamuros* which fired iron shot of 1- or 2-*lbr* calibre.(125) Such guns were typical of merchant vessels of the time, and were carried as insurance against small-scale attack.(126) There were undoubtedly a great many of them throughout the fleet, particularly aboard the requisitioned merchantmen and hulks.

Several guns of this kind were found on the wreck of El Gran Grifón (Figure 53), whose original armament of 27 guns was specified only as being of 6-lbr calibre or less.(127) Some of these, as we know from the wreck finds, were high quality cast-iron pieces, but others were built-up guns of wrought iron. In this process bars of hot iron were hammer-welded together over a mandrel to form a cylinder, which was then reinforced by shrinking on sleeves and hoops along its length. The open breech was then strengthened, and lifting rings added. Separate breech-blocks were constructed on the same principle, and their breech ends plugged. The gun was mounted on a flatbed timber carriage to which it was strapped or lashed, and against which the breech-block could be wedged secure. Sometimes these flatbed carriages were set on a pair of wheels, as recent finds from the Mary Rose have shown,(128) but more often, it seems, they simply sat level on the deck.

The wrought-iron gun barrel from El Gran Grifón (no. 1 in Figure 53) has a bore of c. 7 cm. which if it threw an iron projectile, would make it a 2 1/2-lbr or thereabouts. The four breech-blocks (nos. 2-5) are for guns of similar calibres but, it would appear, of rather different proportions. Such guns, though certainly obsolescent by

1588, were still widely used because they were simple and cheap, and could be turned out by any competent blacksmith. They were doubtless sufficient to preserve a merchantman from many of the petty troubles it might encounter on a voyage, but in a full-blown naval battle, such as that at Gravelines, they would have been all but useless.

4. Shipboard gun carriages

No complete gun carriage has been found on any of the wrecks, but several components from such assemblies have been identified on the Trinidad Valencera site. Many of the pieces are clearly from carriages intended for use ashore, and these are discussed below, although field carriages were quite frequently used by the Spaniards aboard their ships. The question is considered further in Chapter Nine. Proper sea carriages (encavalgados de mar) were, however, much preferred for naval use, and it is clear that when field carriages were employed at sea it was because better mountings were not available. But what, precisely, did a late sixteenth-century Spaniard mean when he spoke of an encavalgado de mar?

The description inevitably conjurs up a picture of the four-wheeled truck carriages which, for more than three centuries, played a central role in the evolution of sailing ship warfare. By the 1540s the English were certainly using such carriages, and by 1588 they appear to have been universally employed aboard all the royal galleons and, no doubt, on many of the hired merchant ships, too (Figures 56 and 57). But a contemporary Spanish sea carriage appears to have been something quite different. Two drawings from Simancas leave us in no doubt that an encavalgado de mar was little more than a cut-down version of a land carriage.(129)

The first drawing (Figure 58) has composite wheels made up of four broad spokes into which four felloes are set. A reinforced axle box surrounds the hub, while the outer circumference appears to be bound with iron strakes. The gun itself sits on two cheek-pieces which form a short trail, and upon which four ornate bolt-heads indicate the locations of the joining transoms. Breech elevation was controlled by two wooden quoins, and a lashing hook was provided at the fore end of the carriage. The gun shown mounted is a 20-*lbr* *media cañón* weighing 40 *qtx*.

A second carriage design from the same source is shown in Figure 59. Here the wheel is of tripartite construction, with a reinforced cross-piece which incorporates the hub. This wheel is considerably larger than the crossed-spoke type, and its trail (not all of which is shown) appears to be longer. This carriage, states the caption, was suitable both for use at sea and for mounting on the walls of a fortress. Pietro Sardi, in his *Artiglieria* of 1621, shows a rather similar design, although the wheel has been considerably reduced in size and the trail shortened so that it barely protrudes beyond the breech (Figure 60).(130)

Three dovetailed pieces forming a single tripartite wheel, and a segment from another of similar type and size, have been found on the wreck of *La Trinidad Valencera* (Figure 61). The wheel is 49 cm in diameter and 7.5 cm thick, and is secured transversely by two iron bolts which pass through all three pieces. There is a 12 cm diameter axle hole. The rim of the wheel is grooved with a U-shaped channel, which at first suggested that it might have been a sheave, but its large size, and particularly the diameter of the axle hole, precludes this interpretation. The groove was no doubt for an encircling iron tyre, which would have clamped the whole wheel together and provided a durable bearing surface. That the remains of such a tyre were not found with it suggests that the wheel may have been a spare.

Close to this wheel was found an axle of appropriate dimensions to mate with it. The axle is 1.18 m long, with arms 12 cm in diameter. It is drilled to take simple lynch pins. With a pair of solid tripartite wheels set on it, this axle would have provided an undercarriage assembly not dissimilar to Pietro Sardi's model, and it was upon such carriages, no doubt, that the Trinidad Valencera's Venetian guns were mounted.

Not far from the tripartite wheel a ten-spoked wheel 1.15 m in diameter was found (Figure 61). While this may, of course, have been intended for a small vehicle, or even a light field piece, several similar wheels have been found attached to light flatbed guncarriages on the wreck of the Mary Rose, and the possibility that it, too, may be from a naval gun mounting cannot be discounted.(131)

No evidence has been found either in the documentary sources or on the wrecks for the use of four-wheeled truck carriages aboard any of the Armada's ships.

Chapter Eight: The Army

1. The infantry and their weapons

The basic unit of troops in the Armada was the infantry company. These were organised into five Spanish regiments, or _tercios_, each of 26 companies, together with an _ad hoc_ contingent of Portuguese levies and pioneers _(compañías sueltas)_ 32 companies strong.(1) Altogether the 162 companies contained 18,973 men, an average of 117 each, although the Lisbon muster shows that actual strengths varied between 37 and 222. The contemporary English soldier, Sir Roger Williams, who knew the Spanish army well, stated that company strengths could be as high as 300, although 150 was normal.(2) Each company was commanded by a captain, and acted as an independent tactical unit under the overall direction of the commander-in-chief. The _tercio_ itself was essentially an administrative grouping and its commander, the _Maestre de Campo_, headed his own regular company of troops like any other captain. This distinction between administrative and tactical command is strikingly similar to the command structure we have postulated for the Armada as a whole.

The proportion of the various arms within the companies is not given in the Lisbon muster, and the figures are difficult to determine. The fleet carried 7,000 arquebuses, 1,000 muskets, 10,000 pikes, 6,000 half pikes, and 1,000 partisans and halberds. But regular Spanish troops were expected to provide their own arms and equipment, and so while some of the fleet's weapons may have been intended for new recruits, most were evidently spares, or earmarked for the ships themselves.(3) The 6,000 half pikes, which made excellent boarding weapons, were doubtless for this specific purpose. Nevertheless the additional arms were probably provided on a scale which broadly reflected the proportion in which they were normally issued to the fighting troops.(4)

Remains of many infantry weapons have been identified among the material recovered from the wrecks. Seven wooden gunstocks were obtained from the wreck of _La Trinidad Valencera_; and the _Girona_ and _Santa María de la Rosa_ have each provided one. The value of these finds as examples of ordinary service weapons, rather than the ornate presentation pieces which more generally have survived into modern times, is considerable.(5) They are very plain and, with one exception, wholly undecorated. All are sear matchlocks of the simplest type, as the recesses and bolt holes for the lock and sear mechanisms clearly show.

An example of each of the two main types in general service, the musket and the arquebus, is illustrated in Figure 62. Both are from _La Trinidad Valencera_. They are typical of the rest, though it should be stressed that no two are exactly alike; military handguns had not reached any standardisation of form by the late sixteenth century, though they came closer to it than did their idiosyncratic cousins, the heavy artillery. Within a fairly loose range of specifications, it seems, there was considerable scope for individual preference, as there was with other items of clothing and equipment.

The smaller of the two weapons, the arquebus, had a calibre of about 1.3 cm - a standard which, for obvious administrative reasons, was fairly closely adhered to. Its lead bullet weighed 14 grams. The _Valencera_ arquebus nicely demonstrates the droop-curved petronel stock which characterised the unsatisfactory system of absorbing recoil on the centre of the firer's breast rather than in the fleshy padding of his shoulder (_cf._ Figure 89). This piece, like most of the fleet's hand guns, is probably of Italian manufacture.(6)

With the introduction of the much heavier musket in the second half of the century the chest recoil system became unworkable and the straight stock, well illustrated by the _Valencera_ example, came into widespread use. Sir Roger Williams knew this weapon well, and much admired it: "...for the recoiling, there is no hurt, if they be straight stocked after the Spanish manner; were they stocked in the French manner, to be discharged on the breast, few or none could abide their recoiling, but being discharged from the shoulder after the Spanish manner there is neither danger nor hurt."(7) Spanish musket stocks, as this example shows, were not really straight, since the butt had to drop slightly to allow the firer's eye to line up comfortably along the barrel. In this design may be seen the origin of the modern rifle butt.

The musket had a calibre of c. 1.9 cm, and fired a ball of 40 grams - nearly three times the weight of the arquebus projectile. To counter the difficulty of handling this cumbersome weapon, which would have weighed well over 10 kg, a wooden rest was provided, and bronze terminals from such rests have been recovered from the Girona site. The general method of operation is demonstrated in Figure 63, which shows a wheel-lock musket of c. 1600 at the moment of discharge.

Musketeers and arquebusiers carried their powder in hopper-shaped wooden flasks, which were inverted to provide a measured charge by means of a spring-loaded metering device fitted to the steel loading funnel. Several such flasks have been found on the wreck of La Trinidad Valencera, and an example is shown in Figure 64, along with a smaller flask used to carry the finely ground priming powder (cf. Figure 89).

Medina Sidonia's orders to the fleet reminded company officers of their duty to ensure that the soldiers' firearms were kept servicable, and cleaned twice a week. They were also enjoined to carry out regular weapon drills, though whether this involved the use of live ammunition is not made clear.(8) As far as it went, the performance of the soldiers in the sea battles was creditable enough, and an instance of sharp-shooting was recorded when one of Don Francisco de Toledo's soldiers brought down an Englishman who was calling from his ship's maintop for the San Mateo to surrender.(9) But such opportunities were rare. The English seldom came near enough for effective small-arms fire to be employed and, when they did, there were all too few human targets on their decks.

The primitive nature of these weapons posed a very real threat to the users, for the handling of loose gunpowder in close proximity to a lighted match was a sure recipe for disaster. That so few accidents in fact occured reflects well on the standards of discipline and arms drill among the troops. We do not know for sure how the San Salvador[56] blew up, but despite more sensational rumours carelessness remains by far the most likely explanation. A mishap of this kind did indeed take place off the Scillies aboard one of the hulks. In June 1588 the Paloma Blanca[93], blown thither by the storm which had separated the Armada off Corunna, broke off a fight with an English merchantman because, as Medina Sidonia later reported to the king, "one of the soldiers' powder flasks caught fire and fell on some cartridges, which might have resulted in the burning of the whole ship."(10)

The third infantry weapon was the pike. Used in defence, it could protect a body of troops against cavalry, although in attack its great length made it unwieldy, and for this purpose the shorter half-pike was normally used. A bundle of the lower ends of ten pikestaves was found on the wreck of La Trinidad Valencera, the longest surviving length being 3 metres. The butt ends terminated in simple iron ferrules. Elsewhere on the site two head-ends have been found, still retaining the concretion which formed around their points. From these remains the complete weapon can be restored as a 6-metre shaft of ash, 3.5 cm thick from its heel to a point about one-third up its length, after which it tapers to a diameter at the point of 2.4 cm. The point was a small conical iron shoe secured to the shaft by iron side straps 0.8 cm wide and 36 cm long, rivetted through at six points. The weight of the complete weapon would have been in the order of 5 kg, and its own inertia was the key to its effectiveness. If held stationary an advancing foe would impale himself upon it, while if thrust against an adversary (the famous "push" of the pike) its momentum would give formidable penetrating power. These factors explain the design of its small but extremely well secured point. The long side straps, moreover, helped to prevent its tip from being lopped off by an edged weapon. The Spaniards, wrote Thomas Digges, held the pike "in so great reputation, that they seldom commit them but to Gentlemen."(11)

Partisans and halberds were short weapons whose function was to some extent ceremonial - they were carried as emblems of office by the company executives - although their more manageable length of two or three metres gave them some advantages over the pike, particularly in trench fighting or boarding. Part of the decorated shaft of such a weapon was found on the wreck of La Trinidad Valencera. It was sheathed in red velvet, studded with dome-headed brass nails.

ii. Armour and accoutrements

Six complete morions have been recovered in concretion from the Trinidad Valencera wreck site, and fragments of several others have been found. No complete example has yet been investigated because of the difficulties inherent in dismantling concretions of this kind (the object itself survives only as a void within the matrix of concretion), but all the fragments show evidence that the steel helmets from which they came carried elaborate surface decoration (Figure 65). Even the lowest ranks, it seems, boasted a measure of finery in their military headgear. The helmets were further decorated with brass rosette-headed rivets which secured the leather lining band and internal padding, and a patterned brass plume-holder was fitted at the rear.(12) Three examples of plume-holders were found loose; they are all identical, which begs the question that the design may represent some kind of regimental emblem (Figure 66).

These morions, though almost certainly of Italian manufacture, are of the parallel-brimmed "Spanish" pattern, with a pointed fore-and-aft ridge and flat sides designed to deflect missiles. One of the concreted helmets retained traces of its internal padding, which was of coarse cloth stuffed with pine needles. This would have provided excellent protective shock absorbtion from a bullet or downward blow, and is similar in concept to the well-padded German infantry helmet of the First World War - and much better, as the writer knows to his discomfort, than the British infantry helmet still in service.(13) The Spanish morions were clearly designed with the hazards of combat engineering and trench warfare in mind.

The troops evidently took precautions to protect their finely decorated helmets from the everyday knocks of service life, for one concreted fragment bears the impression of an outer covering of coarse fabric. No doubt this would have been removed on parade. The discovery probably explains why, in some contemporary illustrations, Spanish soldiers' helmets are represented in a variety of colours.(14)

Two concreted breast-plates, or corseletes, were recovered from La Trinidad Valencera. These would have belonged to pikemen, a proportion of whom were equipped with body armour. The size of this proportion is again open to question. Professor Parker has shown that of the 3000-odd Spanish pikemen serving in the Netherlands in May 1571 about half wore corseletes (15); on the other hand Sir Roger Williams thought that 20 percent was the ideal figure,(16) while Santa Cruz's estimates of 1586 envisaged a figure of only 15 percent.(17) Both the helmets and body armour worn by pikemen, according to Sir Roger, should be proof against caliver (i.e. arquebus) shot at 200 paces. Presumably the armoured pikemen were expected to lead an assault, while their nimbler but less well protected comrades followed in their wake to exploit the initial shock.

No provision was made by the Armada's planners for supplying the sword and dagger which each soldier carried; every man, presumably, was expected to furnish his own sidearms. The wreck of La Trinidad Valencera has yielded a fine leather sword-belt complete with its hanger, and a brass suspension buckle.

A collection of well preserved fabrics from the same site includes the remains of woollen garments and their elaborate facings and finishings. A find of particular interest is part of a heraldic surcoat, or *repostero*, on which traces of a design can still be discerned.(18) Spanish soldiers in the late sixteenth century evidently dressed according to prevailing fashions, without regard to uniform appearance, and this impression is amply borne out by the variety of fabrics and design styles noted in the Valencera collection. Fashion consciousness also extended to footware, and several contemporary styles are evident in leather shoe remains from the same site. The most common form is a lightly constructed slipper-like shoe secured by two flaps tied with a silk ribbon (Figure 67). Less suitable footware for an infantry soldier is difficult to imagine, although the find of a cloth anklet in association with a shoe of this type suggests that gaiters were worn to obtain some additional ankle support (Figure 68). In spite of the latitude evident in an individual soldier's choice of footwear it was felt necessary to provide the fleet with 5,000 spare pairs of leather zapatos, to replace those worn out on campaign. Eight thousand pairs of rope-soled alpargatas (still a popular form of footwear in Spain) were also provided, and several examples of these, in a delicate state of preservation which has so far defied conservation or detailed inspection, have been recovered from the Valencera site.(19) These comfortable and durable sandals would have been much more suitable for campaigning than the fashionable zapatos, although no doubt any Spaniard who aspired to gentility would have scorned to wear them.

The troops carried their personal gear in cloth knapsacks, of which numerous but irrecoverable fragments were observed during excavation.(20) Each man was also equipped with a leather bottle for his ration of wine or water.(21) Several of these have been recovered intact from the Valencera (Figure 69). They consist of welted goatskin bags lined with pitch, with a turned wooden funnel bound into the neck. The funnel was plugged with a tapering wooden stopper through which a narrow hole was bored to enable liquid refreshment to be imbibed on the march in the traditional Spanish manner. The bottles had a capacity of about one litre, and were fitted with shoulder slings of woven cord.

iii. The artillery train

In early February 1588 the Venetian ambassador at Madrid wrote to his government that "...on board [the Armada], besides its own artillery, they have embarked twelve heavy siege guns and forty-eight smaller ones, with a double supply of gun carriages and wheels for the field batteries, and 600 mules..."(22) The Lisbon muster confirms the presence of 12 _cañones de batir_ (but see pp.265-7 above for a suggestion that there may have been more), although it shows only 21 lighter field pieces.(23) Since many of the smaller guns could easily have been used on land or sea without significant modification to their mountings, this discrepency need not concern us unduly. The Guipuzcoan squadron, for which we possess good (but by no means complete) data concerning the mountings of its larger guns, carried at least 26 sets of field carriages of _media culebrina_ size and upwards.(24) There can be no doubt, therefore, that in addition to its twelve or more _cañones de batir_, the Armada possessed a considerable number of sizeable guns which could have been deployed in the field.

The provision of a double supply of field carriages and limbers for the four _cañones de batir_ shipped on board _La Trinidad Valencera_ is confirmed in the lading documents,(25) and ten large spoked wooden wheels together with five associated axletrees have been located on the wreck site. A double set of carriages and limbers for them would account for 16 axles and 32 wheels, so in terms of identified components we have located nearly a third.

The wheels

These fall into two types. The larger is a 12-spoked wheel with a diameter of 1.5 metres, while the smaller is 1.3 m in diameter and has 10 spokes. It seems likely that the 12-spoke wheels, of which five have been identified, are carriage wheels, while the smaller 10-spokers, seven in number, belong to the limbers.

A well-preserved 10-spoke wheel from Grid 16.147 has been raised and examined in detail (Figure 70), while the two complete but heavily concreted 12-spoke wheels at Grids 22.38 and 74.18 have been recorded in situ. Further constructional details have been obtained from an examination of the other wheels, from a fractured nave at Grid 65.51, and from an unused felloe located at Grid 62.48. The drawings presented in Figure 71 are composite reconstructions, based on these sources, of the two types.

The wheel naves are turned out of elm heartwood. Those for the carriage wheels are 62 cm in diameter and 55 cm wide, and are reinforced with iron bands at the hub ends and at either side of the spokes. A tapered hole accommodates the axle bearing, which is lined with an iron sleeve. The tenoned ends of the spokes are housed in rectangular mortices.

The naves on the limber wheels are of a rather different design. They are, in proportion to the diameter of the wheel, considerably less thick and wide than the carriage naves (40 cm x 40 cm), and they are not so bulbous in appearance. They too are reinforced with iron bands. The tapered bearing sleeve is designed to accommodate much the same size of axle arm as does the sleeve on the larger carriage wheel.

On both types of wheel the spokes are of oak. All have a roughly oval section at the centre, which squares off towards the extremities. The spokes of the carriage wheels have a forward curve on their inner faces, which reaches the vertical as it joins the felloe. The outer spoke face is straight from the nave to a point just short of the felloe, where it curves slightly outwards. These spokes are set forward at an angle of 7 degrees. The limber wheel spokes curve forward uniformly on both faces from the nave, squaring as they reach the felloe. Their mean forward set is 8 degrees.

All the felloes are of ash, and each is mortised to receive two spokes. Thus a guncarriage wheel has six felloes, and a limber one five. The butt ends of each felloe are drilled with holes set tangentially to the wheel arc, and fastened to their neighbours with dowels. An unused felloe blank, in which no mortises or dowel holes have been cut, was found at Grid 62.48. Unlike the felloes on the wheels themselves, which in general appear to be sound and well made, the spare is shoddily cut from wood derived from a part of the parent tree so close to its outer surface that a section of its intended inner face actually extends beyond the bark, and so is missing.

A thick build-up of concretion has obscured details of the iron-work fitted to the wheels, although it is certain that they were clamped around the rim with a series of iron strakes, each starting at the centre of a felloe and ending at the centre of the next in order to straddle and reinforce the joints. There would thus have been six strakes on a carriage wheel and five on a limber wheel. The strakes would have been bound to the felloes with cross clamps in the manner illustrated by Pietro Sardi in his work of 1621, which shows two alternating types of clamp, one for the felloe joint and one for the strake joint (Figure 72).(26) Sardi's wheels and axles are so similar to the Valencera ones that I have used his data as a basis for my reconstruction of the complete carriage (Figure 73).

The outward angle which the spokes present between the nave and the felloe gives the wheel a noticable "dish", or concave appearance. This concavity was set outwards; that is, the point of the shallow cone thus formed sits on the inside of the axle arm. Such an arrangement imparted a more even stress to the wheel and improved its stability in rotation. It has been standard practice in European wheelwrightry since *c*. 1500, although controversy about its efficacy still lingered in the late sixteenth century. Collado still firmly believed that an undished wheel was best although, by his own admission, many of his contemporaries felt that dishing improved strength and tractability.(27) They were right.

The axletrees

Of the five heavy axletrees located on the wreck, three were too severely encrusted with concretion derived from their iron fittings to allow accurate measurement. One, however, appeared from its condition to be an unused spare, without linch-pin holes or evidence of attachments except for a wrought iron bar running along its lower length. Another, though partly shrouded in concretion, revealed enough of its original surfaces to allow an accurate reconstruction of its form. The two axles differ in their general dimensions, and it seems likely that one type is for the carriages, and the other for the limbers.

The unused axletree is smoothly and accurately fashioned out of ash. Its bed is 80 cm long and 22 cm square in cross section, save for a 6.5 cm chamfer which has been removed from its lower corners. The arms extend 60 cm on either side, with a circumference tapering from 18 cm to 13 cm. There is a slight shouldering where the arms meet the bed. No hollow (downward inclination) or lead (forward bend) - stabilising offsets which were to become common in later periods - is apparent in the set of the axle arms. The wheels thus ran parallel to one another in both planes.

The iron counter-axle which runs along the underside of this axletree is especially interesting since Collado mentions the use of a contraexe in conjunction with wooden axletrees, though he does not describe it further.(28) Such an arrangement would greatly have improved an axle's strength, particularly in its response to shearing loads. The chamfering of the lower corners of the bed, moreover, demonstrates a sound technical understanding of the stresses involved, since the reduction of the whole underside of the axle to what was in effect a semi-circular cross section would have increased its upward flexibility, and so helped to reduce tension stresses between the axle arm and bed.

These arrangements can be seen as a technically ingenious response to what had undoubtedly been, earlier in the century, a major fault in the design of heavy vehicle undercarriages. The weakest points on a wooden axle with a square-sectioned bed are those where the bed meets the rounded axle-arms, and it was precisely at these points, upon which the inner edges of the naves rotated, that stresses and shock loads would have been at their most severe. In an attempt to counter this weakness gun carriages and heavy wagons were often equipped with elaborate sets of iron linkages which transmitted some of the shock loads from the axle ends to the main chassis of the vehicle. But this system was cumbersome, and not very efficient. By the end of the sixteenth century it had certainly fallen out of use.

There is no archaeological evidence to suggest that the *Valencera* axles were fitted with such linkages, though such evidence was closely sought, nor are they mentioned by Collado or any other contemporary authority. Collado's illustration of the iron fitting (*champiron*) which provided both end reinforcement and bearing surfaces for the axle arms makes it quite clear that only a simple linch pin fitting was involved at the axle ends.(29) Such a fitting can be presumed for the *Valencera* axle arms, together with an iron washer or rubbing plate at either side of the nave. These late-sixteenth century wheels and axles are thus demonstrably superior to their immediate predecessors, and it can reasonably be argued that the simple innovation of a counter-axle together with the chamfered axle bed in the later part of the sixteenth century replaced and greatly improved upon the old linkage system to provide a better, more flexible, and cheaper means of undercarriage suspension. As such, it represents a significant advance in transport technology.

The bed width of the unused axletree suggests that it was meant to be used with a pair of 12-spoked wheels to provide a mounting for one of the *Valencera*'s *cañones de batir*. It is probable that the second axle, the bed and arms of which are rather longer, was intended for the smaller diameter 10-spoked wheels of a limber assembly. Its dimensions are: bed length, 91 cm; bed section, 22 cm^2; axle arms, 67.5 cm; arm diameter, 21 cm tapering to 13 cm. The greater length of this axle was doubtless to allow for the swinging of the limber around the pivot on the carriage trail, upon which the turning circle of the limbered-up gun assembly depended.

Cheeks and transoms

Each carriage would have required two side pieces or cheeks (*caxas*), garnished with iron and fitted with hinged capsquares to lock the gun's trunnions in place. Four transoms, at the head, bed, quoin, and trail, would have joined the cheeks together to form a solid, box-like structure. Into this the undercarriage assembly would have been securely recessed, bolted, and strapped. No cheek or transom components have been identified on the *Valencera* site, although many contemporary illustrations and descriptions are available. Not all of them are reliable but those of Pietro Sardi, of the early seventeenth century, not only inspire technical confidence but also closely parallel, where they can be checked, the archaeological evidence.(30)

Limber fittings

A heavy oak beam (Figure 74) from Grid 8.141 has been identified as a swingletree, doubtless from one of the eight limbers (armones) which the ship carried. A shorter swingletree would have hung from each end to carry the harness traces to the first pair of draught animals, while a linked series of draught poles would have transmitted the whole team's pull via similar (but somewhat lighter) swingletree assemblies which would have floated between each pair of animals.

The *Valencera* swingletree lacks its iron fittings, although it is drilled for the traces, which suggests that it is either a spare or that its limber had been dismantled for stowage. A large curved timber from Grid 3.148 may, perhaps, be the rear support of a limber, upon which the pivoted guncarriage trail slid in an arc as it swung with the articulation of the limber.

Gun-hoists (cabritas)

A heavy hoist was needed to mount and dismount artillery, and one is recorded among the ordnance stores delivered to La Trinidad Valencera.(31) No parts of it have been identified among the wreck material, although it would have consisted of a set of iron-reinforced wooden shear legs with a ratchetted windlass at its base, through which an upward pull could be exerted from its apex through a hanging block. Gun-hoists are illustrated, together with limbers, guncarriages, munition wagons and other artillery gear in Hans Sebald Beham's woodcut of Charles V's artillery train on manoeuvres, published in 1530 (Figure 75).(32)

Draught animals

Although Hieronimo Lippomano, the Venetian ambassador at Madrid, reported on 6 February 1588 that 600 mules and horses had been embarked on the Armada,(33) some deserters from the fleet later stated that "not above 300 horses and some mules for carriage of their field ordnance" were on board when they sailed.(34) Four hulks, the San Gabriel[100] of 280 tons, El Gato[98] of 400 tons, the David[97] of 450 tons, and the Santiago[96] of 600 tons, were earmarked as horse transports, and it is difficult to see how they could have carried between them more than 300 animals, especially as they also had 210 troops aboard.(35) Some 20 horses would have been required to draw each of the twelve mounted cañones de batir, and so this task alone would have accounted for most of the available animals.(36) Many more would have been required for the smaller field guns, for the munition and baggage waggons, as officers' mounts (there was no cavalry as such), and as reserves - animal mortality on the voyage and during the campaign was certain to be high. The main contingent of animals was evidently to come over with the Army of Flanders, no doubt on the logistically sound if strategically dangerous reasoning that the formidable difficulties of foddering and watering over a long voyage would thereby be eased. Parma had 70 flat-bottomed craft which could carry 30 horses apiece, with loading ramps for easy embarkation and disembarkation.(37)

In the event the _David_ failed to make the Corunna rendezvous (her fate is not known), while the remaining animals on board the Armada were jettisoned at sea prior to the north-about voyage, to save water.(38)

Ancilliary equipment

Each gun required a set of implements for its working and maintenance. These changed little throughout the history of smooth-bore artillery and normally included the following:

Ladle: for inserting a loose charge of powder or a prepared cartridge into the breech (see Figure 45)

Rammer: for ramming home charge, ball, and wadding (see Figure 45)

Sponge: for cleaning out the bore and extinguishing any burning matter

Worm: a spiral hook for withdrawing wads or charges from the barrel

Pricker: a metal skewer for cleaning out the touch-hole and piercing the cartridge bag before priming

Touch-hole cover: an apron placed over the priming pan to keep the powder dry

Linstock: a staff by which a lighted match was applied to the priming pan

Handspike: a lever of wood or metal for shifting the trail of the gun

Quoin: a wooden wedge, placed under the breech of the gun, by which its elevation could be adjusted.

Tampion: a plug inserted into the muzzle when the gun was not in use.

A number of finds in this category were recovered from the *Trinidad Valencera* wreck site. They include two sheet copper ladles (*cargadores*), appropriate to guns of approximately 18 cm and 7.6 cm calibre. The design, which is paralleled by finds from the *Mary Rose* (1545) (39) and the *Wasa* (1628) (40), allowed the charge to be deposited by twisting the shaft through 180 degrees when the scoop reached the breech, and it was suitable for loading either loose powder or cartridges. Sheet copper for manufacturing new ladles was carried aboard some of the Armada ships, including *La Trinidad Valencera*, and a piece of it has been found on the wreck site.(41)

A pair of tapered cylindrical oak heads, rounded on their faces and set on shafts, have been identified as sponge cores (Figure 76). In use they would have been cased in sheepskin sheaths, with the fleece outside.(42) Close to the face ends, where the heads are widest, the wool would have compressed tightly into the barrel sides and so have served to dislodge the firing residues, while the looser wool surrounding the taper behind it (which was normally soaked in urine) would have gathered and held the loosened dirt. The heads are 27.5 cm and 26.5 cm long respectively, with maximum diameters of 11.7 cm and 11.0 cm. The bores of the guns they served would, of course, have been slightly greater, to allow for the fit of the sheepskin envelopes.

A touch-hole pricker was also recovered from La Trinidad Valencera. It is made of 3 mm diameter brass wire, and is 22 cm long. One end is looped into a handle, while the other is pointed. When the touch-hole had been reamed and the cartridge bag pierced, the priming powder would have been poured from the gunner's priming flask into the hole, guided by a small funnel. The marquis of Santa Cruz, in his planning document of 1586, called for 4,000 such funnels, of tinplate or copper, which were to be obtained from Seville.(43) After priming, the touch-hole was kept dry with a cover which might either be a hinged flap like those associated with the Remigy cañones de batir (Figure 40), or a sheet metal apron, usually of lead, which was shaped to fit over the breech mouldings.

Two gunner's linstocks from *La Trinidad Valencera* are lively examples of popular art, for their bold but somewhat unsophisticated appearance suggests that they were manufactured by their owners. The designs are closely paralleled by finds from the *Mary Rose*, and seem to represent a widely based gunners' tradition.(44) One, which is complete, is a turned wooden pole 45 cm long with an elaborately moulded handle and a fuse holder at the other end carved in the form of a human hand (Figure 77). An iron spike was set into the handle end so that the linstock might be stuck vertically into the ground, or a sand bucket, to keep the burning fuse out of harm's way until it was needed. The other linstock, of which only the carved fuse end survives, takes the form of a dragon's head with the fuse, which is still *in situ*, emerging from its open mouth (Figure 78).

A well-preserved wooden handspike was also found on the wreck. It is a 1.69 cm long pole of chestnut, with wedged faces cut on its lower end to provide a purchase. None of the *Valencera* guns was found with its tampion in place, but a cork plug was extracted from the broken end of *El Gran Grifón*'s bronze *media culebrina*.

The artillery train required a great deal of specialist equipment and tools for the farriers, wheelwrights, wagon masters, smiths and carpenters responsible for operating and maintaining it. A full break-down of this equipment is provided in Santa Cruz's 1586 planning document,(45) and among the recoveries in this category from La Trinidad Valencera are two iron hammer heads - a carpenter's and a blacksmith's - and a pair of bellows (Figures 79 and 80). Part of a wheel which may be from an ammunition handcart was also found (Figure 81).

The Armada's 700 gastadores, or pioneers, were equipped for heavy labouring in support of the artillery. Their main task was digging, and for this they were provided with spades, mattocks, picks, wooden shovels and baskets, three implements being carried by each man.(46) The pioneers were responsible for helping to set up gun emplacements and platforms, and for erecting defensive obstacles around them. Part of a cylindrical gabion of hurdle construction was uncovered on the Valencera site (Figure 82); filled with earth or sand it would have become an element in a bullet-proof screen to protect the artillery (Figure 83). The Valencera wreck also yielded a number of fir saplings with their branches trimmed to present a series of short spikes. These were doubtless intended for the erection of barricades such as those shown in Ehard Schoen's woodcut of the siege of Munster (Figure 84). Another kind of defensive construction was the *cheval de frise*, and the large number of olive-wood sticks pointed at each end which were found on the *Valencera* may have been intended for this purpose. An illustration in Fronsperger's *Kriegsbuch* of 1573 shows a wooden *cheval de frise* which utilises stakes of this kind.(47) Palisade stakes and constructional timbers of various sizes were also carried by the fleet, and a number of these have been identified on the wrecks.

iv. Munitions

Apart from the 50 rounds allocated to each gun in the fleet, including the sea-mounted _cañones de batir_, 200 further rounds were provided for the guns earmarked for use ashore, together with an appropriate quota of gunpowder. All of the powder carried by the Armada, which amounted to 5,175 _qtx_, was fine-grained, so that it could be used by the hand guns and heavy ordnance alike.(48) The gunpowder was issued in kegs of 1 _qtl_ capacity, and one of these was discovered, still partly full, on the wreck of _La Trinidad Valencera_ (Figure 85). The keg is 61 cm tall, with a maximum width of 35 cm, and was bound with hoops of split birch. No iron was used in its construction, doubtless to avoid the risk of sparking. The viscous black sludge which the keg contained proved on drying to be finely powdered charcoal, with slight traces of sulphur present. This presumably is the residue of its original gunpowder contents, with most of the sulphur and all of the saltpetre having leached away.

The estimated capacity of the restored keg (Figure 90) is 39 litres. Fine-grained gunpowder packed tight has a weight/volume ratio of about 1.14 g per cc, from which we may calculate that the keg's full contents would have been about 97 Castilian _libras_ or, as near as makes no difference, one full Castilian _quintal_.

The Armada carried a considerable number of incendiary devices which the soldiers were expected to use in close sea actions, just before they boarded an adversary. The operation of these dangerous and unpredictable weapons was restricted to men well versed in their use, for in untrained hands they could be more damaging to friend than to foe.(49) A well-preserved example of each of the two main types involved has been recovered from La Trinidad Valencera. The first is an alcancía, or fire-pot, of which 250 were issued for distribution among the Levantine squadron.(50) The weapon consists of a bottle 11.5 cm tall and 10.5 cm wide, about half a litre in capacity, made of lightly fired red earthenware covered externally with a clear glaze (Figure 86). It is of hour-glass shape, with a pinched waist and narrow neck. A very similar device is illustrated by Lucar, in a work published in 1588 (Figure 87); it is shown ready for firing, with several lighted matches tied round its waist to ignite the charge when the pot shattered on impact.(51) The neck is sealed with a tightly whipped canvas patch. Lucar gives several recipes for the content of the charge; all are based on gunpowder, volatile spirits, and viscous materials such as pitch or gum, in order to produce an effect similar to that of modern napalm. He especially recommends firepots for use in close-quarter fights at sea. Several other contemporary writers describe these weapons, and two further examples have recently been recovered from underwater excavations.(52) The Armada's alcancías were probably made in Lisbon.(53)

A second type of incendiary weapon was the bomba, or trunk, of which 150 were issued to the Leventine squadron.(54) The wreck of *La Trinidad Valencera* has yielded a complete example which is, as far as I know, the only one of its kind to have survived into modern times (Figure 88). Its fragile condition and the problems inherent in conserving a composite artifact whose internal arrangements and contents are not known have so far precluded detailed examination, and only a general description can be given at the time of writing. Its external case is a hollow cylinder of wood 70 cm long and 10 cm in diameter, bound along its length with cord and strips of fabric. One end is tapered, and has a socket for a shaft. We may surmise that the interior is filled with a variety of explosive and combustible materials, together with a number of shrapnel-like projectiles, arranged to give a sequential discharge lasting several seconds. Held on long poles by the leading troops in an assault, such weapons were designed to injure, terrify, and confuse the enemy during the storming of a breach or the entering of a ship. Various kinds of trunk are described and illustrated in the contemporary technical literature,(55) while troops are shown carrying them in Hogenberg's woodcut of the arrest of the duke of Aarschot in 1577 (Figure 89).(56)

It is appropriate to mention here another type of close-range weapon particularly suited to the boarding actions which the Spaniards hoped for. A 38 cm hooked iron blade from El Gran Grifón, with its inner curve edged, has been identified as a shear hook, intended to tear down an enemy's rigging when the ships were grappled together. These hooks might either be attached to the ends of the yard arms, or they could be mounted on long poles and wielded by hand.(57)

v. Provisions

By the standards of its day, the Armada was quite adequately provided with food and beverages for the journey to England. The fleet had originally been supplied with six months' rations for all who sailed with it, and in spite of heavy spoilage during the early part of the voyage there had been substantial replenishment at Corunna. Even allowing for 50 percent wastage there was more than enough to cover the expected duration of the campaign, especially since the landings would coincide with the English harvest. It was the unintended voyage home, without replenishment of water, that caused the terrible privations which the Spanish were eventually to endure.

Ration scales were strictly laid down by the duke of Medina Sidonia in his Instructions to Shipmasters, given out at Lisbon on 21 April 1588.(58) Their contents may be summarised thus:

Daily:	1 1/2 lbs of biscuit or 2 lbs fresh bread
	1/3 azumbre of wine (or 1 cuartillo of Candia wine, which was much stronger)
	3 cuartillos of water (for all purposes)
Sundays and Thursdays:	6 ozs of bacon and 2 oz of rice
Mondays and Wednesdays:	6 ozs of cheese and 3 ozs of beans or chick peas

Wednesdays:	6 _ozs_ fish (tunny or cod, failing which 6 _ozs_ of squid or five sardines)
Fridays and Saturdays:	1 1/2 _ozs_ oil and 1/4 _cuartillos_ of vinegar

A considerable quantity of butchered pig bones have been found on the wreck of _La Trinidad Valencera_. All the carcasses appear to have been split lengthwise, including the head. A single tuna vertebra was also identified. In addition to the official rations a good deal of luxury items seem to have been carried, as the finds of brazil nuts, coconut, pine cone, plum and bay-leaf remains indicate.

The fleet's stores of water and wine were accounted for in _pipas_, a measure whose precise value is difficult to ascertain. Fortunately the remains of a large barrel were excavated on the wreck of _La Trinidad Valencera_, from which a full reconstruction has been possible (Figure 90). This is an important discovery in view of the close relationship between liquid measurement and the calculation of shipping tonnages. During the sixteenth century the Seville _tonelada_ (in which there were two _pipas_) underwent major changes which are as yet imperfectly understood. Chaunu has suggested that the _tonelada_ fluctuated from 70 percent to 120 percent of its "classic" standard of 334 gallons (1059 _litres_), giving a range of 233 gallons (1059 _litres_) to 400 gallons (1818 _litres_).(59) The capacity of the restored _Valencera pipa_ is about 130 gallons (591 _litres_), and while distortion and errors of reconstruction may to some extent have affected the accuracy of this estimate it falls well within Chaunu's range and, in default of better evidence, may be taken to suggest that the Armada's _pipa_ of account was around this mark. This gives the _tonelada_ a value of _c_. 260 gallons (1181 _litres_).

With two exceptions, the other commodities were accounted for in _quintales_, which suggests that they were supplied loose, and could be weighed separately from their containers. The exceptions are oil and vinegar, which are accounted for in _arrobas_, and the discovery of two olive jars on _La Trinidad Valencera_ each with a capacity of half a Castilian _arroba_ (6.25 _litres_) strongly suggests that these commodities were supplied in these vessels (Figure 91).(60)

Medina Sidonia emphasised in his Instructions that all ration issues were to be served out strictly in accord with the certified weights and measures supplied to each ship, and a number of weighing implements, including two steelyards, have been recovered from the _Valencera_ site (Figure 92).

vi. General equipment

In addition to its warlike stores and basic provisions the Armada brought with it a vast array of domestic impedimenta. Tentage was provived for the senior officers, the field hospital, and the storage of munitions and foodstuff.(61) Tent pegs and mallets have been found on the _Trinidad Valencera_ wreck. The rank-and-file, however, were expected to improvise their own temporary shelters, or _barracas_, in the field.(62) The basic messing sub-unit in the Spanish army was the _camarada_, a group of seven or eight men who shared a _barraca_, cooked together, and looked after each others' interests.(63) At least some of the rations issued at sea appear to have been cooked centrally and issued to representatives of the individual _camaradas_, but in the field meals were prepared from basic rations within the _camarada_ itself. This fact probably explains the two distinct sizes of food containers which have been identified on the wrecks, of pewter, pottery, and treen: the larger being for the communally prepared _camarada_ meals, and the smaller for individual helpings. Examples of these various utensils in treen are shown in Figure 93.

The marquis of Santa Cruz, in his 1586 planning document, called for 100,000 pieces of glazed earthenware, to be supplied in equal proportions by the potteries of Seville and Lisbon. The vessels specified were "_platos,_ *escudillas, ollas y jarros*"; that is, plates, small bowls or cups, pots and jugs.(64) These pottery forms account for the bulk of the ceramics recovered from the wrecks, and most can be shown to be either of Sevillian or Portuguese origin. A set of Portuguese green-glazed red earthenware vessels from *La Trinidad Valencera* which conforms closely to Santa Cruz's specification is shown in Figure 94. Similar forms have been identified in the distinctive Sevillian tin-glazed wares, while the *Santa María de la Rosa* has yielded a ceramic type, not found on any of the other wrecks, which probably originated at or near her home port of San Sebastian.

Unglazed Merida-type red earthenware, much of which is probably Portuguese, is also common on the wrecks. Most of the forms recorded are lidded jars of many sizes and shapes, with a lack of uniformity which suggests that they may have been containers for luxury commodities brought aboard privately by individuals at Lisbon. The absence of the well-known Mérida-type costrels is notable, and is perhaps best explained by the unsuitability of ceramic water containers for shipboard or campaign use: leather drinking bottles of the kind found on *La Trinidad Valencera* would have provided a more serviceable alternative.

As a domestic group the Armada wares are remarkable for their plainness. Comparable groups from contemporary Spanish and Portuguese contexts include a large proportion of decorated wares, usually amounting to well over half the excavated sherds. This reinforces the probability that the bulk of the Armada's pottery was made to a utility contract standard, intended solely for issue (doubtless against stoppage of pay) to the troops.(65)

Some exotic wares have, however, been identified. They include a small group of Spanish and Italian maiolicas, a single fragment of Raeren stoneware, and four pieces, including an intact bowl, of Wan Li porcelain (Figure 95). Venetian maiolica from *La Trinidad Valencera* reminds us of the ship's origin, while the German stoneware from the same wreck emphasises Spain's links with northern Europe. The Chinese porcelain, which also came from the *Valencera*, would have been a rare and valuable commodity in 1588: it is typical of early export ware, and presumably belonged to one of the wealthier officers or gentlemen-adventurers on board. It reached Spain, we may suppose, by way of the Manila Galleon and the trans-Atlantic *flotas*.(66)

Pewter was an up-market alternative to pottery or treen, although the considerable quantity yielded by the *Trinidad Valencera* suggests that its possession was not confined to the higher ranks. Virtually all of it is probably of Dutch or English manufacture, for there was no domestic pewter industry in Spain and kitchen utensils in this and other materials were frequently imported from these sources. In 1583-4, for example, the English Privy Council authorised the dispatch of a consignment of domestic utensils and musical instruments to no less a customer than the duke of Medina Sidonia himself.(67)

A curious postscript to this trade is provided by a pewter plate from La Trinidad Valencera. It bears the English crowned Tudor rose touch-mark, flanked by the pewterer's initials W R - perhaps William Reo, who flourished between 1547 and 1588.(68) On either side of the touch the customer's initials, I Z have been letter-punched, suggesting that its original owner was Juan Zapata whose son, Sebastián, was on board the Valencera (he died, after capture, at Drogheda).(69) The plate is in perfect condition, except that the central part of the Tudor arms - which might understandably have struck its owner as a thoroughly offensive symbol long before he reached Donegal - has been neatly excised with a punch!

Items of camp equipment represented by finds from the wrecks include lanterns (Figure 97; see also Figure 89), copper buckets, and brushes. More personal objects include various religious medallions (two from La Trinidad Valencera are illustrated in Figure 96), a sweetheart's ring from the Girona which shows an unclasped girdle with the inscription "_no tengo mas que dar te_" ("I have nothing more to give you"),(70) and, from the _Valencera_, a boxwood comb and a birdcage. The _Valencera_ has also yielded parts of three musical instruments - the fingerboard of a cittern, the wooden end-plates of a small accordion, and a tambourine.

Part IV: Conclusion

Chapter Nine: The fighting potential of the Spanish Armada

Whatever credibility the Armada may have possessed as a fighting force does not, of course, alter the historical outcome of the campaign. From the Spanish point of view it failed, and failed completely. But, as we established in the introduction to this thesis, that failure was not necessarily a foregone conclusion. What, therefore, prevented the Armada from achieving the objectives for which it was sent?

It is not my purpose to analyse the weaknesses in the higher-level strategy and planning behind Philip II's Enterprise of England. These factors have already been examined by modern historians and a broad consensus reached.(1) It is widely accepted that the Flanders rendezvous proved to be, in the event, the rock upon which the plan foundered - a danger of which, incidentally, Santa Cruz, Parma, and later Medina Sidonia, had been only too aware. Still, it just might have worked. If, after the fireship attack on 7 August, the rest of the Spanish fleet had stood firm with Medina Sidonia and his close supports, it is difficult to see how the English could have dislodged them. The deep-water port of Calais was only two days' march from Dunkirk, and for months Parma had been courting the goodwill and tacit support of the French, no doubt with this very contingency in mind.(2) The Seigneur de Gourdan, Governor of Calais, might well have been prevailed upon to allow the embarkation of troops. Then again, Justin of Nassau's blockading Dutch flyboats only reached their crucial station off the Banks of Flanders in the nick of time, and had the wind during the first few days of August kept in the westerly quarter they might never have left the Scheldt. If they had remained in port, the Spanish link-up off Flanders could have been achieved without effective opposition.

After Calais the fleets were, in a naval sense, stalemated. For reasons we have already touched upon, and will develop further below, neither side proved able to inflict outright defeat upon the other. This was an outcome for which Philip had not provided. He had accepted that the Spaniards might lose a battle at sea, before Flanders was reached, but he had assumed that the Armada, if it reached the rendezvous at all, would have defeated the English fleet as a _sine qua non_ of getting there. That both fleets might arrive at this point more or less unscathed had not occurred to him. Underlying the detailed instructions he sent to his commanders (none were delivered or discussed in person) is a clear recognition that, unless the mere presence of the Armada off the English coast proved enough to bring Elizabeth to the negotiating table, a sea battle to win supremacy for the cross-Channel jump was inevitable. Perhaps Medina Sidonia's cardinal error was that he did not fully grasp this essential point. He saw his duty simply as one of bringing the Armada intact to Parma. To him, the fleet was an armed convoy concerned solely with getting one component of a combined invasion force from A to B. Seen in these terms, his command of it was almost flawless. But to the king - who must surely carry the blame for failing to convey this crucial information unequivocally to the man he chose as its commander - the Armada was to be a task force, capable not only of playing its role in the invasion but also of clearing any opposition which might prevent that invasion from taking place.

But, had it come to an all-out battle to determine the issue before Flanders was reached, how would the Armada have fared as a naval force? To some extent this question is answered by the outcome of the final engagement off Gravelines when, for the first time, the two fleets came to close quarters. Before we consider this matter, however, we must first demolish once and for all two misconceptions upon which most modern interpretations of the fighting have been based.

Both relate to artillery. The first is the assumption, which we have shown to be incorrect, that long light-shotted culverin-type guns threw their projectiles further than did the short and heavy-shotted cannon-types.(3) The Spaniards, so this argument runs, wanted to close and board, and so opted for short-range heavies with which to immobilise an adversary before launching a final boarding assault. Conversely the English, who wished to avoid just such an eventuality, went for culverin-types so that they could exploit their better sailing qualities to stay just out of range of the Spanish cannons but within range of their own long guns. This supposed difference in armament policy has been held to explain why the English consistently refused to close the range until Gravelines, and then only closed it because (so it was believed) the Spaniards had run out of shot. But, as we have seen, this assumption is based on an entirely false technical premise, and may therefore be discounted without further argument.

A consideration of the guns on both sides, moreover, suggests that the Spaniards had no real supremacy in cannon-types, and that the English did not possess the greater number of culverins.(4) The only true cannons carried by either side in the campaign were the dozen or so _cañones de batir_ of the invasion force's siege train which, although they were specially mounted for temporary service at sea, were probably too heavy and unwieldy for effective shipboard operation. This argument is developed further below, and gains support from the fact that, alone of all the guns recovered from the wrecks, the two _cañones de batir_ from _La Trinidad Valencera_ were not loaded when found. The apparent Spanish superiority in this respect is therefore an illusory one.

In fact the heavy naval guns on both sides appear to have been remarkably similar. Modern confusion in interpreting Armada-period artillery is rooted not in the guns themselves but in the names given to them by their users. An attempt to provide a working vocabulary of Spanish and English gun-names is set out in Appendix 3. From this it appears that a contemporary Englishman would call any gun of around the 18-pounder mark, irrespective of its length, a culverin. A Spaniard, on the other hand, would only label such a gun a culebrina if it possessed true long-gun proportions; otherwise, to him, it would be a medio cañón. But an English demi-cannon would be different again; a short 30-pounder or thereabouts which a Spaniard would call a cañón. I believe that there were very few true full culverins on either side, whatever the misconceptions of the time, since they would simply have been too long to handle aboard ship. Thus the apparent Spanish preponderance of cañones and medios cañones is balanced almost exactly by the greater number, on paper, of English demi-cannons and culverins. From this it appears that the main "ship-killers" in the conflict were short- or medium-length 15- to 30-pounders, and in this category the two sides were fairly evenly matched.

The second modern misconception is that the Spaniards ran out of shot at Gravelines, so rendering impotent their supposed preponderance of short-range ship-killers. This, it is argued, allowed the English to close the range and, for the first time, inflict real hull damage on their adversaries.(5) But, as we have seen, our wrecks have produced large quantities of ammunition, especially of the larger calibres. All of these ships, moreover, were front-line 'trouble-shooting' units, and all of them had been heavily involved in the fighting. Medina Sidonia, it is true, blamed the lack of projectiles as a reason for the Armada's failure at Gravelines, and some of the principal ships may indeed have exhausted their shot lockers in this final fight.(6) It is worth noting, however, that when the duke had earlier complained of a shortage of ammunition, and had sent an urgent request to Parma for fresh supplies, he had specified that the calibres required were 4-, 6-, and 10-lbr.(7) Why, it might be asked, had he exhausted his stocks of light anti-personnel ammunition, but presumably still had plenty of the heavier ship-killing shot left?

We can only conclude that, contrary to modern opinion, both sides possessed substantial ammunition stocks for their main battery guns when the Gravelines engagement began, and that the Spaniards, if anything, were better supplied than the English. By the end of that fight - an ending brought about prematurely because the English themselves ran out of ammunition - considerable punishment had been inflicted on the Armada, which had been able to mete out almost none in return. Why then, if the range was right and the stocks of ammunition not exhausted, did the Spanish gunners fail in the moment of crisis?

It is in the operation and handling of the guns and not in their relative sizes or supplies of ammunition that the answers must be sought. Very little is known of gunnery procedures in the sixteenth century, particularly at sea, and neither the documentary nor the archaeological sources are of much direct help in this respect. Both, however, provide a number of circumstantial clues. On the Spanish side these combine to suggest that the operation of heavy guns at sea had been so little considered or practised as to reduce any attempt to deploy them in battle to irreconcilable chaos. On the other hand, evidence from the English side hints that gunnery procedures aboard ship - though no doubt abysmally sloppy and inefficient if set against the highly disciplined routines of Nelson's day - were in comparison markedly less chaotic. In a battle such as Gravelines, the like of which had never been fought before, quite a modest difference in the degree of chaos upon the gun decks of the contending fleets would provide ample explanation of the final result.

We know more about the composition of the Spanish gun crews than we do of the English ones, and it is therefore convenient to consider them first. Captain Alonso Vanegas, an officer aboard the San Martín, states that each gun on the flagship was manned by a gun-captain (ayudante) and six soldiers, under the overall supervision of a master-gunner (condestable) and six artillery officers.(8) This command structure is confirmed by the duke of Medina Sidonia's battle orders for the flagship, which allocate two artillery officers to each side of the two gun decks, eight in all.(9) There is no further information on how the gun crews were organised, how they operated, or what (if any) training they received.

What is clear, however, is that the crews were composed of soldiers and not seamen. The San Martín's 177 mariners would in any case have been fully occupied in working the ship. But if six soldiers were permanently assigned to each of the flagship's 48 guns, 288 out of the 302 troops she carried would have been thus employed. True, her smaller pieces and swivel guns may have required fewer men to work them, but against this must be set the probability that the bigger guns demanded more - in Nelson's day a 32-pounder, roughly equivalent to a sixteenth century Spanish cañón, needed a crew of twelve. Medina Sidonia's battle orders, however, make it plain that when at action stations the mosqueteros and arcabuzeros were deployed as infantry, not as gunners.(10) This apparent anomaly is best resolved by assuming that working the ship's guns was only a secondary duty of the soldiers, for which they might, as required, be withdrawn from their allotted firing stations.

Such an arrangement, if I have interpreted it correctly, can scarcely have been a satisfactory one. A Spanish infantryman, with his firearm, lighted slow match, powder and shot, morion, jerkin, side-arms, hose, and shoes would have been ill suited to a task for which bare feet, breeches, and headscarf were the traditional attire. Nor was the management of big guns at sea something to be tackled on the spur of the moment by an untrained landsman, however brave and well disciplined he might have been. And finally, to make matters worse, the mountings and equipment with which the Spanish guns were provided appear to have been of entirely the wrong kind for efficient use at sea.

In the late sixteenth and early seventeenth centuries naval gunnery was an evolving and far from perfected art in which the Spaniards, relative to the English, lagged far behind. We have already seen that many of the Armada's guns were mounted on field carriages, and we have reason to believe that those carriages which the Spaniards called encavalgados de mar in the documents were, in fact, little more then cut-down versions of the basic field carriage design: that is, they had a pair of large-diameter wheels and a sliding trail which extended well beyond the breech.

This suspicion is confirmed by Mainwaring and Monson in the early seventeenth century, both of whom blame poor Spanish sea gunnery on a still widespread use of field carriages on board ship.(11)

The technical difficulties of working muzzle-loading guns at sea were formidable. They had to be kept well secured - several tons of bronze or iron mounted on an ungainly chassis might easily, if control of it were lost, sink a ship - but at the same time it was necessary to absorb the considerable recoil and to allow the operations of scouring, sponging, charging and priming to be carried out.(12) Some means had to be provided for elevating and traversing the pieces if targets beyond point-blank range were to be engaged, and for effective tactical deployment in battle a ship's guns had to be responsive to a measure of overall direction and fire control.

Efficient mountings for the guns were therefore of crucial importance. At sea two-wheeled carriages with trails, whether full land carriages or versions cut-down for naval use, possessed fundamental defects. Because of the rearward extension of the trail, weapons thus mounted occupied as much as twice the length of the guns themselves. The forward edges of the carriage wheels, moreover, extended well beyond the guns' centres of gravity (which naturally lay behind the carriage axles), so limiting the amount of muzzle which could protrude through the gunports. Virtually the full length of the guns and their unwieldy carriages therefore had to lie inboard, so taking up much of the severely limited deck space and, in all probability, encroaching upon the line of similarly mounted pieces along the opposite broadside.

A further problem in using such carriages at sea must be considered. The large-diameter wheels and deep cheek pieces would have raised the centre-line of the gun barrels, along the axes of which the whole assemblies recoiled, to a point high above the deck. If allowed an unrestrained recoil the piece would have jumped violently upwards as well as backwards, a potentially dangerous and damaging procedure which could only have been held in check by lashing gun and carriage firmly to the ship's side. But this would have had a less obvious though progressively more damaging effect on the vessel's structure. An incident in the fighting seems to illustrate, in a most graphic way, the cumulative effect such stresses might have on a vessel's hull. It concerns the gallant and much engaged Portuguese galleon San Mateo[6] off the Banks of Flanders which, after heavy fighting, was seen to have been "opened up by her own artillery".(13) This curious phrase can only mean, I think, that the recoil of the San Mateo's guns had begun to pull her structure apart.

In the light of these observations, how did the Spaniards actually operate their artillery during the Armada campaign? The guns were, as we know from Medina Sidonia's instructions to the fleet and from our own discoveries on the wrecks, always kept loaded, so that when battle was joined one salvo was available for immediate use.(14) An operator holding a lighted linstock beside each gun was therefore the only requirement for this preliminary discharge. This is exactly how a galley was expected to loose off its close-range cannonade in the brief moment before it rammed its foe; there would be no opportunity or need for reloading, and so no procedure existed for reloading as a battle-drill. Spanish sailing ship tactics also envisaged the broadside as a device for crippling and confusing an adversary as an immediate prelude to boarding. "The aim of our men," Philip had instructed Medina Sidonia shortly before the Armada sailed, "must be to bring the enemy to close quarters and grapple with him."(15) But the kind of fighting the English had developed, and imposed so successfully on the Spaniards at Gravelines, involved a continuous close-range bombardment intended to destroy an enemy by the attrition of gunfire alone. Given that their inferior sailing qualities prevented the Spaniards from closing and boarding as they would have liked, their only counter to such tactics was to attempt to reply in kind. To do this, however, they would have had to reload their guns time and again during the course of an engagement. Not only was this practice outside the tactical experience of the Spanish commanders and their crews, but it was also one for which their gunnery equipment was fundamentally unsuited.

There are two ways in which muzzle-loading guns can be reloaded at sea. They can either be brought inboard so that access to the muzzle is made available within the ship, or they can be left in the fully run-out position and loaded outboard. As I will discuss further with reference to English gun-drills, the later practice of allowing a gun's own recoil to bring it inboard under the restraint of a breeching rope appears to have been unknown in the sixteenth century, although it was obviously possible, after firing, to unhitch the piece and haul it back manually. This process would be laborious but reasonably efficient, and during the course of it the crew would be covered from the view, and to some extent from the fire, of the enemy. Outboard loading was far more awkward and dangerous, though it required a much smaller crew, and involved straddling the gun outside the port and carrying out the clearing and charging operations from this exposed and difficult position. In spite of its obvious disadvantages this method was still occasionally used in the seventeenth century, and two examples may be cited by way of illustration. The first involved an Icelandic gunner serving aboard the Danish frigate Christianshavn in 1622. His ship, he tells us in his Memoirs, had been cleared for action against a suspected corsair off Gibraltar, and he had been ordered to load his guns outboard. He went on: "When I had loaded the first gun and was lying outside the gunwale on the next, a heavy wave struck the port side three times, whereupon the ship rolled all the starboard guns over, and me on my gun with them. I swallowed much water, and was nearly carried away..."(16) The second incident took place off the Cape Verde Islands in 1686, when an English merchantman was attacked by five pirate ships. An officer on board described the resulting action. The merchantman was able to beat off the attack, he explained, because "their men [the pirates] loading their great guns without board (as is the custom of these West India gunner pirates) were cut off as fast as they appeared to do their duty, and this was the reason they fired but few great guns when they bore down upon us, for which we are beholden unto our small arms..."(17)

Which of these procedures the Spanish gunners used in 1588 we cannot know for certain, but the design of their guncarriages suggests that it would have been impractical, because of the lack of working space on the gundecks, for the pieces to have been loaded inboard while a ship was closely engaged. At the same time it would have been little short of suicidal to attempt outboard loading within small-arms range of an enemy. The probability is, therefore, that once close action was joined most Spanish ships only managed to get off their previously prepared salvo, after which sustained gunfire ceased. This does not necessarily mean that no further firing was possible.

Outboard loading might sometimes have been carried out in comparative safety on the disengaged side, while no doubt the smaller pieces, being shorter and more easily managed, were often hauled in and reloaded. But it seems certain that the big ship-killing guns were never able to apply a continuous close-range cannonade against the enemy, although this was the only way in which they might have achieved success.

This hypothesis explains why the San Martín ran out of light but not heavy shot well before Gravelines, and why so many of the front-line trouble-shooters, as evidenced by the wrecks, still possessed plenty of ship-killing ammunition after the battle was over. It also explains why so much of El Gran Grifón's heaviest shot - that intended for her four medias culebrinas - remained unused. Further indication of the extremely limited rate of fire achieved by the Spanish gunners comes from the records of a number of the hired ships, which were expected to produce a detailed account of each royal projectile expended. The 22-gun Levanter Trinidad de Escala[77] fired thirty-five shots on 2 August (1.6 rounds per gun), twenty-one shots on 4 August (0.96 rounds per gun), and thirty-eight shots on 8 August (1.7 rounds per gun).(18) The Guipuzcoan Santa Bárbara[59], which appears to have had twenty guns instead of the twelve credited to her in the Lisbon muster, fired twenty-two shots on 31 July (1.1 rounds per gun), twenty-eight on 1 August (1.4 rounds per gun), forty-seven on 2 August (2.35 rounds per gun), and 167 on 8 August (8.35 rounds per gun).(19) Over the full period of fighting the Andalusian _almiranta_ _San Francisco_[44] fired 241 rounds from her twenty-one guns, an average of 11.5 per gun.(20) Her two heaviest pieces, full _cañones_ of 75- and 60-_qtx_, discharged ten and twelve balls respectively. These figures come nowhere near to accounting for the fifty rounds with which, according to the Lisbon muster, each gun had been provided.

The conclusion is inescapable that, when it came to the test, Spanish sea-gunnery failed almost completely, and that the larger the calibre of gun the less likely it was to be fired. Confusion on the gun-decks was no doubt exacerbated by the almost total lack of weapon standardisation or of an overall system of weights and measures, by a corresponding weakness in numeracy on the part of the gunners, and by sub-standard and often dangerous guns like the off-centre _media culebrina_ from _El Gran Grifón_. A telling and almost contemporary parallel to this lamentable state of affairs can be drawn from the observations of the Dutch traveller van Linschoten, who in 1589 experienced a minor action with some small English privateers while he was a passenger aboard the 1600-ton Portuguese carrack _Santa Cruz_. "When we shot off a piece," he wrote, "we had at least an hour's work to lade it in again, whereby we had so great a noise and cry in the ship as if we had all been cast away."(21)

A heavy price was paid by the Spaniards at Gravelines for approaching artillery-based sea warfare in logistical rather than in technical and human terms. No matter what guns were carried, how many artillery "experts" employed, or how lavish the provision of powder and shot, little could be achieved unless the weapons-system as a whole could be deployed effectively in battle. Just how ineffective that deployment turned out to be off Gravelines is reflected by the low casualties and minimal ship damage actually suffered by the English fleet.

What, then, of the other side? Without question the English artillery was used to good effect at Gravelines, and although few Spanish ships were actually sunk or crippled at the time the damage many sustained during this action was later to be their undoing off the Atlantic coasts of Scotland and Ireland. Much of the damage was low down in the hull, confirming Philip II's earlier appraisal of English gunnery tactics.(22) Some of the battle damage suffered by the Spaniards has already been considered, and four out of our five wrecks evidently received severe injury to their hulls. The _Santa María de la Rosa_ had been, according to her only survivor, "shot through four times, and one of the shots was between the wind and the water, whereof they thought she would have sunk."(23) Both _La Trinidad Valencera_ and _El Gran Grifón_ sustained hull damage so severe that their crews were forced eventually to run them ashore, while a Ragusan survivor from the San Juan de Sicilia later reported that at Gravelines a group of English ships had battered the ship "so heavily from their guns that they completely shattered her... [we had to] repair the damage from the many shots which the ship had received alow and aloft and from the prow to the stern, and below the waterline in places difficult to repair... The ship remained so damaged and battered by cannon balls that she could move forward only with great difficulty".(24)

But, in spite of these evident successes, the achievements of the English gunners at Gravelines were not without their critics. William Thomas, an English master-gunner stationed at Flushing at the time of the campaign, was one of them. On 30 September 1588 he wrote to Lord Burghley: "...if it had pleased God that her Majesty's ships had been manned with a full supply of good gunners according to the forces they carry... it would have been the woefullest time or enterprise that ever the Spaniards took in hand... What can be said but our sins was the cause that so much powder and shot spent, and so long time in fight, and, in comparison thereof, so little harm?"(25)

One shortcoming was certainly in the provision of shot. But while we know that the Spaniards carried, on paper at least, fifty rounds per gun, we do not know the corresponding English figure. There are, indeed, no grounds for supposing that any standard quota existed, for the response to the Armada had been an essentially *ad hoc* business throughout. The ships simply had to make do with what they could get, and royal supplies of ammunition were chronically short and jealously husbanded. Professor Lewis has considered the question in detail, and concluded that the average figure per gun probably fell somewhere between twenty and thirty - that is, almost exactly half the Spanish one.(26) This shortfall was to some extent made good by a trickle of fresh supplies from the royal arsenals as the crisis developed, and by a hurried distribution of ammunition from the captured *San Salvador* and *Nuestra Señora del Rosario*. Even so, a considerable proportion of the limited stock available was expended to little effect during the long-range engagements in the Channel, and after only a few hours at Gravelines all that remained had been used up. Had replenishment been possible at this point the outcome would no doubt have been much more decisive.

And yet, as we have seen, it was decisive enough. If the Spaniards' failure at Gravelines was due to their almost total inability to work ship-killing guns in a close engagement, England's limited successes in the same fight must imply at least some measure of competence upon the gun decks. Several reasons may be adduced. First, the English gunners were seamen, and were therefore presumably familiar both with the particular guns carried aboard their own vessels and with the tasks of handling them on shipboard. Men detailed to work the guns were not expected, as were the

Spaniards, to double as soldiers, and in consequence they would have been unencumbered with military clothing and accoutrements. At least some of them, moreover, had undergone training with the precious live ammunition, though apparently such prodigality met with official disapproval. Overall, considered the contemporary English artillery theorist William Bourne, his practical counterparts made good gunners because they were "hardy and without fear of their ordnance", and they were "handsome about their ordnance in ships, on the sea...".(27)

Bourne unwittingly touches upon yet another probable cause of the English superiority in gunnery. He possessed, as he explained in his Introduction to the <u>Arte of Shooting in Great Ordnaunce</u>, no personal experience as an artilleryman, but he had read all the continental books on the subject and could therefore justify his presumption in attempting to distil their joint wisdom in English by pointing out that, unlike the Italians, French and Spaniards, Englishmen had no ready access to the theoretical basis of the subject, excellent though they were as working gunners. His book was intended to make good that deficiency. Most of this theoretical knowledge, however, we now know to have been unnecessarily complicated, usually inaccurate, often spurious, and generally of little practical help. <u>Not</u> to have easy access to or interest in such information may have been one of the English gunners' greatest strengths. Early modern gunnery was a dangerous and haphazard business, but it was not essentially a complex one, and the real requirement for it was not booklearning but common sense, familiarity, and a good measure of brawn. The possession by the English of a single standard of weights and measures must have been another practical advantage of inestimable value.

What techniques, then, did the English use to work their guns at Gravelines?

That the use of the four-wheeled truck carriage was in widespread service aboard English ships well before the end of the sixteenth century has long been known from documentary and iconographic sources, and the date of its introduction has now been pushed back at least as far as the 1540s by the recent discovery of several intact examples on the wreck of the *Mary Rose*.(28) The design of such a carriage was much better suited to shipboard use than the two-wheeled trail carriages with which the Spaniards were evidently equipped (Figure 56). It was very simple. Two short wooden cheek pieces were fastened to a base-board to which were fixed axletrees fore and aft, upon each of which was set a pair of small wooden wheels or trucks. The front trucks were rather larger than the rear ones, partly to accommodate deck camber and partly because they took the main weight of the whole assembly. The gun sat on its trunnions close to the fore part of the carriage so that its centre of gravity lay just to the rear of the front trucks.

Because of the small wheel diameter almost the whole of the gun's chase could be thrust through the gunport, while the rear of the carriage did not extend beyond the breech. A gun mounted on such a carriage would therefore protrude further through its port than one mounted on the two-wheeled type, and it had no awkward trail or wide wheels to obstruct its sides and rear. Adequate working space for the crew was therefore available beside and behind it.

Although a number of structural refinements were added to this design over the succeeding two centuries, its general appearance remained substantially unchanged until well after Nelson's day. At some time during the first half of the seventeenth century - probably around 1625 - the practice of allowing the whole assembly to recoil inboard for reloading was introduced, a procedure for which the compact design of the truck carriage was particularly well suited.(29) Such a practice was not, however, current in 1588. William Bourne implied as much when he instructed how a ship's ordnance should be "fast breeched" when run out for action, while a detail on the Smerwick map of 1580 confirms that truck-mounted guns were always made secure before firing.(30) The detail (Figure 57) shows two ship's guns which have been brought ashore from the English fleet to invest the Papal force's position from the landward side. Both are emplaced behind a gabion-built rampart and ditch, in front of which substantial anchor holdfasts have been rigged. Such an arrangement would only have been necessary if it had been intended to hold the guns' recoil fully in check.

It does not follow, however, that if the guns were not allowed to recoil inboard they had to be reloaded outboard. With truck mountings there would have been ample space on the decks to haul them in manually after firing and this, I suggest, was the procedure adopted by the English in 1588. An inventory of gunnery equipment issued to the Queen's ships Elizabeth Bonaventure and Aid in 1585 includes bowsing tackles (for running guns out), talling or tailing tackles (for pulling them inboard), and double and single blocks for providing the necessary mechanical advantages.(31) Breechings and lashers were provided for securing the guns inboard when not in use. That provision was also made for traversing and elevating the gun assemblies is indicated by the issue of crows, sledges and quoins. Bourne stressed the importance of elevation and timing in shooting the roll, with the enemy rising from a trough to present his vulnerable lower hull.(32) Gunner and steersman, he emphasised, must work in the closest co-operation. The application of such principles at Gravelines must surely explain the hull damage meted out to the Spaniards, confirming Philip II's fears that the dastardly English would indeed fire low.

Guns, however, are only part of a naval weapons system. The platforms upon which they are carried, and the capacity of those platforms to be placed where the weapons may best be deployed, must also be taken into account. It takes two sides to fight a battle, and any such assessment can only be approached in relative terms. A review of the performance achieved by the Armada's ships must therefore be preceded by a consideration of the vessels which opposed them.

Contemporary opinion was in little doubt as the the merits of Queen Elizabeth's front-line navy. It was generally agreed that the new breed of race-decked galleons which had been built under John Hawkins's inspired supervision were superb warships. "I protest before God," enthused Charles Howard, "...that I think there were never in any place in the world nobler ships than these were."(33) And again, after an inspection of the royal galleons in February 1587 (in his zeal the Lord Admiral had visited "every place where any man may creep"), he wrote to Burghley that there was not one but he "durst go to the Rio de la Plata in her".(34) Other letters confirm both the sound build and sprightly performance of his ships. In March 1587 the 600-ton Elizabeth Bonaventure grounded at the entrance to Flushing harbour and endured the stresses of two complete tidal cycles before she could be refloated. "In all this time," wrote the Lord Admiral later, "there never came a spoonful of water into her well. My Lord, except a ship had been made of iron, it were to be thought impossible to do as she had done; and it may be well and truly said that there never was nor is in the world a stronger ship..."(35) Of his newly-built flagship the Ark he wrote to Burghley: "I think her the odd ship in the world for all conditions... We can see no sail, great or small, but how far soever they be off we fetch them and speak with them."(36)

These were not the prejudiced views of an uncritical sycophant. Howard was an able and perspicacious commander who was not afraid to speak his mind, and his confidence in his own ships is confirmed by an observation made during the battles by his opposite number on the Spanish side. "The English ships," wrote Medina Sidonia after his first encounter with them, "were very swift and well handled, so that they could do as they liked with them."(37)

Although the English galleons were fast and agile they were evidently able to carry a formidable armament. Little detail is available on the actual gun strengths of individual English ships during the Armada campaign, but the armament issued to two of the Queen's galleons three years earlier is probably typical.(38) They were the 600-ton Elizabeth Bonaventure and the 250-ton Aid, both of which were to serve with distinction in 1588. The information may be broken down thus:

Elizabeth Bonaventure

Gun Type	Number	Average Weight
demi cannon	4	4532 pounds
cannon perrier	4	2737 pounds
culverin	8	3761 pounds
demi culverin	12	2895 pounds
sacre	6	1839 pounds
minion	1	1400 pounds
falcon	3	840 pounds
port piece (with chamber)	4	1288 pounds
fowler (with chamber)	2	759 pounds

Aid

Gun Type	Number	Average Weight
culverin	4	3965 pounds
demi culverin	4	2680 pounds
sacre	10	1708 pounds
minion	4	1273 pounds
falcon	4	882 pounds
fowler	4	743 pounds
base	2	-

The point to be made is not the heavy firepower of these two English front-line armaments - though that is remarkable enough - but their physical weights. In gun barrels alone the Elizabeth Bonaventure carried 51.5 tons of ordnance, amounting to 8.6 percent of her rated tonnage, while the _Aid_'s twenty-seven tons of weaponry gives her the even highter figure of 10.8 percent. To these figures should be added the weight of the guns' mountings, crews, and ready-use ammunition. The ability to carry loads of this magnitude on the decks above the waterline indicates that the ships were exceptionally strong and stable, and the fact that these characteristics were obtained without apparently sacrificing an edge of sailing performance over the best of their rivals further emphasises the revolutionary design of these late sixteenth century English warships.

The Castilian galleons were, no doubt, superficially rather similar in design but, as earlier suggested, their single high-placed gundecks limited the weight of ordnance they could carry. We can estimate that the thirty-six guns aboard the squadron's 700-ton _capitana San Cristóbal_[27] weighed about twenty tons, or rather less than three percent of her rated tonnage, while the other ships in the squadron carried, if anything, even lower percentages.(39) In spite of this their performance still evidently fell below that of front-line Elizabethan warships carrying up to three times their firepower. In a straight tail-chase, lamented Purser Calderón, the two fastest galleons in the Armada appeared, in comparison with their English quarry, to be standing still.(40)

In contrast, the Portuguese royal galleons were heavier in terms both of displacement and in weight of armament. The only one for which we possess a detailed break-down of guns, the 1050-ton almiranta San Juan[2], carried an armament amounting to about 4.5 percent of her rated tonnage. These ships were evidently able to take a good deal of punishment in battle, though the curious case of the San Mateo[6] suggests that they may have been prone to internal stresses from the prolonged recoiling of their own guns. But they were not particularly manoeuvreable ships nor were they, in the strict sense of the word, galleons. They were high-charged, strongly built battleships of carrack design which could carry plenty of troops stationed in their towering castleworks and fighting tops. The guns they carried were intended to be fired as a preliminary to close-quarter boarding action. During the campaign the English wisely denied them the opportunity of putting their undoubted capabilities in this respect to the test.

Although many ships on both sides were requisitioned merchant vessels the English rarely, if ever, employed these as front-line units. A number of the biggest fighting ships in the Spanish fleet, however, were vessels of this kind. Martin de Bertendona believed that the large and capacious Mediterranean-built merchantmen of his Levantine squadron would, because of their overbearing grandeza, prove to be formidable fighting ships, while one contemporary Spanish opinion went even further, and suggested that in a fight each Levanter would be worth ten or twelve English ships. Certainly the four or five principal ships of Bertendona's squadron were armed as front-line troubleshooters, and were to play a central role in much of the fighting. But they were not a success, and the extent of their ultimate failure may be gauged from the fact that, by the time the campaign was over, eighty percent of them had been lost.

This exceptionally high casualty rate, though sustained through subsequent wrecking and not in the course of the battles themselves, requires explanation. The Portuguese galleons had been even more hotly engaged, and yet most of them got home. Perhaps this was because they had been built as warships, and were designed to receive punishment as well as to mete it out. Bulk cargo carriers like the Levanters, on the other hand, were conceived on strictly economic grounds, and their design criteria did not include possible involvement in a close range artillery battle. It may be that Bertendona's optimistic assessment was based on their suitability for boarding action, and in this he was probably justified. Had it come to clapping sides with a smaller adversary the _grandeza_, backed by aggressively handled Spanish steel, might well have proved a winning combination. In such an encounter height and troop capacity were the main considerations. Structural strength beyond the minimum necessary to ensure seaworthiness was of little consequence, since a conventional boarding assault placed few abnormal stresses on a ship's hull.

The same could not be said of sustained artillery action, in which the extra stresses to which a hull might be subjected included not only the obvious one of enemy bombardment but also the strains imposed by the working of its own guns. These were not stresses which the hull of a merchant ship was ordinarily designed to bear. The harmonisation of hull design, constructional techniques, cargo behaviour, safety margins and economic operation involved a set of complex equations which were not always easy to balance, but certain broad generalisations can be expressed. A merchant hull had to be light but strong, so as to minimise the cost of materials used in its construction and maximise its load-carrying capabilities. Where possible it made use of small and simply-shaped components because these were cheaper and more readily obtainable than large or complex ones. In consequence its designers sought to achieve an overall structural integrity based on a large number of small and closely fitting parts which, though individually slight, locked together to form a light self-stressing structure. Like an egg-shell, it was external shape rather than a massive internal skeleton which provided its ultimate strength.

The stuctural remains discovered on the wreck site of *La Trinidad Valencera* show clearly that this ship had been built according to such principles, and to a high degree of standardisation and perhaps prefabrication. No doubt she was quite strong enough for her normal commercial tasks in the Mediterranean. But such a hull would have been highly susceptible to the effects of localised damage because, to continue the simile of the egg-shell, a self-stressing structure of this kind is prone, if only slightly cracked in one part, to overall collapse. In modern parlance it has no structural 'redundancy' to back up partial failure because partial failure was not, from the point of view of the designers, a likely contingency. Naturally enough, they had not anticipated Gravelines.

Yet another factor should be borne in mind. Quite apart from the stresses of bombardment and recoil ships like *La Trinidad Valencera* may have been subject to what might best be termed negative stresses when not employed in the capacity for which they were built - the bulk transport of grain. Stored grain exerts a very considerable sideways pressure, which is why granaries require strong external butressing to counter its thrust. We do not know what structural arrangements were made in grain ships of the early modern period to stand up to this pressure but, whatever they were, they are likely to have diminished rather than strengthened a hull's capacity to resist external forces when it was not carrying the load for which it was designed. An empty granary will collapse more readily than a full one because its conflicting stresses are out of balance, and for the same reason a modern supertanker is at its most vulnerable when sailing in ballast.

The squadrons of Biscay and Guipúzcoa, which consisted of merchant shipping drawn from the Atlantic coast of northern Spain, suffered lower casualty rates than the Levanters, at twenty and forty percent respectively. While this may in some measure reflect their more limited employment as front-line ships it is unlikely to be the only reason, since many of them were quite heavily engaged. Further explanation must be sought. Their better rate of survival may perhaps have been due to the more resiliant "Atlantic-type" build which the wreck of one of their number, the *Santa María de la Rosa*, has demonstrated archaeologically. Even so, the Basque ships were built for commercial operation and not war, and like the Levanters they were almost certainly ill-suited to give or receive heavy gunfire. The same judgement may be passed on the Andalusian squadron, whose vessels came from Spain's southern ports and Mediterranean seaboard. In short, the converted merchantmen which made up four of the Armada's territorial squadrons were probably adequate as armed transports but altogether unsuitable as gun platforms in a close artillery engagement.

The hulks need not detain us. They were not meant to take part in the fighting at all, although their capitana El Gran Grifón, does seem to have operated as a front-line troubleshooter. This is to be explained not by her suitability for such a role but by the status of her commander and senior officers. As a group, the function of the hulks was simply to provide cargo support, and in the event their contribution to the campaign was a negative one, in that their abysmal sailing performance acted as a continual impediment to the Armada's rate of progress.

More surprising is the almost total failure of the galleasses, with their apparently formidable capacity to combine mobility with heavy firepower. But, as we have seen, the source of that mobility was itself vulnerable to gunfire, while the need to concentrate armament in cramped fore and aft castleworks must have imposed even greater restrictions on working space than we have postulated for the galleons. No doubt the galleasses would have been superb weapons in a ramming and boarding fight, as they had been at Lepanto, but, denied such an opportunity, they proved clumsy and all but ineffective. Their hybrid design, moreover, made them unsuited to oceanic sailing, and their awkwardly hung steering gear was particularly prone to disastrous injury.

Poor sea-keeping abilities and difficulties with steering also dogged the four galleys, and indeed prevented them from taking part in the campaign. An assessment of their likely performance in the battles is therefore entirely academic. But the failure of Pedro de Acuña's squadron against Drake at Cadiz in 1587, where conditions for galley operation were theoretically ideal, gives no grounds for supposing they would have done any better in the Channel engagements. In fairness it should be remembered that sea fighting was not the role for which they had been intended, and no doubt their unique capabilities would have been put to good use had they been present at either the Flanders link-up or off the invasion beaches.

Hurtado de Mendoza's communications squadron of zabras and pataches deserves greater recognition than it has hitherto been given. Physical communication within the fleet, and between the fleet and Parma, was at all times excellent, thanks to these bustling and sprightly small craft which closely attended Medina Sidonia's flagship. They were central to the Armada's closely ordered command structure and, had the link-up and cross-Channel jump come about, they would have been vital to the control and smooth-running of the whole complex operation.

A final matter which must be considered before we conclude our assessment of the fleet's fighting capacity is that of the men. How good were they, and under what system of command did they work?

Let us take the seamen first. The skill in ship management which the Armada's formation-keeping demonstrated is all the more remarkable when the clumsy, and variable, performance of its 120-odd floating units is taken into account. Individual examples of fine seamanship are numerous. One of the most revealing is Juan Martínez de Recalde's performance off the south-west coast of Ireland during the voyage home. Not only did the lion-hearted old admiral, who by this time was quite literally dying on his feet, display almost unbelievable seamanship in gaining the shelter of Great Blasket Island but, in the thirteen days he remained there, he acted with unflagging skill, forethought, and resolve to ensure the survival of his own ship and those in his company. During the day of high crisis on 21 September, after the _Santa María de la Rosa_ had gone down, he made strenuous and partly successful efforts, in spite of the appalling weather, the state of near exhaustion to which he and his men had been reduced, and what must by then have seemed the total futility of the five painful months they had been at sea, to transfer heavy guns from another ship which was about to sink so that they could be brought back to Spain and used to fight another day.(42) This implies seamanship, leadership, and morale of the very highest order, and also reflects and explains the performance of the seamen under Recalde's command.

The Basque mariners who manned the squadrons of Biscay and Guipuzcoa were judged to be Spain's finest seafarers. Nearly half a century later that old veteran of the 1588 campaign, Sir William Monson, wrote that were it not for the Biscay sailors the Armadas of Spain could not have been maintained. Their skill, Monson pointed out, was in large measure derived from their experiences in Newfoundland waters, where hardy Basque seafarers vigorously exploited the vast stocks of cod and whales.(43) By implication Monson suggests that, in comparison, the other mariners in Spanish service were not up to much. But this is not entirely fair. The trade routes of the Mediterranean and Atlantic, the long and exposed coast of Portugal, the North Sea and the Baltic, make stern demands on those who navigate them, and the hard realities of conditions afloat leaves little room for fair-weather sailors. Most of the Armada's seamen were professionals in that they were, in the main, the original crews of the ships allocated or requisitioned for the campaign. There is nothing whatever to suggest that as a group they were inexperienced or below normal standard.

But the complement of a merchant ship is far smaller than that of a warship, and the Armada crews undoubtedly suffered from a lack of skilled seamen to fight their ships. On average there was only one seaman for every 7 1/2 tons of shipping, while the corresponding English figure was less than two tons per man. To some extent this deficiency was made good by the employment of soldiers on general duties about the ships and, as we have seen, the bulk of the gun-crews was drawn from this source. Nevertheless, the fact that less than a third of the manpower carried by the Armada consisted of trained seamen must have been a severe impediment to its efficient handling, especially in the labour-intensive business of battle.

The presence of so many soldiers aboard the ships, moreover, created severe difficulties of co-operation and command. Spanish soldiers considered themselves more than a cut above their seafaring comrades, and would not have taken kindly to working with them as equals, let alone taking orders from them. Medina Sidonia anticipated this problem in his General Orders, which sternly enjoined the soldiers not to interfere with the running of the ships or to "pull rank" on the crews over rations and other privileges.(44) He could not, however, alter the heirarchal and divisive command structure which lay at the root of these traditional antipathies. William Monson, no doubt drawing upon the experiences of his youth, has provided a graphic critique on the shortcomings of Spanish naval command. They had, he said, "more officers in their ships than we: they have a captain for their ship, a captain for their gunners, and as many captains as there are companies of soldiers; and, above all, they have a commander in the nature of a colonel above the rest. This breeds a great confusion, and is many times the cause of mutinie among them. They brawl and fight, commonly, aboard their ships as if they were ashore."(45) Here we see the reason for Medina Sidonia's directive that for the duration of the campaign no man should bear a feud or carry a dagger, and that "perfect good feeling" should prevail among the soldiers and sailors of his command.(46)

A similar structure had once governed the command of English ships, but the naval reorganisations of Elizabeth's reign, and especially the highly individual genius of Francis Drake, had replaced it with the more logical if socially revolutionary system of unified command under a single captain: a ship's complement, said Drake, must "all be of a company."(47) His celebrated dictum that the gentlemen should "hale and draw" with the mariners was evidently normal practice aboard English ships in 1588, and even so illustrious an officer as Lord Henry Seymour, commander of the eastern squadron and a cousin of the Lord Admiral, was not above lending a hand on deck when it was needed. On 23 June 1588 he dispatched a report to Walsingham from his blockading station aboard the Rainbow off Dunkirk, with a postscripted apology that it was not written in his own hand, which he had strained "with hauling of a rope".(48) No Spanish gentleman, however modest his rank, could have countenanced so menial a task.

We turn now to a consideration of the 19,925 troops which the fleet carried. Not all were veterans; about half were recently trained conscripts, but they were well equipped and disciplined, and a good proportion of them were experienced and battle-hardened men.(49) So too, in the main, were their officers, although there was always a tendency for supernumerary officers and gentlemen-adventurers to seek commands for which they were not necessarily well qualified. Recalde warned of the dangers of this practice in a letter to the king from Corunna on 11 July 1588.(50) Nevertheless, the overall quality of the troops was high and Medina Sidonia, though he would have liked more of them, was not prepared to lower standards. When 400 hurridly gathered replacements were sent to join the fleet at Corunna he judged them to be unsuitable for employment even as pioneers, and sent them home.(51)

Medina Sidonia had good reason for this concern, for he knew that upon its soldiers depended the Armada's hoped-for superiority in a boarding fight. When the ships went into action their decks would be crowded with fully equipped troops whose duty it was to bring down a hail of small-arms fire as the range closed, to wield the pre-boarding weapons of grapnel, shear-hook, missile, and incendiary device, and finally to enter and overwhelm the adversary. But although the Spaniards were denied the opportunity of putting these tactics into effect their soldiers remained a vital part of the Armada's own defences, for while they remained at their stations there was no way short of physical annihilation or surrender in which the English could actually defeat a Spanish vessel. At Gravelines this resolved itself into a strange stalemate. The Spaniards could not defeat their enemies because they could not catch them or seriously damage them with gunfire, while on the other hand the English, though they could batter the Spaniards to the extent that their limited stocks of ammunition allowed, were able neither to sink nor to capture them.

The fact that a Spanish ship deprived of its soldiers was virtually defenceless explains Medina Sidonia's reluctance to detach troops from the fleet to reinforce Parma's army on the beaches. After much haggling it was agreed that the Armada should disembark 6,000 of its best troops for the invasion, though at the last minute this figure was raised to 10,000 to cover a shortfall in the contingent which the Army of Flanders was able to provide.(52) This in itself represents another serious weakness in the overall plan, for after the landings the Armada's presence and close support would still have been required, yet stripped of more than half its troops - and most of its best ones - its own security against the English fleet would have been dangerously compromised.

We are now in a position to consider in general terms what actually happened while the fleets were in contact, from the first skirmishes off Plymouth on 31 July to the disengagement after Gravelines on 8 August, and why it happened as it did. In approaching this question it is important to bear in mind that before the fighting began there were no guiding precedents; neither side had any experience of the kind of action which was to follow, nor did it possess reliable knowledge of the strengths or shortcomings of its rival. But one fact is clear. From its conception and throughout the traumas of its birth the Armada had been intended, whatever its other capabilities might have been, to impress and overawe. Philip never lost sight of the possibility, to him a most attractive one, that his aims might be achieved simply by parading the Armada in the Channel. Negotiations with Elizabeth were already in hand, and in his sealed instructions to Parma, which Medina Sidonia was to deliver the moment the Army of Flanders landed on English soil, the king made it clear that, once this stage in the campaign had been reached, the threat of further force might be used as a bargaining counter to reach a negotiated settlement. In such negotiations, Philip directed, the "*reputación*" of the Armada should be exploited to the full: the fleet's *grandeza*, real or imagined, was therefore an important element in its make-up.(53)

At first the English were wholly taken in. "We never thought," wrote a contemporary observer, "that they could ever have found, gathered and joined so great a force of puissant ships together and so well appointed them with their cannon, culverin, and other great pieces of brass ordnance."(54) The deep sense of awe which the appearance of the Armada evoked is echoed by Lord Admiral Howard's early reaction to it: "We durst not adventure to put in amongst them, their fleet being so strong."(55) Other reports stress the "majesty" of the Armada, and comment especially on the good order with which its progress was managed. The initial English naval reactions to it were extremely cautious, often experimental, and sometimes even half-hearted. "We pluck their feathers little by little," wrote the Lord Admiral, but apart for the fortuitous capture of the San Salvador and Nuestra Señora del Rosario his feather-plucking was largely ineffectual, for it was conducted in the main at excessively long ranges, and at the expense of a "terrible value" of precious round-shot.(56) Nothing, it seemed, could prevent the Armada's orderly progress up the Channel.

But, after the fireship episode off Calais, an entirely new approach was adopted by the English. In the wake of the dislocation which that attack brought upon the Armada's hitherto tight and steadfastly maintained defensive formation, Howard's galleons, now reinforced by Seymour's eastern squadron, launched an aggressive close-range gunnery assault on the retreating but reforming Spanish fleet, anticipating by more than two centuries the tactics which were to win Trafalgar. But, as the English must have known then and we have discovered again, the Spaniards had not run out of large-calibre ammunition and were theoretically as capable of delivering ship-smashing broadsides as they had been at the start of the campaign. What, therefore, changed the caution which the English had displayed in the Channel skirmishes to the vigorously confident close-action shown at Gravelines?

The answer must surely be that, at last, the bubble of the Armada's invincibility had been pricked, and in particular its shortcomings in gunnery clearly identified. This realisation must have dawned upon the English some time _before_ Gravelines, and explanatory clues are therefore to be sought in accounts of the earlier fighting. One key fact stands out. After the battles off the Isle of Wight on 3/4 August all fighting ceased for three days, while the Armada progressed to Calais. This suggests that on or before 4 August the English had made a firm decision to reserve their ammunition for an all-out attack on the Armada when it reached its vulnerable and uncertain station off Flanders. By this time, it follows, they knew they could come close enough to the Spaniards to deliver really effective ship-smashing broadsides without risking serious retaliation, so long as they used their decisive sailing advantage to avoid being grappled and boarded. Who first made this momentous discovery, and when, we may never know for sure. Perhaps it was a gradual realisation in the minds of many men. But one mind we can single out as a particularly likely candidate is that of Francis Drake, and we can point to a number of incidents which may have helped him towards this vital conclusion.

The first was the capture, on the morning of 2 August, of Pedro de Valdez's Nuestra Señora del Rosario, one of the Armada's most heavily gunned ships. The reasons behind Don Pedro's ready surrender need not concern us here; what matters is that Drake had ample opportunity to inspect every detail of the ship and her equipment and to extract, with his ready wit, infectious charm, and lavish hospitality, as much as he wanted to know from her haughty and disillusioned commander. He would have seen for himself the unsuitable gun-mountings and scratch crews of soldiers, noted the clumsy and divisive structure of command, and doubtless observed that the ship's biggest guns had scarcely been fired. No one was better qualified to make assessments such as these, and it may well be that Drake's capture of the Rosario, though bitterly criticised by some of his contemporaries, was one of the most significant actions of the campaign.

It is tempting to link the dawn attack on the straggling _urca capitana El Gran Grifón_, which took place off the Solent on 3 August, with the discoveries Drake had made aboard the _Rosario_ the day before. Here, for the first time, we hear of a really close single-ship action in which mobility and firepower were skilfully deployed, and it cannot be coincidence that the aggressor was almost certainly the _Revenge_. Was Drake perhaps testing a developing theory about the Spaniards' inability to fight a mobile artillery action, and wisely choosing one of the less well-armed troubleshooters for his experiment? If so, he must have found the results profoundly encouraging, for he struck his target forty times and killed many soldiers on her decks, while the _Grifón's_ bronze _medias culebrinas_ - the biggest guns she carried - remained virtually silent throughout.

A day later, if my interpretation of the second phase of the Isle of Wight battles is correct, Drake repeated his experiment in full squadron strength, breaking the Armada's right wing and so forcing it past Selsey Bill and away from the Solent. The English now had all the information they needed to identify the Armada's fundamental weaknesses, and it was precisely at this point that a decision was made to conserve ammunition for the final battle.

Where, then, does this leave our final assessment of the Armada's potential as a fighting force? As we have now seen, it could not under any foreseeable circumstances have defeated the English in naval terms, but at the same time - and this is important - the English did not possess the means of destroying or capturing it. This caused a stalemate, and in the end both fleets could only disengage and make for home. That the Spanish route home was longer and much more hazardous than the English one, and that many of the ships were damaged and the weather unusually severe, accounts for the magnitude of the Armada's final losses. It was a failure, and a catastrophic one at that, but it was not an outright defeat.

There were important elements in the Armada which, seen retrospectively, may be counted successful. Its performance as an armed convoy was exemplary, and there is little doubt that it could have entered the Thames estuary on its own and landed troops and equipment on the Kent beaches. There would doubtless have been a Gravelines-type attempt on the part of the English to counter this, but the kind of damage which was later to precipitate such disaster off the coasts of Scotland and Ireland would have been of little consequence in the sheltered waters of the Thames. And by this time, in any case, the English would have run out of ammunition.

Why did the Armada not press its advantage at this point? At the Council of War aboard the San Martín on 9 August the option was not even considered. Unless the weather allowed a return to the Channel, and then only if Parma's barges came out to meet the fleet, it was decided unanimously to return home by the north-about route.(57) There were, I think, a number of reasons which precluded the Armada from acting without Parma's support. First, such an attempt would have been in total contradiction to the king's orders. More compellingly, perhaps, the fleet did not possess on its own all the elements necessary to mount even a scaled-down invasion of England. Most obviously, it did not have enough troops. Even if 10,000 veterans had been put ashore they would scarcely have constituted an adequate force for the task of securing London, especially since they would have been in far from peak condition after more than three months living in the cramped and unhealthy conditions aboard the ships. Then again, if stripped of its soldiers, the fleet would have had no adequate defence itself, so compromising the close support which the Armada was expected to give the advancing land forces. Finally, there was a serious shortage of the draught and pack animals which would have provided the mobility upon which the campaign depended, especially in respect of the artillery train. Only four hulks were fitted out as horse transports. Most of the animals were to come over with Parma, no doubt to ease the problems of foddering and water supply which a long voyage would have entailed. Thus an army landed by the Armada on its own would have been small, lacking in mobility and heavy transport, and inadequately supported by the fleet. Without the Army of Flanders there was nothing the Armada could do except go home, and none of its officers seriously thought otherwise.

It remains to pass final judgement on the Armada as a fighting force. There can be no doubt that Santa Cruz's proposals of 1586, had they been put into effect, would have stood an excellent chance of success. If a self-contained invasion fleet had entered the Channel in 1588 with orders simply to sail to Margate and land troops there it is difficult to see what could have stopped it. Even an operation less ambitious than the 1586 scheme might well have worked. With a few thousand extra troops, and perhaps a dozen horse transports, the Armada on its own would have constituted a formidable self-contained force.

The failure of the Armada is not to be blamed on any single inadequacy in its composition or performance. True, its achievements in heavy gunnery were poor to the point of uselessness, and in the event the space and load capacity taken up by its bigger guns would have been better occupied by extra troops. The heavy siege guns, though vital for the campaign ashore, had no place on the decks, and should have been stowed in the holds.(59) But the Armada did not fail because its gunnery was bad. Its lighter anti-personnel pieces together with the small-arms fire of the troops were more than enough to guard against a boarding assault. Nor did the structural weaknesses displayed by the requisitioned merchant shipping, particularly the big Levanters, cause the fleet's downfall. Despite the damage they had suffered most would still have been able to land their massive cargoes of troops and invasion stores, and this of course was their primary function. Those that were eventually lost only fell apart when, on top of their battle damage, they were subjected to the stresses of the return voyage: the English on their own were not able to knock them out. And the overall lack of manoeuvreability displayed by the Spanish ships was more than compensated by the rigid discipline with which their defensive formation was maintained. Even when broken and severely attacked, as at Calais and Gravelines, the Armada demonstrated a quite remarkable ability to regroup and fight on.

These shortcomings, although serious enough in themselves, do not therefore explain the Armada's ultimate failure. The underlying cause of that failure lies, beyond any doubt, in Philip II's inability to recognise what his Armada, as it was actually composed in 1588, could and could not do. It could advance where it willed in a defensive and virtually impregnable formation, but it could not defeat a seaborne enemy in open battle. Any plan which utilised its capacity of defensive mobility, as Santa Cruz's did, was therefore likely to achieve success, while on the other hand a strategy which required it first to win naval supremacy was doomed to failure. That it was expected to carry out the latter must be blamed on the king, upon whose insistence Santa Cruz's original plan had been modified. Once the link-up with Parma became an integral part of the overall strategy the Armada's role changed from that of an armed convoy to that of a naval task force. What did not change, however, was its fundamental inability to substitute a wholly defensive capability for one which, at sea, was primarily offensive. In 1588 nothing could have been done by the Spaniards, whether or not they recognised their shortcomings in sailing performance and gunnery tactics, to challenge the English fleet on its own terms. Yet without first winning a naval battle there was no realistic hope of achieving a rendezvous with the Army of Flanders.

While the king did not appreciate the significance of these unpalatable facts, and countered all criticism by invoking his confidence in divine guidance and support, his loyal servant Alvaro de Bazán, Captain-General of the Ocean Sea, hero of Lepanto, Portugal and the Azores, most certainly did. Here, perhaps, we come close to the root of the old marquis' uncharacteristic reluctance to press forward with the Enterprise, once the king's decision to rely on a link-up with Parma had been taken. The same reasoning might well have lain behind the self-denigration with which his successor sought to refuse his appointment to the command. The marquis of Santa Cruz had known only too well why the Armada as it had evolved by early 1588 was not likely to succeed. When the fleet sailed in May the duke of Medina Sidonia knew why too, and so did his understandably lukewarm comrade-in-arms, the duke of Parma.

But the king did not know why, and no one was able to tell him.

Appendix 1

Spanish and English tonnage measurements in 1588

Evidence of the method whereby the Spaniards calculated ship tonnage, and the relationship of this figure to the overall dimensions of the hull, is provided by a document dated at Lisbon on 30 April 1588 which lists the principal dimensions and tonnages of six large Mediterranean ships requisitioned or hired for the campaign.(1) They are: La Nave Marino Prodanela (San Nicolas [74]); La Nave de Stéfano Deoliste (Anunciada [73]); Santa María de Visón [76]; El Galeón del Duque (Florencia [8]); La Regazona Beneziana [68]; and La Nave Lavia Beneziana [69]. The first three ships were probably Ragusan, the last two Venetian, while the fourth belonged to the Grand Duke of Tuscany. All sailed with the Levant Squadron, except the Florencia, which was attached to the Squadron of Portugal.

It was necessary for requisitioned vessels to be rated for tonnage so that the amount to be paid by the Crown for their charter, or compensation in the event of loss, could be calculated. As elsewhere, the calculations were based on established formulae which were intended to safeguard the interests of both owner and hirer. Such formulae were not, it should be stressed, intended to give exact load capacities or displacements in a scientific sense: they were no more than rules-of-thumb by which dues or hire charges could be worked out simply and without argument.

In 1590 reforms were introduced by the _Casa de la Contratación_ at Seville which laid down, among other things, that tonnages were in future to be rated according to the formula:

$$\frac{\left(\frac{manga}{2} \times puntal \times esloría\right) - \frac{1}{20}}{8}$$

where _manga_ = beam taken internally at midships, _puntal_ = depth from beneath the main deck at midships to the bottom of the hold, and _esloría_ = length of main deck from stem to sternpost, exclusive of the thickness of head and stern timbers.(2) The 1/20th, or 5 percent, was subtracted from the solid number - which assumed a constant cross-section - to allow for the entry and run of the hull. The dimensions were expressed in _codos_, or Castilian cubits, which according to Veitia Linage were 33/48ths of a Castilian _vara_ (835.9 mm), giving the _codo_ a value of 547.7 mm.(3) This calculation gave the ship's capacity, or burden, in _toneles machos_; her war-rating, in _toneladas_, was obtained by adding an arbitrary fifth.

Although the formula used in the 1588 calculations is not specified in so many words (the form in current use was presumably taken for granted), figures are given, in _codos_, for the _puntal_, _manga_ and _esloría_ measurements of each of the six ships, together with the resultant _toneles machos_ and _toneladas_ ratings. It is also implied that a subtraction of three percent has been made at some stage in reaching the _toneles machos_ figure, and that one-fifth has been added to that result in order to obtain the _toneladas_.

It seems likely that the 1590 formula was a simple revision of an earlier and similar one, the only apparent difference being the substitution of five percent for the three percent deducted to allow for the entry and run of the hull. Such an alteration would no doubt reflect the increasing fineness of underwater lines towards the end of the sixteenth century. Unfortunately this neat conclusion is only partly borne out by the arithmetic, although it should be remembered that sixteenth century numeracy, especially in Spain, was abysmally bad, a fact which has been amply demonstrated in our examination of the artillery. There is no reason to suppose that the tonnage calculations, despite their awkward fractions (or perhaps because of them) were not worked out by an equally rough-and-ready process of "guesstimation".

The figures for the six ships, together with the results of my calculations based on the postulated "three percent" formula (in brackets, rounded to the nearest tun), may be found in the following table (overleaf).

Ship	manga (codos)	puntal (codos)	eslorÍa (codos)	toneles machos	toneladas
Nave de Marino Prodanela (San Nicolas)	18	11	53	$695\frac{5}{8}$ (636)	$834\frac{5}{8}$ (763)
Nave de Stéfano Deoliste (Anunciada)	$17\frac{1}{2}$	$11\frac{1}{2}$	48	$586\frac{3}{8}$ (586)	$703\frac{1}{2}$ (703)
Santa María de Visón	16	10	$47\frac{1}{2}$	472 (461)	666* (553)
El Galeón del Duque (Florencia)	17	11	68	801 (771)	961 (925)
La Regazona Beneziana	21	12	59	1079 (901)	1294 (1081)
La Lavia Beneziana	$18\frac{1}{4}$	$10\frac{3}{4}$	51	$607\frac{1}{8}$ (607)	$728\frac{1}{2}$ (728)

* This figure should surely be 566.

Though the results are admittedly not consistent, they are close enough to be reasonably convincing. The figures for the Annunciada and Lavia match to the tun, while those for the Santa María de Visón and Florencia agree within three and four percent respectively. Only in the case of the San Nicolas and the Regazona, with differences of ten and sixteen percent, may we suspect more fundamental errors than can be blamed on sloppy arithmetic. This suspicion is reinforced by the obvious mistake of 100 toneladas in the case of the Santa María de Visón.

Caution must be exercised in drawing comparisons between English and Spanish tonnage calculations, since the formulae employed were quite different and the respective units involved impossible to quantify with any certainty. However, since we possess the actual dimensions of these ships it is worth considering how their tonnages might compare with a contemporary Englishman's rating. English tonnages of this period were obtained, it is generally agreed, by dividing keel length x beam x depth (all in feet) by 100, although a divisor of 97 was sometimes used.(4) This gave the vessel's burden, to which one-third was added to obtain the "tun and tunnage" figure.

Applying this formula to the _Lavia_ by assuming a keel length of 41.58 _codos_ and converting her dimensions to feet, we obtain a burden of 546 tuns and a tunnage of 728.(5) The first figure is 61 tuns, or ten percent, short of the Spanish _toneles machos_, while the second - surely coincidentally - is exactly the same as the _toneladas_ figure. Not withstanding the obvious differences of approach in Spanish and English methods of tonnage calculation, this admittedly inconclusive sample does tend to suggest that the relative size of the ships of these two countries at the time of the Armada may have been closer to that suggested by their rated tonnages than has often been supposed.(6)

Appendix 2

Bore and shot measurement in practice: the gunner's rule and shot gauges from La Trinidad Valencera (Figures 98 and 99).

Our investigations into bore and shot sizes have shown that it was no easy matter for a sixteenth-century gunner to find exactly the right diameter of ball for his piece, and that the difficulty doubtless was immeasurably greater when each ship in a heterogeneous fleet such as the Armada had to be issued with a quota of ammunition matched to its particular set of guns. Not all of the gun-weights and calibres were expressed in constant units and, even when they were, variations in the specific gravity of shot might be sufficient to upset what were, by sixteenth-century standards, quite small tolerances. Evidence recovered from the wreck of La Trinidad Valencera shows how some of these difficulties were overcome, but at the same time indicates previously unsuspected factors which might, particularly in the heat of battle, have caused yet more inaccuracy, confusion, and ultimately chaos.

The evidence consists of a wooden scale, identified as a gunner's rule, and four circular wooden shot gauges.

The gunner's rule

This instrument (Figure 98) was recovered in three pieces of boxwood which can be restored to a length of 22.2 cm, though a small decorative finial, of no significance to the interpretation of the object, is missing. The rule is 1.05 cm wide and 0.65 cm thick. A scale of horizontal lines, each associated with a number, appears on both sides of the instrument. The graduations, which are irregularly spaced and so do not represent a linear measure, are numbered 1, 3, 6, 12, 14, 16, 20, 30, 40, 50, 60, 90, 100, and 120. The sequence and proportions of the graduations are the same on both sides, but one set is laid out to a larger scale than the other. The relationship between the two scales is not immediately apparent.

The instrument is a gunner's rule, intended to convert the linear measurement of bore (represented by the horizontal lines) into weight of roundshot (represented by the figures). Such instruments are described in several late sixteenth-century published works, while a number of examples survive in the form of the fusetto di bonbardiere, or gunner's stiletto, on whose steel blades similar scales are engraved.(1) These daggers are invariably Italian and of seventeenth or eighteenth century date, and served as a gunner's symbol of office. In 1661, for example, a corporal in the Venetian Compagnia di Bombardieri was given authority by the Council of Ten to carry the _stillo sagomoto_, and all _scolari bombardieri_ were enjoined to obey him. Regulations connected with the wearing of the _stillo sagomato_ were still in force at Verona in 1770 but by that date, and probably long before, gunners' stilettos were entirely ceremonial in purpose and not in any sense working instruments.(2)

The _Valencera_ rule, on the other hand, was almost certainly intended for operational use, since a short wooden stick can hardly have possessed the symbolism of an ornate ceremonial dagger. It is, to my knowledge, the earliest surviving example of a gunner's rule, though a drawing of one was published by Girolamo Cataneo in his _Tratto degli Essami de' Bombardieri_ of 1571.(3) Cataneo's scale is similar, though not identical, to the larger of the two scales on the _Valencera_ rule, and the sequence of numbers is the same except for the addition, in Cataneo's version, of the figure 9. Comparable scales were also published by Eugenio Gentilini(4) and Alesandro Capo Bianco,(5) both in 1598. Three published scales, and the _Valencera_ instrument, are shown in Figure 98.

When one tries to make sense of these scales, however, unexpected complications arise. The first modern attempt to do so was by J.G. Mann, in an article published in 1931.(6) Mann, followed by M. Terenzi in 1962 and H.L. Blackmore in 1976, noted that calculations aimed at resolving the relationship between the linear and volumetric figures on the scales consistently failed to produce satisfactory results.(7) Exasperated, the modern authors sought to blame the wide variations in the weight of pound units in contemporary use, and further suggested that some of the figures on the scales related to lead, some to stone, and some to iron projectiles. Such assumptions do not, however, lead to workable solutions, and it is therefore necessary to approach the problem from its roots.

The first graduation on the larger of the two Valencera scales is located 4.4 cm from the top of the rule, and the figure shown above it is 1. This means, according to the sixteenth-century theorists, that a 4.4 cm diameter sphere of the material for which the scale was intended will weigh one pound. We can calculate that the volume of such a ball would be 45 cc, and if we assume that the material of which it was made is iron, and take an average specific gravity for the metal of 7.26, we find that it would weigh 327 grams - quite a convincing figure, for it falls within the range of the most common Italian pounds in use during the sixteenth century (the light Milanese pound, with a value of 326.75, is the closest).(8) It is not unreasonable to conclude that the scale is indeed for iron shot, and that an Italian weight unit is probably involved.

This being so, it is a simple matter to work out all the values on the scale, reducing each to a unit value in grams. The results are as follows:

Figure in scale	Length (mm) of graduation from zero	Spherical volume (cc)	Shot weight in grams (sp. gr. 7.26)	Unit value (grams)
1	44	45	327	327
3	63	131	951	317
6	72.5	199	1445	241
12	91.5	400	2904	242
14	108	660	4792	342
16	115.5	807	5859	366
20	123.5	987	7166	358
30	138	1376	9990	333
40	150	1767	12828	321
50	169	2527	18346	367
60	176.5	2882	20923	349
90	191	3648	26484	294
100	205	4511	32750	327
120	215	5204	37784	315

Note: "subtile" pound of Venice = 301 g
"light" pound of Genoa = 317 g
"light" pound of Milan = 326.75 g Lewis, 1961,
"heavy" pound of Genoa = 348 g p. 218.
Florentine pound = 378 g

These results are clearly not consistent with the regular progression of a single weight unit. What formula was used to calculate the scale I do not know, except that it was erroneous; it would be tedious, and almost certainly fruitless, to investigate the possible sources of error. However, with three exceptions (those for the figures 6, 12, and 90) all the unit values fall within the range of the five most common Italian pounds and so we shall follow the example of the Spanish inventorists (with increased sympathy for their predicament) in describing the rule as being marked, more or less, in pesos de Italia. Further than this we cannot go.

Next, let us apply the same calculations to one of the published scales. I have chosen Gentilini's partly because his lower figures are somewhat at variance with the other scales (and might therefore produce interesting divergencies), and partly because his higher ones - particularly those between 40 and 100, where they are identical - coincide with the Valencera's "iron" scale.

His figures work out thus:

Figure in scale	Length (mm)	Spherical volume (cc)	Shot weight in grams (sp. gr. 7.26)	Unit value (grams)
1	42.5	40	290	290
2	61	119	834	417
4	72.5	199	1445	361
6	80	268	1946	324
8	89	369	2679	335
14	106.5	634	4603	329
16	114	776	5634	352
20	123	974	7071	354
30	137.5	1365	9910	330
40	150	1767	12828	321
50	169	2527	18346	367
60	176.5	2882	20923	349
90	191	3648	26484	294
100	205	4511	32750	327
120	214	5132	37258	310

Again, with three exceptions, the results indicate a pretty rough-and-ready _peso de Italia_, so remarkably similar (though incorrect) in some cases to the _Valencera_'s scale as to suggest a common source. The other scales I have reproduced look as if they would give broadly similar results although further detailed arithmetic is, I think, unnecessary to make the point.

But before we leave these calculations we must tackle the problem of the smaller of the two scales on the Valencera's rule. If we accept that the larger one relates to iron, then the smaller must have been calibrated against a material of greater mass, for which lead is the only practical candidate. But when we apply the specific gravity of lead (11.37) to the spherical volumes indicated by the scale we do not, as I had imagined we would, obtain a broadly similar unit value. Far from it, as the figures show:

Figure in scale	Length (mm) of graduation from zero	Spherical volume (cc)	Shot weight in grams (sp. gr. 11.37)	Unit value (grams)
1	27	10	114	114
3	38	29	330	110
6	44.5	46	523	87
12	55	87	989	82
14	65	144	1637	117
16	70.5	184	2093	131
20	75	221	2513	126
30	84	310	3525	117
40	90.5	389	4423	111
50	101.5	548	6231	125
60	106	624	7095	118
90	114	775	8812	98
100	124	998	11347	113
120	130	1150	13075	109

There is no conceivable weight unit which falls within the range of 82 to 131 grams, and the figures therefore seem entirely spurious. However, the linear ratios between the larger and smaller scales show, for the figure 1, that the smaller is 62 percent of the larger, while for the figure 120, it is 60.5 percent. Now if we compare the weights of iron and lead (assuming specific gravities of 7.26 and

11.37) we find that the former is 64 percent of the latter, a figure close enough to the linear proportions of the scales to raise more than a suspicion that the instrument maker (or, more probably, the theorist whose manual he consulted) succumbed to the fundamental arithmetical error of supposing that an adjustment of the linear proportions according to the relative weights of iron and lead would result in a proportional adjustment to their spherical masses. In this case the error is so great as to render the figures meaningless.

The shot gauges

The four Italian iron-calibrated gunners' rules we have examined underline the general lack of standardisation and agreed forms of measurement which prevailed in sixteenth-century gunnery. But these four scales, or a combination of similar diversity, might well have been in the possession of gunners aboard a single Armada ship together with, perhaps, scales graduated (or allegedly so) according to Castilian, Portuguese, French, German, Flemish, or other systems of measurement. Even superficially similar gunners' rules, like the four we have analysed, show sufficient variation to have caused considerable errors in practice. If, say, the owner of a Cataneo rule, who had just measured a gun's bore and found it to be of 20-pounder calibre (11.95 cm) by his scale, called to the owner of the *Valencera* rule for a 20-pounder shot to put in it, the latter would assume from his scale that the bore concerned was 12.35 cm which, even if he allowed the correct five percent windage for the ball (0.6 cm), would have resulted in a dangerously tight fit. And had anyone been so naive as to attempt to select a ball on the basis of the actual weight indicated by the rule, he would almost certainly have come to grief. It must follow, therefore, that neither of these systems was actually used in practice.

How gunners overcame this problem is indicated by the discovery, in the same deposit within which the gunner's rule was found, of four circular wooden templates clearly intended to gauge roundshot (Figure 99). The smallest of these has an internal diameter of 4.4 cm - exactly the measurement of the 1-pounder graduation on the Valencera gunner's rule. The next size, represented by one complete gauge and a segment of another, is 9.15 cm in diameter - precisely equivalent to the 12-pounder graduation on the scale. The largest gauge found, with a diameter of 11.75 cm, is 2 mm larger than the 16-pounder mark on the rule which, in view of the absolute correlation of the smaller gauges, suggests that it may have been part of a different set. This gauge is the only one which carries recognisable markings: the Roman figure XII, cut crudely across its handle, and a series of twelve small notches roughly nicked at its outer edge. These marks, the possible significance of which is discussed below, are so out of keeping with the neat appearance of the gauge itself as to suggest that they were casually added at some stage after manufacture. We may therefore suppose that it, and the unmarked gauges, were originally identified by painted or inked numerals which related each gauge to the corresponding graduation on a gunner's rule.

The implication is clear: a gunner's rule was only part of the equipment used for equating calibre to shot size. Each rule was supplied with a matched set of shot gauges, one for each of the fourteen or fifteen graduations on its scale. With such equipment it would be a straightforward procedure to measure the bore with the rule, select the gauge which represented the calibre shown, and pass it over likely-looking pieces of roundshot until the right one was found, windage presumably being judged by eye. That many of the figures were spurious in terms of the actual weight marked did not really matter: in practice the system relied on simple linear measurement and not on volumetric calculation, despite the illusion to the contrary that the instruments themselves give.

Such a system no doubt served the individual land-based gunner well enough, steeped as he was in the pseudo-science and mystique of his calling. The fiddling about with rules and gauges, combined with the adjustment of complicated instruments (themselves of questionable relevance and precision) designed to compute traverse and elevation, was all part of an elaborate conjurer's trick consciously intended to awe and mystify, in which the careful selection of the "right" projectile was one of the highlights. But on the heaving deck of a ship at sea, with many weapons being worked in close confinement under the bombardment of a skilful and aggressive enemy, such niceties would hardly have been practicable. Under such circumstances the individual rule-and-gauge system would surely have been unworkable: the picture of a dozen powder-monkeys, each clutching his wooden shot-gauge as he scrabbled in a dark shot-locker for a ball to fit the gun he served, is scarcely a credible one.

In the face of such predictable confusion an attempt must have been made to impose some kind of regularity in the allocation of shot to guns aboard each ship, and in the overall issue of ammunition to the fleet. The duke of Medina Sidonia's instructions to the Armada concerning the operation of its guns imply as much: "near each piece," he stipulated, "must be placed its magazines with ammunition."(9) Nine years later, in his fleet orders of 1597, Martin de Padilla ordained that "...numbers must be set down upon every cartridge, according to the piece."(10) What applied to cartridges must also have applied to shot and, if so, a common standard of measurement must have been employed. There is evidence from the Trinidad Valencera to suggest that an overriding Castilian standard was indeed imposed over the mainly Italian guns and artillery instruments aboard this ship - and, by implication, over those carried by the rest of the fleet. The evidence comes from the largest of the four shot-gauges which, as we have seen, carries the inscribed numeral XII and twelve edge nicks, these marks almost certainly having been added after manufacture. We have also postulated that it, and the other gauges, were originally identified by painted or inked numerals which related them to individual Italian gunner's rules, on which criterion this gauge would represent a ball of 16-pounder calibre. The added marks, both of which indicate the figure twelve, must therefore relate to another, heavier, weight unit. The obvious candidate is the Castilian _libra_ of 460 grams, and indeed the 12-_lbr_ ball illustrated in Acuña Vela's diagram of Spanish shot sizes (Figure 39) would fit it very closely (ball diameter 11.4 cm; gauge diameter 11.75 cm).

It thus seems likely that the Armada's gunners, whatever their nationalities or those of their guns and instruments of measurement, were expected to conform to a common Castilian standard. How well this worked in practice is beyond the scope of our evidence to determine, but we have already seen enough of sixteenth-century arithmetic for us to suspect that errors will have been common and often of considerable magnitude. And there is another factor to take into account. Shot could only be matched with the guns aboard an individual ship if the ammunition issued in the first place included projectiles of the right calibres and in the right proportions. How this infinitely more complex logistcal exercise was accomplished is nowhere made clear, although the detailed ammunition figures available for the four Neapolitan galleasses and two ships of the Levant squadron (_Anunciada_[73] and _Santa María de Visón_[76]) show that twenty-one distinct sizes of iron shot were needed to serve the 183 iron-throwing guns aboard them, while their forty-one _pedreros_ will have required a further undefined but presumably substantial variety of stone shot.(11) Nor was this an isolated case. The iron shot sample recovered from the wreck of _El Gran Grifón_ has yielded forty-five sizes of roundshot, as measured in arbitrary differentials of 0.1 cm (see Figure 49).

Bearing in mind the general inefficiency of manufacturing processes and distributive services of sixteenth-century Europe, the chronic muddle of weights and measures, and the demonstrable fact that sixteenth-century sums are almost never right, it is reasonable to conclude that the equation between calibres and shot sizes often fell short of its theoretical solution. The neat allocation of fifty rounds per gun throughout the fleet, recorded in the Lisbon muster, should not therefore blind us to the probability that much of this shot was unsatisfactory or even useless for the guns it was intended to serve.

Appendix 3

A comparison of Spanish and English gun-type nomenclature: the inventories of the Nuestra Señora del Rosario [43] and the San Salvador [56] (1)

Only two Spanish ships were captured by the English during the Armada battles. The first was the Guipuzcoan San Salvador, which was seriously damaged by an explosion early in the fighting. The duke of Medina Sidonia made a valiant attempt in adverse weather to tow her into the main body of the fleet, but during the confusion the Andalusian capitana, the Nuestra Señora del Rosario, which had broken her bowsprit in an earlier collision, was taken aback and lost her foremast. After further attempts to rescue the two crippled ships Medina Sidonia decided to abandon them both to the enemy rather than imperil his primary objective. In due course the San Salvador's burnt-out hull was towed into Weymouth, while the Rosario, having been captured by Drake and relieved of her commander, Pedro de Valdes, and a considerable quantity of treasure, was taken to Dartmouth under escort by Captain Jacob Whiddon of the Roebuck.

The English authorities later took detailed inventories of the contents of both ships, with particular emphasis on their artillery. By good fortune, these two vessels are among the few for which we possess full armament lists from Spanish sources. It is possible therefore to match one list against the other and so obtain a Spanish-English "dictionary" of gun-names in which the meanings are defined by the weapons themselves. Naturally, there are difficulties. The Spanish gun-lists do not necessarily reflect the exact armament with which each ship actually sailed, since additions or subtractions, or both, may subsequently have been made by the Spaniards. Then again, some illicit subtractions certainly took place between the capture of the ships and the time their official English inventories were taken. Another problem arises in the different criteria used in describing the pieces. In general, the Spaniards gave the name of each gun and the weight of shot it threw, but not the weight of the gun itself. The English, on the other hand, omitted the weight of shot but recorded the weight number marked on each piece, together with their version of its name.

I have therefore attempted, somewhat arbitrarily, to reconcile the lists by first arranging the Spanish-named pieces in a logical progression of types, starting with the largest, and then by setting the guns in the English column, which is incomplete, against the Spanish master column in a way which seems to me (on the basis, where no better evidence is available, of common sense) to provide the best set of equations between them. The result is, I think, reasonably convincing. Not every gun, I am sure, is placed correctly against its mirror in the opposite list, but I believe that the reconciliation is close enough for us to extract a working vocabulary from the two languages.

Nuestra Señora del Rosario

Guns listed by the Spaniards	Guns listed by the English	
cañón 35-lbr	demi cannon	5230
cañón 28-lbr	demi cannon, 6-inch bore, no mark	
medio cañón 21-lbr	demi cannon, 6-inch bore, no mark	
medio cañón 20-lbr	culverin	4736
medio cañón 20-lbr	culverin	4728
medio cañón 16-lbr	culverin	4589
medio cañón 16-lbr	-	
medio cañón 15-lbr	culverin	3200
culebrina 18-lbr	basilico	4840
culebrina 17-lbr	-	
tercio cañón (iron) 10-lbr	demi culverin (iron)	2300
media culebrina 8-lbr	-	
sacre 8-lbr	-	
sacre 7-lbr	-	
sacre 6-lbr	-	
sacre 6-lbr	-	
sacre 6-lbr (iron)	-	
sacre 5-lbr	-	
	cannon pedro	3032
-	cannon pedro	3021

-	cannon pedro	2934
-	cannon pedro	2894
-	cannon pedro	2639
-	cannon pedro	2566
falcón pedrero 6-lbr	great base	779
falcón pedrero 6-lbr	great base	775
falcón pedrero 5-lbr	great base	753
falcón pedrero (iron) 5-lbr	great base	708
falconete (iron) 4-lbr	minion	1100
falconete 3 1/2-lbr	great base	675
falconete 3 1/2-lbr	base	
falconete 3 1/2-lbr	base	
falconete 3-lbr	base	
falconete 3-lbr	base	
falconete 3-lbr	fowler	
falconete 3-lbr	-	
falconete 3-lbr	-	
15 esmeriles de camaras dobles	-	
Total: 46 guns	26 guns	

San Salvador

Guns listed by the Spaniards	Guns listed by the English	
cañón 50-lbr, Spanish founding	cannon	5329
cañón 50-lbr, Spanish founding	cannon	5222
medio cañón 22-lbr, Gregorio Lefer	culverin	-
medio cañón 22-lbr, Gregorio Lefer	culverin	-
cañón pedrero, nueva fundición	cannon pedro	2572

cañón pedrero, nueva fundición	cannon pedro	2318
cañón pedrero, nueva fundición	cannon pedro	2077
cañón pedrero, nueva fundición	cannon pedro	2019
cañoncete 10-lbr, Juan Manrique	culverin	-
media culebrina reforzada 8-lbr	culverin	-
media culebrina reforzada 8-lbr	culverin	2866
media culebrina, nueva fundición	demi culverin	2866
14 iron guns, 1- 2 1/2-lbr	4 iron minions	
-	1 old fowler and a bad sling	-
Total: 26 guns	18 guns	

These comparisons reveal a number of significant points. First, it appears that to an Englishman only the larger _cañones de batir_ qualified as full cannons. The two 50-_lbr_ _cañones_ from _San Salvador_ are so listed in the English inventory. But lighter guns like the 28- and 35-_lbrs_ aboard the _Rosario_, which the Spaniards called _cañones_, appeared in English eyes to be demi cannons, used as they were to a shot-weight of around 30 pounds for this class of weapon. Spanish _medios cañones_ were clearly much lighter pieces altogether. Four of the _Rosario_'s six appear to square with four culverins bearing weight marks between 3200 and 4736 in the English inventory: the shot-weight range of these pieces, from the Spanish source, was 15- to 20-_libras_. One _medio cañón_ appears to be missing from the English list while a sixth, the 21-_lbr_, may just have scraped into the English demi cannon category if my interpretation, based on an estimate of its bore, is correct. Then again, the two 22-lbr medios cañones from the San Salvador pair convincingly with two of the culverins, whose weight marks are not recorded, from the English list. Even by English criteria a heavy culverin and a light demi cannon might easily overlap their bore dimensions.

Any attempt to compare the gun strength of the two sides must therefore take into account the fact that a Spanish cañón, unless it is suffixed by "de batir", will almost certainly equate with an English demi cannon. It should also be appreciated that Spanish medios cañones were, for all practical purposes, synonymous with English culverins. This suggests, in turn, that by 1588 an 18-lbr (or thereabouts) with a barrel length of 25 calibres or less, which a Spaniard would instinctively have called a medio cañón, would in England have been classed as a culverin. From this we may suspect that the true culverin, with its length of 30 calibres or more, was falling out of use in England, and perhaps, as the rarity of the type aboard the Armada ships suggests, to a lesser extent in Spain too. Thus when a Spanish culebrina (which we know must have been a true long culverin, otherwise it would have been classed as a medio cañón) like the Rosario's 18-lbr, was inventoried by an Englishman, he listed it - assuming my equation to be correct - not as a culverin but as a basilico, a comparatively rare type of gun characterised by its unusual length.

Much the same conclusion can be drawn from the equation between the Rosario's iron 10-lbr tercio cañón and the 2300-pound iron demi culverin of the English list. Here the pairing is virtually certain, because this is the only iron gun among the higher calibres in both lists. A Spanish tercio cañón was, presumably, distinguishable from a media culebrina by its cañón proportions of 25 calibres or less: a length which evidently appeared, to a contemporary Englishman, perfectly appropriate for a demi-culverin. The implication once again is that the English culverin family, by the 1580s if not before, had lost it length attribute. William Bourne's remarks, published in 1587 and already touched upon, deserve to be quoted again:

> "...and furthermore, upon good consideration, for divers causes, and especially for the Queen's navy, they have decided to make their ordnance shorter than the accustomed manner, and so by that means they are lighter than the pieces before time made, and yet as servicable as the longer in some points, shooting that weight in powder and in shot that the heavier doth, in all points as the other; for that metal is taken from the length of the piece hurteth not the fortifying of the piece."(2)

Most of the other "translations" demonstrated by the lists are straightforward enough. Cañones pedreros and cannons pedro are one and the same, while the breech-loading falcones pedreros match the English great bases, with their chambers and halls. Falconetes were bases or fowlers and one suspects, on both sides, considerable diversities of form among these smaller pieces. One obvious omission in the English sources is that of the Rosario's fifteen esmeriles de cameras dobles, whose usefulness and portability doubtless ensured their disappearance long before the English inventorists arrived at Dartmouth.

The anomaly presented by the six sacres which are included in the Spanish list of the Rosario's armament but which are not identifiable in the English inventory, and the six cannons pedro which are listed in the latter but not in the former, is easily resolved. In March 1588, Pedro de Valdes asked that some of his squadron's guns might be exchanged for heavier pieces, and the king approved his request. The replacements Don Pedro had his eye on were guns "which had been cast in that city" - that is, at Lisbon.(3) Much of Acuña Vela's last-minute output of artillery consisted of cañones pedrero, and it is this type of gun that the Rosario apparently now received. We do not know the weight of shot thrown by these guns, but to judge from their weight marks as recorded in the English inventory, which range from 2566 to 3020, the pieces will have been 15- to 20-_lbrs_, giving the _Rosario_ a formidable if extremely short-range total firepower in excess of 100 _libras_ (stone) in exchange for the 38 _libras_ of rather longer-range iron firepower provided by the six sacres. We must suppose that Don Pedro saw in the exchange a gain in the fighting efficiency of his ship, which indicates that he, like most of his compatriots, subscribed to the "close and board" school of tactical thought.

Appendix 4

The Order of Battle of the Spanish Armada

As far as can be ascertained, no manuscript copy of the fleet muster held on 9 May 1588 has survived. A version of it was however published at Lisbon within a matter of days, and numerous editions subsequently appeared throughout Europe. The edition I have consulted is the one published by Pedro de Paz Salas at Lisbon in 1588, of which there is a copy in the British Library (192 f. 17. (1)), annotated in the hands of Lord Burghley and others.

The following tables are based on the Paz Salas edition, and on the summary *relación* issued by the duke of Medina Sidonia on 14 May 1588 (see p. 54 above). I have also incorporated information contained in the two undated lists (see p. 109 above), which record ships lost in the campaign, and those which returned to Spain. These lists are not entirely consistent or correct. When a ship appears on both, it is reasonable to assume that she returned safely. Some of the ships listed as missing, moreover, may simply have made for other ports; some of the hulks, and many of the smaller craft, almost certainly did so, while the galleass *Zuniga* reached Le Havre, where she remained disabled for almost a year.

Most of the ships which carried 60 *quintales* or more of gunpowder were, I suggest, front-line "troubleshooters".

	Ship	Tons	Sold-iers	Sea-men	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
	SQUADRON OF PORTUGAL, commanded by the duke of Medina Sidonia										
1	Galeón San Martín (capitana general)	1000	300	177	48	2400	140	23	18	at Santander	
2	Galeón San Juan (almiranta general)	1050	321	179	50	2500	136	23	18	at Corunna	
3	Galeón San Marcos	790	292	117	33	1650	85	18	15		X
4	Galeón San Felipe	800	415	117	40	2000	85	18	15		X
5	Galeón San Luís	830	376	116	38	1900	69	18	15	at Santander	
6	Galeón San Mateo	750	277	120	34	1700	82	18	15		X
7	Galeón Santiago	520	300	93	24	1200	46	18	15	at Santander	
8	Galeón Florencia	961	400	86	52	2600	75	18	15	at Santander	

	Ship	Tons	Soldiers	Seamen	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
9	Galeón San Cristóbal	352	300	78	20	1000	22	12	9	at Santander	
10	Galeón San Bernardo	352	250	81	21	1050	30	12	9	at Corunna	
11	Zabra Augusta	166	55	57	13	650	9	4	3	at Santander	
12	Zabra Julia	166	44	72	14	700	10	4	3	at Santander	
	SQUADRON OF BISCAY, commanded by Juan Martínez de Recalde										
13	Nao Santa Ana (capitana)	768	323	114	30	1500	71	22	10		
14	El Gran Grin (almiranta)	1160	256	73	28	1400	72	22	18		X
15	Santiago	666	214	102	25	1250	47	13	8	at Guipuzcoa	
16	La Concepción de Zubelzu	468	90	70	16	800	45	15	8	at Guipuzcoa	X

	Ship	Tons	Sold-iers	Sea-men	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
17	La Concepción de Juanes del Cano	418	164	61	18	900	30	11	6	at Guipuzcoa	X
18	La Magdalena	530	193	67	18	900	38	11	6	at Guipuzcoa	
19	San Juan	350	114	80	21	1050	36	7	4	at Santander	
20	La María Juan	665	172	100	24	1200	61	14	8		X
21	La Manuela	520	125	54	12	600	30	10	9	at Santander	
22	Santa María de Monte-Mayor	707	206	45	18	900	38	15	12	at Santander	
23	Patax La María de Aguirre	70	20	23	6	300	2				X
24	Patax La Isabela	71	20	24	10	500	3				
25	Patax de Miguel Suso	96	20	26	6	300	2				X
26	Patax San Esteban	78	20	26	6	300	2				

	Ship	Tons	Soldiers	Seamen	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
	SQUADRON OF CASTILE, commanded by Diego Flores de Valdes										
27	Galeón San Cristóbal (capitana)	700	205	120	36	2160	88	28	25	at Santander	
28	Galeón San Juan Bautista (almiranta)	750	207	136	24	1440	53	27	23	at Santander	
29	Galeón San Pedro	530	141	131	24	1440	48	19	25	at Santander	
30	Galeón San Juan	530	163	113	24	1440	49	19	20		X
31	Galeón Santiago el Mayor	530	210	132	24	1440	47	19	19	at Santander	
32	Galeón San Felipe y Santiago	530	151	116	24	1440	47	18	19	at Santander	
33	Galeón La Asunción	530	199	114	24	1440	49	19	19	at Santander	
34	Galeón Nuestra Señora del Barrio	530	155	108	24	1440	49	19	22	at Santander	

	Ship	Tons	Soldiers	Seamen	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
35	Galeón San Medel y Celedón	530	160	101	24	1440	48	20	19	at Santander	
36	Galeón Santa Ana	250	91	80	24	1440	27	11	12	at Santander	
37	Nao Nuestra Señora de Begoña	750	174	123	24	1440	52	22	25	at Corunna	
38	Nao La Trinidad	872	180	122	24	1440	48	20	27		X
39	Nao Santa Catalina	882	190	159	24	1440	49	23	24	at Santander	
40	Nao San Juan Bautista	652	192	93	24	1440	47	20	24		X
41	Patax Nuestra Señora del Socorro	75	20	25	24	1440	3	3	3		X
42	Patax San António de Padua	75	20	46	12	720	3	3	3		X

	Ship	Tons	Soldiers	Seamen	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
	SQUADRON OF ANDALUSIA, commanded by Pedro de Valdes										
43	Nao Nuestra Señora del Rosario (capitana)	1150	304	118	46	2300	114	21	10		X
44	San Francisco (almiranta)	915	222	56	21	1050	43	15	12	at Santander	
45	Galeón San Juan	810	245	89	31	1550	50	16	13	at Santander	
46	San Juan de Gargarín	569	165	56	16	800	21	9	8	at Santander	
47	La Concepción	862	185	71	20	1000	83	15	12	at Santander	
48	Urca Duquesa Santa Ana	900	280	77	23	1150	30	19	15		X
49	Santa Catalina	730	231	77	23	1150	41	15	12	at Santander	
50	La Trinidad	650	192	74	13	650	20	15	12	at Santander	

	Ship	Tons	Sold-iers	Sea-men	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
51	Santa María del Juncal	730	228	80	20	1000	31	17	14	at Santander	
52	San Bartolomé	976	240	72	27	1350	32	15	12	at Corunna	
53	Patax el Espíritu Santo	70	31	33							X
	SQUADRON OF GUIPÚZCOA, commanded by Miguel de Oquendo										
54	Nao Santa Ana (capitana)	1200	303	82	47	2350	106	25	18		X
55	Santa María de la Rosa (almiranta)	945	225	64	26	1300	80	20	16		X
56	San Salvador	958	321	75	25	1250	130	20	16		X
57	San Esteban	936	196	68	26	1300	43	18	14		X
58	Santa Marta	548	173	63	20	1000	43	11	9	at Guipuzcoa	
59	Santa Bárbara	525	154	45	12	600	22	10	8	at Guipuzcoa	

	Ship	Tons	Soldiers	Seamen	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
60	San Buenaventura	379	168	53	21	1050	20	10	8	at Guipuzcoa	
61	La María San Juan	291	110	30	12	600	14	8	6	at Lisbon	
62	Santa Cruz	680	138	36	18	900	30	8	6	at Santander	
63	Urca Doncella	500	156	32	16	800	28	9	8		X
64	Patax La Asunción	60	20	16	9	450	2				X
65	Patax San Bernabé	69	20	23	9	450					
66	Pinaza Nuestra Señora de Guadalupe			15	1	50					X
67	Pinaza Magdalena			14	1	50					X

	Ship	Tons	Sold-iers	Sea-men	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
	SQUADRON OF LEVANT, commanded by Martín de Bertendona										
68	La Regazona (capitana)	1249	344	80	30	1500	35	22	18	at Corunna	
69	La Lavia (almiranta)	728	203	71	25	1250	39	15	12		X
70	La Rata Coronada	820	335	84	35	1750	80	19	15		X
71	San Juan de Sicilia	800	279	63	26	1300	69	19	18		X
72	La Trinidad Valencera	1100	281	79	42	2100	125	19	16		X
73	La Anunciada	703	196	79	24	1200	46	15	11		X
74	San Nicolas Prodaneli	834	274	81	26	1300	40	17	13		X
75	La Juliana	860	325	70	32	1600	67	12	12		X

	Ship	Tons	Soldiers	Seamen	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
76	Santa María de Visón	666	236	71	18	900	32	12	10		X
77	La Trinidad de Scala	900	307	79	22	1100	41	23	18	at Santander	
	SQUADRON OF HULKS, commanded by Juan Gómez de Medina										
78	El Gran Grifón (capitana)	650	243	43	38	1900	48	19	15		X
79	San Salvador (almiranta)	650	218	43	24	1200	40	11	9	at Santander	
80	Perro Marino	200	70	24	7	350	7	3	2	at Santander	X
81	Falcón Blanco Mayor	500	161	36	16	800	24	8	6		X
82	Castillo Negro	750	239	34	27	1350	23	8	6		X
83	Barca de Amburg	600	239	25	23	1150	31	8	6		X
84	Casa de Paz Grande	650	198	27	26	1300	26	8	6		

	Ship	Tons	Sold-iers	Sea-men	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
85	San Pedro Mayor	581	213	28	29	1450	21	5	4		X
86	El Sansón	500	200	31	18	900	24	9	6	at Corunna	
87	San Pedro Menor	500	157	23	18	900	34	8	6		X
88	Barca de Anzique	450	200	25	26	1300	29	7	6		
89	Falcón Blanco Mediano	300	76	27	16	800	19	4	4		X
90	Santo Andrés	400	150	28	14	700	20	6	6	at Santander	
91	Casa de Paz Chica	350	162	24	15	750	12	5	3	at Santander	
92	Ciervo Volante	400	200	22	18	900	19	6	5		X
93	Paloma Blanca	250	56	20	12	600	11	3	3	at Corunna	
94	La Ventura	160	58	14	4	200	8	3	3	at Santander	X

	Ship	Tons	Sold-iers	Sea-men	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
95	Santa Bárbara	370	70	22	10	500	12	6	5		X
96	Santiago	600	56	30	19	950	24	3	3		X
97	David	450	50	24	7	350	8	3	3		X
98	El Gato	400	40	22	9	450	8	3	3	at Santander	
99	Esayas	280	30	16	4	200	5	3	3	at Santander	
100	San Gabriel	280	35	20	4	200	5	3	3		
	SQUADRON OF PATACHES AND ZABRAS, commanded by Antonio Hurtado de Mendoza										
101	Nuestra Señora del Pilar de Zaragoza (capitana)	300	109	51	11	550	18	11	5		X
102	La Caridad (inglesa)	180	70	36	12	600	20	3	3		X
103	San Andrés (escocés)	150	40	29	12	600	14	3	3		

	Ship	Tons	Sold-iers	Sea-men	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
104	El Crucifijo	150	40	29	8	400	5	3	2		X
105	Nuestra Señora del Puerto	55	30	33	8	400					
106	La Concepción de Carasa	70	30	42	5	250	2				X
107	Nuestra Señora de Begoña	64	20	26			1				X
108	La Concepción de Capetillo	60	20	31	10	500	2				
109	San Jerónimo	55	20	37	4	200	1				X
110	Nuestra Señora de Gracia	57	20	34	5	250	1			at Santander	
111	La Concepción de Francisco de Latero	75	20	29	6	300	2				X
112	Nuestra Señora de Guadalupe	70	20	42						at Santander	
113	San Francisco	70	20	37							X

	Ship	Tons	Sold-iers	Sea-men	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
114	Espíritu Santo	75	20	27						at Santander	
115	Zabra Trinidad			23	2	100					
116	Nuestra Señora de Castro			26	2	100					X
117	Santo Andrés			15	2	100					
118	La Concepción de Valmaseda			27	2	100					X
119	La Concepción de Somanila			31							X
120	Santa Catalina			23							X
121	San Juan de Carasa			23							X
122	Asunción			23	2	100					X

	Ship	Rowers	Soldiers	Seamen	Guns	Shot	Powder (qtx)	Lead (qtx)	Match (qtx)	'Safe' list	'Missing' list
	GALLEASSES OF NAPLES, commanded by Hugo de Moncada										
123	San Lorenzo (capitana)	300	262	124	50	2500	132	16	22		X
124	Patrona (or Zúñiga)	300	178	112	50	2500	118	16	22		X
125	Girona	300	169	120	50	2500	130	15	22		X
126	Napolitana	300	264	112	50	2500	118	14	22	at Santander	
	GALLEYS OF PORTUGAL, commanded by Diego Medrano										
127	Capitana	303	106	106	5	300	15	5	5		
128	Princesa	200	90	90	5	300	15	5	5		
129	Diana	192	94	94	5	300	15	5	5		X
130	Bazana	193	72	72	5	300	15	5	5		

M E N

General Staff

The duke of Medina Sidonia, <u>capitán general</u>

23 members of his personal staff, with 50 retainers

Alonso Martínez de Leyva, <u>capitán general</u> of Milanese cavalry

Juan Martínez de Recalde, <u>general</u> of the Biscayan squadron and <u>almirante</u> of the Armada

Diego Flores de Valdes, <u>general</u> of the Castilian squadron (and Medina Sidonia's semi-official Chief of Staff)

Pedro de Valdes, <u>general</u> of the Andalusian squadron

Miguel de Oquendo, <u>general</u> of the Guipuzcoan squadron

Martín de Bertendona, <u>general</u> of the Levant squadron

Hugo de Moncada, commanding the four Neapolitan galleasses

Diego de Medrano, commanding the four Portugese galleys

Juan Gómez de Medina, commanding the hulks

Antonio Hurtado de Mendoza, commanding the <u>pataches</u> and <u>zabras</u>

Jorge Manrique, <u>veedor general</u> (inspector-general), with 50 members of his staff

Bernabé de Pedroso, <u>proveedor</u> (purveyor)

Martín de Aranda, <u>auditor general</u> (judge-general), with 19 members of his staff

Tomás del Monte, <u>alguacil real</u> (royal constable)

Alonso de Alameda, <u>contador</u> (accountant)

Pedro Coco Calderón, <u>contador</u>

Juan de Huerta, <u>pagador</u> (paymaster)

Felipe de Porras, <u>veedor</u> of the galleasses

Bernabé de Aliva, <u>contador</u> of Guipúzcoa

Pedro de Igueldo, _contador_ of Biscay

Juan de los Rios, _comisario de muestras_ (commissary for muster-rolls)

Ochoa de Anuncibay, _comisario_

Pedro de Arbisua, _comisario_

Agustín de la Guerra, _comisario_

Diego Infante del Aguila, _comisario_

Juan Martínez de Guilistequi, _comisario_

Melchor Pérez, _veedor_ of the Sicilian _tercio_

Andrés Roseto, _escribano de raciones_ (ration clerk)

Francisco López de Espino, _tenedor de bastimentos_ (supply officer)

Fray Diego Calohorrano, _capellán general_ (chaplain-general)

Gentlemen-adventurers

122 _aventureros_ (gentlemen-adventurers), all named in the original

460 _criados_ (retainers)

Unattached officers

214 _entretenidos_ (unattached officers)

146 _criados_

Artillery personnel

Alonso de Céspedes, _teniente de capitán general_ (lieutenant to the captain-general, i.e. to Juan de Acuña Vela, who did not sail with the fleet)

Capellán mayor (vicar-general)

Gentile hombre (gentleman)

2 _ingenieros_ (engineers)

Mayordomo de artillería con su ayudante (superintendant of artillery with his aide-de-camp)

Médico (doctor)

Cirujano (surgeon)

Boticario (apothecary)

Alguacil (provost)

Maestro mayor de carpentería (master carpenter)

Maestro mayor de herrería (master blacksmith)

9 herreros y carpinteros (blacksmiths and carpenters)

95 artilleros (artillerymen)

23 comisario de mulas y sus mozos (commissar of mules and his stable lads)

8 criados de los oficiales

Hospital service

Martín de Alarcón, administrador general

Teniente (his lieutenant)

5 médicos

Cirujano mayor

4 cirujanos

5 ayudantes (assistants)

4 curas (priests)

Veedor (inspector)

Mayordomo (steward)

62 oficiales y mozos de servicio (officials and servants)

Chaplaincy

180 religiosos of various orders (listed by numbers of each order in the original)

<u>Infantry</u>

(names of company captains, and their company strengths, are given in the original)

Francisco de Bobadilla, <u>maestre de campo general</u>

<u>Tercio</u> of Sicily, <u>maestre de campo</u> Diego Pimentel

26 companies totalling	2493

<u>Tercio</u> of <u>maestre de campo</u> Francisco de Toledo

26 companies totalling	2694

<u>Tercio</u> of Naples, <u>maestre de campo</u> Alonso de Luzón

26 companies totalling	2889

<u>Tercio</u> of Nicolás de Isla

26 companies totalling	2439

<u>Tercio</u> of Agustín Mexía

26 companies totalling	2670

<u>Compañías sueltas</u> (irregular companies)

32 companies totalling	3589
Portugese troops under Gaspar de Sosa and António Pereira	2000

E Q U I P M E N T

Field artillery

12 _cañones de batir_ with field carriages

21 other field pieces

40 mules

Artillery carts

Tackles, shear-legs, and beams

Hand Weapons

7000 arquebuses

1000 muskets

10,000 pikes

1000 partisans and halberds

6000 half-pikes

Munitions
(for fleet and army combined)

123,790 pieces of roundshot, of all calibres

5175 _quintales_ of powder, all of fine-grained arquebus grade

1238 _quintales_ of lead for small shot

1151 _quintales_ of match

Pioneers' tools
(for 700 men)

Spades

Mattocks

Picks

Wooden shovels

Earth baskets

Knapsacks

General equipment

Plates, cups, and bowls of wood and earthenware

Buckets of all kinds

Lanterns of various sizes

Sheet lead

Cowhides

Calfskin bags for gunpowder

Tapers and candles for the lanterns

Bags and knapsacks

Scales

Wooden barrel hoops

8000 leather bottles for wine and water

5000 pairs of zapatos (shoes)

11,000 pairs of alpargatas (rope-soled shoes)

Rigging tackle, sailcloth, oakum and iron

Banners of Christ, Our Lady, and the Royal Arms

P R O V I S I O N S

(estimated to supply the Armada for six months)

110,000 quintales of biscuit

11,117 pipas of wine

6000 quintales of bacon

3000 quintales of cheese

6000 quintales of fish of various kinds

4000 quintales of rice

6000 fanegas of beans and chick-peas

10,000 arrobas of oil

21,000 arrobas of vinegar

11,000 pipas of water

I.A.A. Thompson's estimate of the Armada's total gun-strength, which he published in his Spanish Armada guns, appears below, with comparative information for the English fleet derived from Michael Lewis's Armada guns. Because of the various anomalies which existed between Spanish and English gun-type nomenclature, as discussed in Appendix 3, these lists should not be treated as strictly synonymous.

	Armada	English fleet
Cañones (28-50 lbr)	31	1
Medios cañones (15-27 lbr)	81	54
Cañoncetes (9-14 lbr)	24	
Pedreros (4-12 lbr)	231	43
Culebrinas (16-21 lbr)	21	153
Medias culebrinas (7½-14 lbr)	151	344
Sacres (5-8 lbr)	244	662
Medias sacres (3-4 lbr)	70	715
Larger iron guns	264	
Miscellaneous small pieces	1297	
	2394	1972

NOTES

Introduction

1. Hawkins to Walsingham, 31 July 1588 (OS), John Knox Laughton (Ed.), State Papers relating to the defeat of the Spanish Armada (2 vols., London, 1894-5), vol. 1, 361.

2. Howard to Walsingham, 8 August 1588 (OS), ibid., vol. 2, 59.

3. Drake to Walsingham, 10 August 1588 (OS), ibid., vol. 2, 97.

4. Howard to Walsingham, 7 August 1588 (OS), ibid., vol. 2. 54.

5. Cesáreo Fernández Duro, La Armada Invencible, (2 vols., Madrid, 1884-5).

6. E. Herrera Oria, La Armada Invencible (Valladolid, 1929).

7. Martin A.S. Hume, Calendar of Letters and State Papers relating to English affairs, preserved in, or originally belonging to, the Archives of Simancas, Vol. IV, Elizabeth, 1587-1603 (London, 1899).

8. Laughton, op. cit., vols. 1 and 2.

9. Horatio F. Brown, Calendar of State Papers and Manuscripts relating to English affairs, existing in the archives and collections of Venice and in other Libraries of Northern Italy, Vol. VIII, 1581-1591 (London, 1894).

10. Alfred Thayer Mahan, The influence of Seapower upon History (Boston, 1890).

11. The best-known modern accounts of the Armada are: J.A. Froude, The Spanish story of the Armada (London, 1882); Winston Graham, The Spanish Armadas (London, 1972); J.R. Hale, The Great Armada (London, 1913); David Howarth, The Voyage of the Armada (London, 1981); Michael Lewis, The Spanish Armada (London, 1960); Alexander McKee, From Merciless Invaders (London, 1963); Bryce Walker, The Armada (Time-Life Books, Alexandria, Va., 1981); D.W. Waters, "The Elizabethan Navy and the Armada Campaign", The Mariner's Mirror 35 (1949). Useful accounts of the campaign and its background may also be found in K.R. Andrews, Drake's Voyages (London, 1967) and J.E. Corbett, Drake and the Tudor Navy (2 vols., London, 1898).

12. Garrett Mattingly, The Defeat of the Spanish Armada (London, 1959).

Chapter One

1. For a contemporary view of the organisation and operational techniques of the Spanish army in Flanders, by someone who has served in it, see Roger Williams, A Brief discourse of Warre (London, 1590), and the same author, The Actions of the Lowe Countries (London, 1618). Both volumes have been reprinted, with commentaries, by John X. Evans, The works of Sir Roger Williams (Oxford, 1972). Geoffrey Parker, The Army of Flanders and the Spanish Road (Cambridge 1972) gives a detailed description of Spanish army life and analyses its organisation and logistics.

2. R.C. Anderson, Oared Fighting Ships (London, 1962).

3. John Francis Guilmartin, Jr., Gunpowder and Galleys: changing technology and Mediterranean warfare at sea in the sixteenth century (Cambridge, 1974), pp. 194-220.

4. Maurice Aymard, "Chiourmes et galères dans la Méditerranée du XVIe siècle", in Edouard Privat (ed.), Mélanges en l'honneur de Fernand Braudel: Histoire économique du monde méditerranéen, 1450-1650 (Paris, 1973), Vol. 2, pp. 49-64.

5. Guilmartin, op. cit., pp. 95-122.

6. Parker, Army of Flanders, pp. 4-5.

7. The campaigns against Portugal are described in the anomymous Historie of the Uniting of the Kingdom of Portugall to the Crowne of Castill (London, 1600) which is a translation of an earlier Italian version, published at Genoa in 1585. The Lisbon operation is covered on pp. 211-218. See E.M. Tenison, Elizabethan England (10 vols., Lemington Spa, 1933-58), vol. 4, pp. 3-22.

8. My account of the battle of São Miguel is based on the published documents and comments in Tenison, op. cit., vol. 4, pp. 165-215.

9. The aftermath of the battle is vigorously depicted in one of the scenes in the Escorial's Hall of Battles, painted by Nicholas Granello in 1590. It is reproduced in Tenison, op. cit., vol. 4, p. 166. A better reproduction, in colour, appears in Walker, The Armada, pp. 22-3. The scene shows Strozzi's flagship being towed from the action by Santa Cruz's San Martín. On board a longboat astern of the Spanish flagship a number of French prisoners are depicted with their hands tied behind their backs, apparently about to be cast overboard.

10. Cesáreo Fernández Duro, La Conquista de las Azores en 1583 (Madrid, 1886), número 64, pp. 402-7.

11. Tenison, op. cit., vol. 4, pp. 295-306.

12. Colección Navarrete, Museo Naval, Madrid, vol. V, doc. 1, fol. 3, cited and translated by Guilmartin, op. cit., pp. 216-217.

13. Tenison, op. cit., vol. 4, p. 291, quoting from A Treatise Paraenetical... by a Pilgrim Spaniard (London, 1598).

14. Santa Cruz to Philip II, written from Terceira on 9 August 1583. Duro, Armada Invencible, vol. 1, pp. 241-243.

15. Santa Cruz's commission is translated and published by Tenison, op. cit., vol. 5, pp. 199-203, from an original manuscript then in possession of the duke of Berwick and Alba.

16. "...fleets at sea... are subject to as great uncertainties as the waves that bear them." Charles V to his son, January 1548, quoted by Tenison, op. cit., vol. 7, p. 11.

17. Santa Cruz to Juan de Idiáquez, 22 March 1586, enclosing estimates for the Enterprise of England to be presented to the king. The letter, and the full list of estimates, is published in Duro, Armada Invencible, vol. 1, pp. 248-319.

18. Duro, Armada Invencible, vol. 2, pp. 258-259. The barcas chatas were to be built at Seville.

19. The idea had been mooted by Martin de Bertendona, writing to Philip II, on 5 August 1586 (AGS GA 187, f. 157). Rather than carry out a naval attack against England, he believed that the precedent of the relief of Malta should be followed; with 50 galleys, the Army of Flanders could be ferried without difficulty from Dunkirk to Dover.

20. The first mention of this change of plan is contained in a letter from Parma to Philip II dated 30 October 1586 (AGS Estado 592/135), in answer to an instruction sent by the king on 26 July. From the outset, Parma strongly disapproved of the alternative scheme.

21. Philip II to Parma, 4 September 1587, State Papers (Spanish), pp. 135-137.

22. Geoffrey Parker, Philip II (London, 1979), pp. 210-211, has suggested that the king may have suffered from the psychological phenomenon of 'cognitive dissonance', in which a person ignores fresh knowledge or advice if it conflicts with a decision he has already taken. While it is dangerous for historians to speculate too heavily on psychological or medical matters concerning their subjects, Philip's behaviour over the Armada certainly shows all the classic symptoms of this disorder. See Norman Dixon, On the

psychology of military incompetence (London, 1976), p. 164, "Those commanders with weak egos, with over-strong needs for approval and the most closed minds will be the very ones least able to tolerate the nagging doubts of cognitive dissonance. In other words it will be the least rational who are the most likely to reduce dissonance by ignoring unpalatable facts."

23. AGS Estado 590/22, Parma to the king, 28 February 1586, cited by Geoffrey Parker, The Dutch Revolt (London, 1977), p. 222.

24. "Every day one hears of fresh preparations for war in various parts of Spain." Hieronimo Lippomano to the Venetian Doge and Senate, 8 January 1587, State Papers (Venetian), p. 233.

25. Ibid.

26. Ibid., 18 October 1586, p. 214.

27. Ibid., 8 January 1587, p. 233.

28. Ibid., 18 October 1586, p. 214.

29. Ibid., 10 February 1587, p. 242.

30. Ibid., 10 February 1587, p. 242; 27 June 1587, p. 289.

31. Ibid., 10 February 1587, p. 243.

32. Giovanni Gritti to the Doge and Senate, 31 January 1587, ibid., p. 240.

33. Ibid., 11 January 1587, p. 236; Hieronimo Lippomano to the Doge and Senate.

34. The manuscript map of Cadiz and its approaches drawn by Drake's second-in-command during the raid, William Borough, clearly shows the Spanish dispositions and the tactics of the English fleet (PRO S.P. 12/202/20). A good reproduction is published in Walker, The Armada, p. 57.

35. Drake to Walsingham, 27 April 1587 (OS), J.S. Corbett, The Spanish war, 1585-1587 (London, 1898), pp. 107-108. See also Hieronimo Lippomano to the Doge and Senate, 9 May 1587, State Papers (Venetian), pp. 274-275.

36. Duro, Armada Invencible, vol. 1, pp. 334-335.

37. Thomas Fenner to Walsingham, 17 May 1587 (OS), Corbett, op. cit., 134-140. See also Hieronimo Lippomano to the Doge and Senate, enclosing a report from Lisbon dated 21 May 1587, in State Papers (Venetian), pp. 282-283.

38. Drake to Walsingham, 17 May 1587 (OS), Corbett, op. cit., pp. 131-134.

39. Lippomano to the Doge and Senate, 5 July and 16 July 1587, State Papers (Venetian), pp. 292 and 295-296.

40. Ibid., 5 November 1587, p. 319.

41. Ibid., 27 November 1586, p. 224.

42. Ibid., 31 October 1587, p. 318.

43. Garrett Mattingly, The defeat of the Spanish Armada, chapter 18, pp. 193-213.

44. This possibility is frequently mentioned in Lippomano's reports to the Doge and Senate. In June 1586, for example, the ambassador wrote that he believed "all these preparations... are intended rather to facilitate the conclusion of an accord than with a view to a genuine attack on England." (State Papers (Venetian), p. 173). And again, on 18 March 1587 (ibid., p. 259), he writes: "The greater their hopes of peace with England the more active their preparations for the Armada with a view to driving the queen to come to some determination." For a modern discussion on this aspect of the Armada's strategy see I.A.A. Thompson, "The appointment of the duke of Medina Sidonia to the command of the Spanish Armada", Historical Journal, 12, 2 (1969), pp. 197-216.

45. Philip II to Bernardino de Mendoza, 28 July 1587, State Papers (Spanish), p. 125.

46. Lippomano to the Doge and Senate, 18 August 1587, State Papers (Venetian), p. 305.

47. Ibid., 4 September 1587, pp. 310-311.

48. Ibid., 7 October 1587, pp. 313-314.

49. Ibid., 12 October 1587, p. 315.

50. Ibid., 18 October 1587, pp. 315-316.

51. Ibid., 27 October 1587, pp. 316-317.

52. Ibid., 5 November 1587, pp. 318-319.

53. Ibid., 4 November 1587, pp. 320-323: copy of a letter from Santa Cruz to the king.

54. Parma to Philip II, 31 January 1588, ibid., pp. 199-201.

55. Philip II to Parma, 4 September 1587, ibid., pp. 135-137.

56. Ibid.

57. Parma to Philip II, 22 February 1588, ibid., p. 211.

58. Count of Fuentes to Philip II, 4 February 1588, AGS

Estado 431/70. Fuentes arrived at Lisbon on 30 January, and Santa Cruz died on 9 February.

59. Thompson, *op. cit*.

60. *State Papers (Spanish)*, pp. 207-209.

61. Mattingly, *op. cit*., chapters 17 and 20.

62. Medina Sidonia to Philip II, 14 May 1588, *State Papers (Spanish)*, pp. 295-296.

63. Pedro de Paz Salas, *La Felicissima Armada* (Lisbon, 1588).

64. Duro, *op. cit*., vol. 2, pp. 82-84.

Chapter Two

1. Medina Sidonia to Philip II, 14 May 1588 and 29 May 1588, Duro, Armada Invencible, pp. 99-101; ibid., pp. 101-105.

2. Ibid., 30 May and 1 June 1588, pp. 105-106; pp. 106-107.

3. Ibid., 14 June 1588, pp. 117-119.

4. Ibid., 13 June, pp. 115-117.

5. Ibid., 21 June, pp. 121-124.

6. Unsigned letter dated Corunna, 24 June 1588, enclosed with his report to the Doge and Senate by ambassador Lippomano, 2 July 1588, State Papers (Venetian), pp. 363-365.

7. The fleet muster at Corunna on 13 July shows that by that day the fleet was substantially intact, and had been strengthened by the addition of 9 water-carrying carabelas and 6 falucas. Duro, Armada Invencible, vol. 2, pp. 194-200. By 19 July the only ships still missing were the hulks Casa de Paz Grande [84] and the David [97], ibid., pp. 203-205.

8. Medina Sidonia to Philip II, 24 June 1588, ibid., vol. 2, pp. 134-135.

9. Philip II to Medina Sidonia, 5 July 1588, ibid., vol. 2, pp. 150-154.

10. Medina Sidonia to Philip II, 30 July 1588, ibid., vol. 2, pp. 217-221.

11. Relación of Alonso Vanegas, ibid., vol. 2, pp. 370-399. Vanegas is quite specific that this Council took place, athough Medina Sidonia makes no mention of it in his own diario.

12. Medina Sidonia to Philip II, 30 July 1588, ibid., pp. 221-222.

13. Medina Sidonia's diario of the campaign, sent to Philip II by the hand of Don Baltasar de Zúñiga from Scalloway, 21 August 1588, ibid., pp. 228-247.

14. Mattingly, Defeat of the Spanish Armada, notes to chapter 22, pp. 356-357, cites three of them: one to Florence (Flor. Arch. Med. 4919, f. 340); one to the Vatican (Vat. Spagna, 38); and one to Mantua (Arch. di Stato, Esterini, 601). The Florentine version is reproduced in Walker, The Armada, p. 88, which I have shown in my Figure 1.

15. Lippomano, the Venetian ambassador at Madrid, reported to the Doge and Senate on 12 July 1588 that Philip II had "sent to the commander-in-chief (i.e. Medina Sidonia) the order and plan of an engagement with Drake, which I enclose." He was able to have it copied, he claims, "from the original which lay on his Majesty's table." State Papers (Venetian), pp. 367-368.

16. Filippo Pigafetta, Discorso sopra l'ordinanza del' armata catolica (Rome, 1588).

17. See Guilmartin, Gunpowder and Galleys, pp. 42-56.

18. Ibid., pp. 221-252.

19. Duro, Armada Invencible., vol. 2, p. 33. The ship described as the 'old' capitana of Oquendo must be the Santa María de la Rosa [55], a status which she lost to the Santa Ana [54] between 7 January and 19 March 1588, ibid., vol. 1, p. 405 and p. 441). The document must therefore fall between these dates.

20. Ibid., p. 255.

21. Medina Sidonia to Philip II, 28 May 1588, ibid., vol. 2, pp. 101-106.

22. In a curt note sent on 2 August 1588 by Medina Sidonia to Don Hugo de Moncada of the galleasses, after the latter's poor showing in the engagement off Portland Bill, the duke ends by instructing Don Hugo to keep three of the galleasses close together, "ready to proceed without further instructions [my italics] to any point where they may be needed", State Papers (Spanish), p. 359. For the fate of the erring captain, see page 108, note 2.

23. Ordenes generales a la Armada (undated), Duro, Armada Invencible, vol. 2, pp. 22-32.

24. See J.S. Corbett, Fighting Instructions, 1530-1816 (London, 1904), for a general discussion on the development of signalling and fleet tactics.

25. Ordenes generales, Duro, Armada Invencible, vol. 2, p. 26.

26. Corbett, Drake and the Tudor Navy, vol. 2, pp. 215-219.

27. William Camden, Annals, or the Historie of the most reknowned Princess Elizabeth (English translation from the latin by R. N[orton]., London, 1635), p. 366.

28. For convenience the main Spanish sources are listed below. They are not hereafter cited in my narrative of the fighting, except where points of particular interest arise.
Diario of the duke of Medina Sidonia, Duro, Armada Invencible, vol. 2, pp. 228-247.
Relación of Pedro Coco Calderón, State Papers (Spanish),

pp.439-450.
Relación of Alonso Vanegas, Duro, op. cit., vol. 2, pp. 370-379.
Relación of the master of one of the Sevillian ships, Duro, op. cit., vol. 2, pp. 273-278.
Relación of a survivor from El Gran Grifón, Duro, op. cit., pp. 279-293.
Relación from the galleass Zúñiga, State Papers (Spanish), pp. 459-462.

29. The document is in the British Library (Cotton MS., Julius, f. x, ff. 95-101), and is published in full by Laughton, Spanish Armada, vol. 1, pp. 1-18. For Howard's "brief abstract" of 7 August (OS) see Laughton, op. cit., vol. 2, pp. 53-54.

30. Royal MSS., 14.A.xi, (Howard) and ibid., x, (Drake). The latter version is published, with an introduction, by G.P.B. Naish, in The Elizabethan Navy and the Armada of Spain, National Maritime Museum Maritime Monographs and Reports, No. 17 (Greenwich, 1975), pp. 69-100.

31. Camden, Annals, p. 366.

32. General Orders issued by Sir Walter Raleigh at Plymouth, 1617, Corbett, Fighting Instructions, p. 42.

33. Hawkins to Walsingham, 31 July 1588 (OS), Laughton, Spanish Armada, vol. 1, 358.

34. Englished copy of a letter of Don Pedro de Valdes to Philip II, 21 August 1588 (OS), Laughton, op. cit., vol. 2, pp. 133-136.

35. Howard to Walsingham, 21 July 1588 (OS), Laughton, op. cit., vol. 1, pp. 288-289.

36. Henry Whyte to Walsingham, 8 August 1588 (OS), Laughton, op. cit., vol. 2, pp. 63-65.

37. The cause of the explosion remains a mystery. Medina Sidonia infers that it was brought about by an accidental fire in the powder magazine, while Ubaldini (Naish, op. cit., p. 89) suggests that it was an act of vengeance on the part of a Flemish gunner who had been cuckolded (presumably before the fleet sailed) by a Spanish officer. In any event the incident demonstrates the vulnerability of armed wooden sailing ships to fire, and helps to explain the horror with which the Spaniards regarded the fireship attack off Calais. After a valiant attempt to salvage and repair the burnt-out hull, Medina Sidonia abandoned her, with her guns, to the enemy. She was later brought to Weymouth.

38. Petition of the captain, master and lieutenant of the Margaret and John of London, c. 11 August 1588 (OS), Laughton, op. cit., vol. 2, pp. 104-108.

39. Deposition of Mathew Starke, 11 August 1588 (OS), ibid.,

vol. 2, pp. 101-104.

40. Sir John Gilberte and George Cary, Deputy Lieutenants of Devon, to Walsingham, 26 July 1588 (OS), _ibid_., vol. 1, pp. 326-327.

41. Medina Sidonia to Parma, 1 August 1588, _State Papers (Spanish)_, p. 358.

42. Medina Sidonia's _diario_, Duro, _Armada Invencible_, vol. 2, p. 232; _Zúñiga relación_, _State Papers (Spanish)_, p. 460.

43. See p. 108, note 2.

44. Camden, _Annals_, p. 367.

45. _Relación_ of Alonso Vanegas, Duro, _Armada Invencible_, vol. 2, p. 383.

46. _Relation of Proceedings_, Laughton, _Spanish Armada_, vol. 1. p. 12.

47. Hawkins to Walsingham, 31 July 1588 (OS), Laughton, _op. cit_., vol. 1, p. 359.

48. Howard to Walsingham, 29 July 1588 (OS), Laughton, _op. cit_., 340-341.

49. The action is described by Alonso Vanegas in his _relación_, Duro, _Armada Invencible_, vol. 2, pp. 384-385.

50. _Relation of Proceedings_, Laughton, _Spanish Armada_, vol. 1, p. 12.

51. Unsigned _relación_, Duro, _op. cit_., vol. 2, p. 275.

52. Corbett, _Drake and the Tudor Navy_, vol. 2, pp. 254-256. Corbett's account of the Channel battles is the most objective and convincing so far published.

53. _State Papers (Spanish)_, pp. 309-310 (letter of 10 June); p. 354 (letter of 25 July); p. 358 (letter of 1 August); p. 360 (letter of 4 August).

54. Medina Sidonia to Parma, 6 August 1588, _ibid_., pp. 362-363.

55. Medina Sidonia's _diario_, Duro, _Armada Invencible_., vol. 2, p. 239.

56. Parma to Philip II, 8 August 1588, _State Papers (Spanish)_, p. 366.

57. Wynter to Walsingham, 1 August 1588 (OS), Laughton, _Spanish Armada_, pp. 7-8.

58. Mattingly, _The Defeat of the Spanish Armada_, p. 276.

59. Medina Sidonia's _diario_, Duro, _Armada Invencible_, vol. 2, p. 240.

60. The action is described by Richard Tomson of the _Margaret and John_, who led the boarding party, in a letter to Walsingham, 30 July 1588 (OS), Laughton, _Spanish Armada_, vol. 1, pp. 344-350.

61. Wynter to Walsingham, 1 August 1588 (OS), _ibid_., vol. 2, p. 10.

62. Medina Sidonia's _diario_, Duro, _Armada Invencible_, pp. 244-245.

63. Wynter to Walsingham, 1 August 1588 (OS), Laughton, _Spanish Armada_, vol. 2, p. 11.

64. _Relación_ of Pedro Coco Calderón, _State Papers (Spanish)_, p. 445.

65. _Ibid_., p. 444.

66. _Relación_ by _padre_ Gerónimo de la Torre, Duro, _Armada Invencible_, vol. 2, p. 405.

67. _Relación_ of Pedro Coco Calderón, _State Papers (Spanish)_, p. 446.

68. _Relación_ of Alonso Vanegas, Duro, _Armada Invencible_, vol. 2, p. 392.

69. Emanuel van Meteren's account of the Spanish Armada, in Richard Hakluyt, _The Principal Navigations, Voiages, Traffiques and Discoveries of the English Nation_ (3 vols., London, 1598-1600): World Classics, selected and edited by Janet Hampden, XXXVIII, pp. 358-398.

70. The story is recounted by van Meteren, _ibid_., p. 387 and, in almost identical form, by Ubaldino (Naish, _op. cit_., p. 96).

71. Survey of Her Majesty's ships, 25 September 1588 (OS), Laughton, _Spanish Armada_, vol. 2, pp. 241-249; also A Survey of the Navy, 28 September 1588 (OS), _ibid_., pp. 250-254.

72. Philip II to Medina Sidonia, 1 April 1588, _State Papers (Spanish)_, p. 247.

73. Medina Sidonia's _diario_, Duro, _Armada Invencible_, vol. 2, p. 244.

Part Two: Introduction

1. Medina Sidonia's report to Philip II, 21 August 1588, State Papers (Spanish), p. 403.

2. Wilful desertion of the flagship was laid down as a capital offence in Medina Sidonia's General Orders to the fleet (State Papers (Spanish), p. 291). The point was reinforced after some ships broke station on 31 August (ibid., p. 397). Cristóbal de Ávila, who commanded the hulk Santa Bárbara [95] and was a close neighbour of Medina Sidonia's, was the only offending captain actually executed after Gravelines (anonymous relación of a survivor from El Gran Grifón, Duro, Armada Invencible, vol. 2, p. 286), although Francisco de Cuéllar, whose graphic account of the campaign and his subsequent shipwreck has survived, was sentenced along with Ávila but later pardoned (Carta de uno que fue en la Armada de Inglaterra, from Antwerp, 4 October 1589, ibid., vol. 2., pp. 337-370).

3. "On Friday the 12th at dawn the enemy's fleet was quite close to us, but as they saw we were well together, and that the rearguard had been reinforced, the enemy fell astern and sailed towards England until we lost sight of him" (Medina Sidonia to Philip II, 21 August 1588, State Papers (Spanish), p. 404). "...we... gave them chase... until we had cleared our own coast and part of Scotland of them" (Howard to Walsingham, 7 August 1588 (OS), Laughton, Spanish Armada, vol. 2, p. 54).

4. Undated sheet forwarded by Lord Deputy Fitzwilliam to Burghley on 1 October 1588 (OS). It was said to have been found and taken from one of the wrecked ships in Ireland. There is an error in the last leg of the course, which must surely be SE and not SSW (Hans Claude Hamilton, ed., Calendar of State Papers (Ireland) 1588, August - 1592, September, [London, 1885], pp. 49-50). Purser Calderón, in his relación, says that these orders were given out on 13 August State Papers (Spanish), p. 447).

5. This was the route followed by many of the Baltic hulks during the Armada preparations (Matheo Zane, Venetian ambassador in Germany, to the Doge and Senate, 17 June 1586, State Papers (Venetian), p. 172). In later years this route was almost invariably taken by outward-bound ships of the Dutch East India Company.

6. The San Martín reached Santander on 23 September in company with 21 other ships. 180 of her company had died on the voyage, and typhus was rampant among the survivors. See Medina Sidonia to Philip II, 23 September 1588, State Papers (Spanish), pp. 432-433.

7. Duro, Armada Invencible, vol. 2, pp. 328-330, Relación de los navios del Armada del Duque de Medina Sidonia que arribaron a los puertos de España; ibid., 181, pp. 330-332, Relación de los galeones, navios, patajes, galeazas, galeas

y otros navios que salieron de la Coruña, y los que de ellos han vuelto a España.

8. This is the figure suggested by Mattingly, *The Defeat of the Spanish Armada*, pp. 361-364.

9. The identities of these three ships, long a matter of controversy, are now firmly established by Geoffrey Parker's discovery of a declaration made by some survivors on 6 December 1594 (AGS CMC/2a/1200). Francisco de Cuéllar (see note 2 above) was on board one of them.

10. Lord Deputy Fitzwilliam to the Privy Council, 31 December 1588, *State papers (Ireland)*, pp. 92-98. See also Secretary Fenton's report to Burghley, 28 October 1588, *ibid*., p. 68.

11. The first, and in many respects the most authoritative, attempt to relate the documentary sources for the wreckings to Ireland's coastal topography was that of W. Spotswood Green, "The wrecks of the Spanish Armada on the coast of Ireland", *Geographical Journal*, 27 (1906), pp. 429-451. See also K. Danahar, "Armada losses on the Irish Coast", *The Irish Sword*, 2 (1956), pp. 320-331, and Niall Fallon, *The Armada in Ireland* (London, 1978). Don Alonso de Leyva's tragic story, and the wrecking of the *Girona*, is admirably covered by Robert Sténuit, *Treasures of the Armada* (Newton Abbot, 1972).

12. George Cary to the Council, 5 November 1588 (OS), Laughton, *Spanish Armada*, vol. 2, pp. 289-291.

13. The Adams chart which shows the Armada's course around the British Isles includes symbols for wrecks off the western Hebrides (in the vicinity of South Uist) and on the southern point of Islay. The fact that most of the other wrecks depicted are genuine suggests that Adams had access to authoritative sources not now available - which is hardly surprising, since the charts were commissioned by Lord Admiral Howard himself. It is noteworthy that the *Girona* and *San Juan de Sicilia* sites are not indicated. Since these were the last two wrecks to occur (on 28 October and 5 November respectively), it seems that Adams completed the originals of his charts well before the end of 1588. They were engraved and published in 1590.

14. Two are shown in the Adams chart off islands west of Bergen.

15. Cf. the fate of the *Castillo Negro*, note to chapter 5 below.

16. Since the early seventeenth century, if not earlier, this wreck has been claimed to be that of the Grand Duke of Tuscany's *Florencia* [8], which in fact got back safely to Spain. Her true identity was established by Andrew Lang, "The mystery of the Tobermory galleon revealed", *Blackwood's Magazine*, 191 (1912), pp. 422-436, and R.P. Hardie, *The*

Tobermory Argosy (Edinburgh, 1912). More recently Veselin Kostić, "The Tobermory galleon", *Blackwood's Magazine*, 326 (1979), pp. 152-162, has confirmed the identification from archival sources in Dubrovnik, and added much valuable information on the ship's background and the circumstances of her loss.

17. Sténuit, *op. cit*.

Chapter Three

1. AGS CS 2a/280/1460.

2. Fernand Braudel, The Mediterranean and the Mediterranean world in the age of Philip II (2 vols., London, 1972-3), vol. 1, pp. 570-606.

3. Lists of ships mustered at Andalucia, 18 July 1587, AGS GA 221/2.

4. Summary of the guns aboard the five ships from Sicily, 26 September 1587, AGS GA 221/39.

5. "...he laboured to procure his discharge, but could not... the marquis of Santa Cruz did command the said Horatio to grave his ship, who refused so to do because he would have been discharged of the voyage." Examination of Don Alonso de Luzón at Drogheda, 13 October 1588 (OS), PRO SP 63/137/15.

6. Inventory of arms and munitions loaded aboard Bertendona's squadron, 14 May 1588, AGS GA 221/156.

7. This was received from the San Juan (?de Sicilia) on 16 January 1588. It had no weight mark. AGS CMC 2a/1012/5.

8. Examination of Don Alonso de Luzón (see note 5 above).

9. Examination of Baltasar López del Arbol at Drogheda, 13 October 1588 (OS), PRO SP 63/137/16.

10. Depositions of two Dutch sailors, Jan Henricx, and Jacob Cornelius, who were in the Spanish Armada, 11 August 1588 (OS), Calendar of manuscripts of the Marquis of Salisbury, preserved at Hatfield House, Part III (Historical Manuscripts Commission, London, 1889), pp. 343-346.

11. Duro, Armada Invencible, vol. 2, pp. 34-39.

12. Ibid., pp. 66-70.

13. Ibid., pp. 138-140.

14. Ibid., pp. 194-200.

15. Duke of Medina Sidonia to Philip II, 21 August 1588, State Papers (Spanish), p. 397.

16. Unsigned relación written aboard the galleass Zúñiga [124] at Havre de Gràce, 4 October 1588, State Papers (Spanish), p. 460.

17. Ibid., p. 461.

18. William Asheby to Walsingham, 22 August 1588 (OS), William K. Boyd (Ed.), Calendar of State Papers (Scotland),

vol. IX, 1586-1588 (Glasgow, 1915), pp. 599-600.

19. State Papers (Venetian), (undated), pp. 394-396.

20. Unsigned relación of a survivor from El Gran Grifón, Duro, Armada Invencible, vol. 2, p. 287, Examination of Don Alonso de Luzon (see note 5 above), item 14.

21. The position is accurately located on Robert Adams' chart.

22. Examination of Don Alonso de Luzón (see note 5 above), item 3.

23. Examination of Baltasar López del Arbol (see note 9 above), item 3.

24. Statement of Juan de Nova and Francisco de Borja, 21 January 1589, State Papers (Spanish), pp. 506-510.

25. Richard and Henry Hoveden to the Lord Deputy, 12 September 1588 (OS), State Papers (Ireland), p. 35.

26. Unsigned relación of Gran Grifón survivor, Duro, Armada Invencible., vol. 2, p. 288.

27. Sir George Carew to the Lord Deputy, 22 June 1589 (OS), Carew MSS., 618, p. 25.

28. Commission from the Lord Deputy to Sir George Carew, 1 August 1589 (OS), ibid., p. 84.

29. Commission from the Lord Deputy to Captain Thornton of her Majesty's galleon The Popingay, 1 August 1589 (OS), ibid., p. 84.

30. Licence to James Stewart to export and sell brass ordnance recovered by him from the sea off Ireland, 14 July 1612 (OS), David Masson (Ed.), The Register of the Privy Council of Scotland, vol. IX (1610-1613), (Edinburgh, 1889), p. 409. See also James I to Sir Arthur Chichister, 18 March 1610, directing him to employ only James Stewart's services in raising the ordnance, C.W. Russell and John P. Prendergast (Eds.), Calendar of State Papers relating to Ireland (1611-1614), (London, 1877), p. 21.

31. H.P. Swan, Twixt Foyle and Swilly (Dublin, 1949), p. 166, citing Phillips's map of Inishowen of c. 1700.

32. The most notable was that by Robert Sténuit and his team in 1969.

33. The circumstances of the discovery are described in Colin Martin, Full Fathom Five: wrecks of the Spanish Armada (London, 1975), pp. 189-191.

34. The weight marks on the two recovered guns, 5260 and 5316, coincide with the marks recorded on two of the cañones

de batir described in AGS CS 2a/280. A third gun, listed with a weight of 5185, may well be the piece depicted in Juan de Acuña Vela's drawing of 25 July 1587 (see Figure 42).

35. For a general account of the archaeological methods used on this and the other wreck sites see Colin Martin, "Archaeology in an underwater environment", in Unesco technical handbooks for museums and monuments, 4, Protection of the underwater heritage (Paris, 1981), pp. 15-76.

36. For a preliminary report on the excavations see Colin J.M. Martin, "La Trinidad Valencera: an Armada invasion transport lost off Donegal. Interim site report, 1971-76", International Journal of Nautical Archaeology, 8.1 (1979), pp. 13-38.

Chapter Four

1. Petition of Martín de Villafranca to Philip II, 1 February 1588, AGS GA 237/88.

2. Information from Robert Grenier of Parks, Canada, who is directing the excavation.

3. Relación of guns on board the seven naves and four pataches of Oquendo's squadron, 31 October 1587, AGS GA 221/41.

4. Fleet muster at Lisbon, 7 January 1588, Duro, Armada Invencible, vol. 1, pp. 404-408.

5. Fleet muster at Lisbon, 19 March 1588, ibid., pp. 439-445.

6. Undated statement of artillery needed by Oquendo's squadron, remitted with a letter of Alonso de Bazán (Santa Cruz's brother) dated 5 March 1588, AGS GA 221/82.

7. Arms and munitions issued to Oquendo's squadron, 14 May 1588, AGS GA 221/153.

8. The San Estéban [57] required modifications to her main deck and prow castle; the San Salvador [57] needed her fore and aft gratings strengthened; while similar modifications had to be carried out on the Santa Bárbara [59], the María San Juan [61], and the Santa Cruz [62], Duro, Armada Invencible, vol. 1, pp. 441-442.

9. Fleet muster at Lisbon, 14 May 1588, ibid., vol. 2, pp. 60-84.

10. Medina Sidonia to Philip II, 24 June 1588, ibid., vol. 2, p. 132.

11. Medina Sidonia to Philip II, 11 July 1588, ibid., vol. 2, p. 175.

12. Fleet muster at Corunna, 13 July 1588, ibid., vol. 2, pp. 194-200.

13. Undated list of ships which have not returned to Spain, ibid., vol. 2, pp. 330-332.

14. Second examination of Giovanni de Manona, 15 September 1588 (OS), PRO SP 63/136/41v.

15. First interrogation of Giovanni de Manona, 11 September 1588, Certaine Advertisments out of Ireland (London, 1588).

16. Relación of Pedro Coco Calderón, State Papers (Spanish), p. 449.

17. Edward Whyte to Walsingham, 30 September 1588 (OS), PRO

SP 63/136/57.

18. See Martin, Full Fathom Five, pp. 23-56, for an account of the Spanish activities in Blasket Sound.

19. Undated relación of Marcos de Aramburu, Duro, Armada Invencible, vol. 2, pp. 315-326.

20. James Traunte to Sir Edward Denny, 11 September 1588 (OS), PRO SP 63/136/43x.

21. Second examination of Giovanni de Manona, 15 September 1588 (OS), PRO SP 63/136/41v.

22. The now-extinct Blasket Island community is sympathetically described by Robin Flower, The Western Island or the Great Blasket (Oxford, 1944). Native authors from the island itself are: Tomas o Crohan, The Irishman, translated from the Irish by Robin Flower (London, 1937); Maurice O'Sullivan, Twenty years a-growing, translated by Moya Llewelyn Davies and George Thomson (London, 1933); and Peig Sayers, An Old Woman's reflections, translated by Seamus Ennis (London, 1962).

23. W. Spotswood Green, "Armada ships on the Kerry coast", Proceedings of the Royal Irish Academy, 27 (1907-9), pp. 265-269. "About seventy years ago the Blasket islanders fished up a small brass cannon, with a coat-of-arms on it bearing the device of an uprooted tree. It is preserved in Clonskeagh Castle, near Dublin." (p. 269)

24. The story of the search is told in Martin, Full Fathom Five, pp. 57-97. See also John Grattan, "How to Find: the Divers Swimline Search", British Sub-Aqua Club Paper No. 2 (London, 1972).

25. Colin J.M. Martin, "The Spanish Armada expedition, 1968-70", in D.J. Blackman (Ed.), Marine Archaeology, Colston Papers, 23 (London, 1973), pp. 439-459.

26. Relación of Marcos de Aramburu, Duro, Armada Invencible, vol. 2, pp. 321-322. Lippomano, the Venetian ambassador, confirmed in a letter to the Doge and Senate on 22 October 1588 that the San Juan's crew and some of her artillery were saved. State Papers (Venetian), p. 405.

27. Francisco Ruiz Matute was a captain in Don Diego Pimentel's Sicilian tercio (Duro, op. cit., vol. 2, p. 77). He embarked with his 95-strong company on the Nuestra Señora de la Rosa de Oquendo - that is, the Santa María (ibid., 101, p. 35). Giovanni de Manona, in his second interrogation on 15 September 1588 (OS), says "Matuta was Captain of the Infanterie of that ship". (PRO SP 63/136/41v.

28. Informacion by Archibald Miller anent the ship sunck in Tippermorie in ye Sound of Mull, 20 November 1683, Bodleian, Rawlinson MSS., A/189/423.

29. J.N. Green and C.J.M. Martin, "Metal detector survey of the Armada ship *Santa María de la Rosa*", *Prospezioni Archeologiche*, 5 (1970), pp. 95-100.

30. Sir Henry Mainwaring, *Seaman's Dictionary*, in G.E. Mainwaring and W.G. Perrin (eds.), *The Life and Works of Sir Henry Mainwaring*, (2 vols., London, 1920 and 1922), vol. 2, p. 200. The *Dictionary* was evidently compiled *c.* 1623 (*Introduction*, pp. 69-82).

31. W. Salisbury, "The Woolwich Ship", *Mariner's Mirror*, 47 (1961), pp. 81-90.

32. H. Lovegrove, "Remains of two old vessels found at Rye", *Mariner's Mirror*, 50 (1964), pp. 115-122.

33. Mainwaring, *op. cit.*, p. 113.

34. As, for example, the *Santa María*'s sister Guipuzcoan, the *San Estéban* [57], which carried 100 rounds of 40-*lbr.* shot (AGS GA 221/153), although she appears to have carried no *cañones de batir* (*ibid.*, and AGS GA 221/49).

Chapter Five

1. An annotation in Lord Burghley's hand in Pedro de Paz Salas, La Felicíssima Armada (Lisbon, 1588) (British Library copy, Catalogue 192.F.17.[1]), has "of Rostock" written against the name of El Gran Grifón.

2. AGS CS 2a/280/1931.

3. List of ships mustered in Andalusia, 18 July 1587, AGS GA 221/2.

4. Fleet muster at Lisbon, 19 March 1588, Duro, Armada Invencible, vol. 2, pp. 439-445.

5. Arms and munitions issued to Gómez de Medina's squadron, 14 May 1588, AGS GA 221/147.

6. Fleet muster at Lisbon, 14 May 1588, Duro, op. cit., vol. 2, pp. 60-84.

7. AGS GA 221/2 (see note 3 above). The unsigned relación of a Grifón survivor (Duro, op. cit., vol. 2, p. 293) states that 50 of his comrades died on Fair Isle, including the master and mate of the hulk.

8. Allocation of infantry companies to the ships (undated), Duro, op. cit., vol. 2, pp. 34-39; list of aventureros, ibid., pp. 66-70. See also Martin, Full Fathom Five, pp. 137-155.

9. Juan Gómez de Medina to Philip II, 6 July 1588, Duro, op. cit., vol. 2, 139, p. 168; Relación of Alférez Esquivel, commander of the pinaza sent to gather in the scattered ships, ibid., 137, pp. 163-166.

10. Relación of Grifón survivor, Duro, op. cit., p. 281.

11. Relación of Alonso Vanegas, Duro, op. cit., pp. 384-385.

12. Unsigned relación by a crew member of the galleass Zúñiga [124], 4 October 1588, State Papers (Spanish), pp. 459-462.

13. Relación of Grifón survivor, Duro, op. cit., vol. 2, pp. 279-293. A suggestion that he may have been Juan Gomez de Medina was made by W.P. Ker, "The Spanish Story of the Armada", The Scottish Historical Review, 17 (1920), pp. 165-176.

14. Their adventures can be followed in Boyd, State Papers (Scotland), vol. IX, and ibid., (Eds., William K. Boyd and Henry W. Meikle), vol. X, 1589-1593 (Edinburgh, 1936), mainly through the regular reports sent by William Asheby to Walsingham. See also R. Pitcairn (Ed.), The autobiography and diary of Mr. James Melvill (Edinburgh, 1842), pp. 260-264, and R. Sibbald (Ed.), A description of the Isles

of Orkney from the mss. of Robert Menteith, Laird of Egilsha and Gairsa 24 September 1633 (Edinburgh, 1845). A general account is given in Martin, Full Fathom Five, pp. 145-155.

15. On a preliminary visit to Fair Isle in May 1970 the wreck site was pointed out to me, with what later proved to be complete precision, by Mr. Jerome Stout of Leogh. The Armada traditions on Fair Isle particularly impressed H.V. Morton during a visit in 1935, and he recorded them in an article (Daily Mail, 25 September 1935). It is necessary, however, to distinguish between 'primary' and 'secondary' traditions (i.e. those obtained from written sources in modern times).

16. Irvine of Midbreak Papers, Scottish Record Office (microfilm), RH 4/388/35/32, original in Shetland County Library, Lerwick.

17. A great deal of material concerning the eighteenth century salvage operations is contained in the records of an action brought against Rowe and Evans by Captain Simon Fraser of Broadland, who was one of their backers, in 1728/9, SRO AC 8/398. See also Evans's action for a reduction of this decree, ibid., AC 9/1182.

18. William Asheby to Walsingham, 30 November 1588 (OS), Boyd, State Papers (Scotland), vol. IX, 547, pp. 640-641.

19. Action brought by the Dutch East India Company and their Factor, William Drummond of Grange, against Alexander Mackenzie, younger of Delvine, one of the Principal Clerks of the Court of Session and Admiral Depute of the Western Isles. SRO AC 7/37, pp. 450-710 (Decree) and AC 9/1203 (Warrants). See also SRO Abercairny Muniments, GD 24/1/464D., fo. 69 ff.

20. Information from the late Jerome Stout of Busta, who witnessed the event.

21. Relación of Grifón survivor, Duro, op. cit., vol. 2, 291-292.

22. Cf. the break-up of the Dartmouth wreck, as postulated in Colin J.M. Martin, "The Dartmouth, a British frigate wrecked off Mull, 1690. 5. The ship", International Journal of Nautical Archaeology, 5.1 (1978), pp. 29-58.

23. Ibid., p. 39.

Chapter Six

1. Tenison, Elizabethan England, vol. 4, note to plate 15.

2. Medina Sidonia's orders for the defence of the San Martín, 7 June 1588, Duro, Armada Invencible, vol. 2, pp. 44-51.

3. For a preliminary report on the Mary Rose see Margaret Rule, The Mary Rose: The excavation and raising of Henry VIII's Flagship (Greenwich, 1982). Further information is contained in Ernle Bradford, The story of the Mary Rose (London, 1982).

4. Relación of the 295 pieces of artillery aboard the sixteen ships of the squadron of Castile, 14 May 1588, AGS GA 221/148.

5. Waters, "The Elizabethan navy and the Spanish Armada", p. 3.

6. Mattingly, Defeat of the Spanish Armada, pp. 175-179. See also Frank Howard, Sailing ships of war, 1400-1860 (Greenwich, 1979), pp. 50-53.

7. Waters, op. cit., p. 15.

8. Cf. the "pre-Armada" armament of the 945-ton merchantman Santa María de la Rosa, p. 138.

9. Howard, op. cit., pp. 177-228.

10. Relación of Pedro Coco Calderón, State Papers (Spanish), p. 443.

11. Guilmartin, Gunpowder and Galleys, pp. 71-72.

12. Ibid., chapter 5, pp. 194-220.

13. Deposition of Jan Henricx and Jacob Cornelis, 11 August 1588 (OS), Salisbury MSS., p. 344.

14. Guilmartin, op. cit., Appendix 6, pp. 295-303. See also Anderson, Oared fighting ships, pp. 69-70.

15. For a calculation of the proportion of gunpowder required by the fleet's various elements see Thompson, "Spanish Armada guns", pp. 365-366.

16. Guilmartin, op. cit., pp. 208-210.

17. Medina Sidonia to Philip II, 30 July 1588, Duro, Armada Invencible, vol. 2, p. 220.

18. For example, Mattingly, Defeat of the Spanish Armada, p. 216; and Lewis, Spanish Armada, p. 68.

19. Medina Sidonia to Philip II, 16 February 1588, Duro, op. cit., vol. 1, p. 417.

20. Juan Martínez de Recalde to Philip II, 11 July 1588, Duro, op. cit., vol. 2, p. 172.

21. Santa Cruz's account of the action, cited by Guilmartin, op. cit., pp. 216-217.

22. Juan de Acuña Vela to Philip II, 30 January 1588, AGS GA 219/36.

23. The galleasses' full complement of guns is given in an inventory of 9 July 1587, Duro, op. cit., vol. 1, p. 389. It may, of course, subsequently have been adjusted.

24. See Anderson, op. cit., chapter 9, pp. 74-83. A contemporary representation of a sixteenth century Venetian galleass, from an original in private hands, is reproduced by Braudel, The Mediterranean, vol. 2, plate 40.

25. Guilmartin, op. cit., pp. 246-247.

26. Reproduced in Tenison, op. cit., vol. 4, plate 22.

27. Cf. the Henrician coastal fortifications of the 1530s and '40s along the south coast of England, Ian Hogg, The History of Fortification (London, 1981), pp. 96-109.

28. "Our galleasses fired their stern guns," writes Medina Sidonia of the action of 3 August, off the Isle of Wight, Duro, op. cit., vol. 2, p. 235.

29. John Montgomery, Censura Literaria (London, 1588), v., p. 260.

30. Examination of Emanual Fremoso, 12 September 1588 (OS), PRO SP 63/136/41i.

31. The late George Naish pointed out to me that the sailing ships shown in the cartoon are not equipped with spritsail topsails, which indicates a date before the turn of the century.

32. In 1739 John Pine engraved copies of a set of tapestries which had been made immediately after the campaign for Lord Admiral Howard by Francis Speirrig from designs provided by Cornelis de Vroom. The tapestries were destroyed in the House of Lords Fire of 1834, Lewis, Spanish Armada, p. 116. The Pine engravings of galleasses are reproduced by Stenuit, Treasures of the Armada, pp. 65 and 67.

33. Pedro de Igueldo to Bernardino de Mendoza, 27 April 1589, State Papers (Spanish), pp. 534-535.

34. Bartolomo Crescentio, Nautica Mediterranea (Rome, 1607), pp. 58-61.

35. Anderson, op. cit., pp. 76-77.

36. Joseph Furttenbach, Architectura Navalis (Ulm, 1629), p. 79.

37. Van Meteren, Spanish Armada (ed. Hampden), p. 362.

38. Relación of ships (undated, but probably February 1588), AGS Estado 431/135. The average for the four galleasses is given as 2000 toneladas.

39. Hawkins to Walsingham, 31 July 1588 (OS), Laughton, Spanish Armada, vol. 1, p. 360.

40. The San Rafael was present at the Fleet muster on 7 January 1588 (Duro, op. cit., vol. 1, p. 404), but on 19 March she was declared to be rotten and unfit for service (ibid., vol. 1, p. 440). For the story of the Florencia see Mattingly, op. cit., pp. 187-189.

41. Duro, op. cit., vol. 1, p. 250.

42. Hieronimo Lippomano to the Doge and Senate, 23 February 1588, State Papers (Venetian), p. 341.

43. Ibid., 29 February 1588, pp. 341-342.

44. Martín de Bertendona to Philip II, 27 February 1588, AGS GA 220/61.

45. Medina Sidonia to Philip II, 1 June 1588, Duro, op. cit., vol. 2, pp. 106-107.

46. Philip II to Medina Sidonia, 5 July 1588, ibid., pp. 150-154.

47. Geoffrey Rickman, "The grain trade under the Roman Empire", Roman Seaborne Commerce, Memoirs of the American Academy in Rome, 36 (1980), pp. 261-275.

48. Richard W. Unger, The ship in the medieval economy, 600-1600 (London and Montreal, 1980), pp. 220-221 and 265.

49. F.C. Lane, "Naval architecture about 1550", Mariner's Mirror, 20 (1934), pp. 24-49.

50. Braudel, op. cit., vol. 1, plate 10.

51. Martin, "The Dartmouth", p. 48.

52. Cf. Mainwaring, Seaman's Dictionary, p. 104.

53. Peter and Joan Throckmorton, "The Roman wreck at Pantano Longarini", International Journal of Nautical Archaeology, 2.2 (1973), pp. 243-266.

54. F.C. Lane, Navires et constructeurs à Venise pendent la renaissance (Paris, 1965), pp. 259-260.

55. R. Romano, "Economic aspects of the construction of warships in Venice in the sixteenth century", in B. Pullan (ed.), Crisis and change in the Venetian economy in the sixteenth and seventeenth centuries (London, 1968), pp. 59-87.

56. Copy of a memorandum by the ninth earl of Argyll about the Spanish wreck, dated 1677, uncatalogued manuscript at Inveraray Castle. I am grateful to Alison MacLeay for providing me with this information.

57. Informacion by Archibald Miller... 1683, Bodleian Library, Rawlinson Mss., A/189/423.

58. Martin, op. cit., pp. 42-49.

59. Quoted by A. Clarke, The treasure of the great reef (London, 1964).

60. Information from Robert Grenier of Parks, Canada.

61. Petition of Martín de Villafranca, January 1588, AGS GA 237/88.

62. Timbotta's treatise is published and discussed by R.C. Anderson, "Italian naval architecture about 1445", Mariner's Mirror, 11 (1925), pp. 135-163.

63. Basil Greenhill, The archaeology of the boat (London, 1976), pp. 283-284.

64. Unger, op. cit., pp. 168-171.

65. John Roche Dasant, Acts of the Privy Council of England, new series, vol. XVII (1588-1589), (Norwich, 1898), meeting of 27 July 1589, pp. 447-450.

66. Mateo Zane to the Doge and Senate, 17 June 1586, State Papers (Venetian), p. 172.

67. Giovanni Dolfin to the Doge and Senate, 23 June 1586, ibid., p. 173.

68. Hieronimo Lippomano to the Doge and Senate, 14 July 1586, ibid., pp. 179-181.

69. Hieronimo Lippomano to the Doge and Senate, 8 January 1587, ibid., pp. 233-234.

70. Medina Sidonia's General Orders to the fleet, Duro, Armada Invencible, vol. 2, pp. 26-27.

71. Medina Sidonia to Philip II, 1 June 1588, ibid., vol. 2, pp. 106-107.

72. Philip II to Medina Sidonia, 5 July 1588, ibid., vol. 2, p. 153.

73. Medina Sidonia to Philip II, 30 July 1588, _ibid._, vol. 2, p. 217.

74. _Enciclopedia Universal Ilustrada_, vol. 70, p. 859; see also under _bergantín_, _ibid._, vol. 8, p. 237.

75. See J.H. Parry, _The Age of Reconnaissance_ (New York, 1964), pp. 67-75.

76. Statement by Pedro Esquivel, 5 July 1588, _State Papers (Spanish)_, pp. 328-329.

77. _Ibid._, pp. 378-379. When the fleet scattered, the prince, who was a member of Medina Sidonia's personal staff, failed to regain the flagship and was forced to put ashore at Dunkirk.

78. Duro, _Armada Invencible_., vol. 1, pp. 258-259.

79. Acuña Vela to Philip II, 30 January 1588, AGS GA 219/36.

80. _Relación_ of Marcos de Aramburu, Duro, _op. cit._, vol. 2, p. 320.

81. Boetius Clancy to Sir Richard Bingham, 6 September 1588 (OS), _State Papers (Ireland)_, pp. 29-30.

82. "The number of the King of Spain's shipping in the Low Countries": a report by Jo. de Barnex, 30 May 1588, _State Papers (Spanish)_, p. 306.

83. The various types of small Dutch coastal craft are admirably portrayed in the etchings of Reinier Nooms (Facsimile edition published by the _Nederlandsch Historisch Scheepvaart Museum_, Amsterdam, 1970) which, although of mid-seventeenth century date, show much the same sort of shipping as would have been available to Parma in 1588.

84. Parma to Philip II, 31 January 1588, _State Papers (Spanish)_, p. 199.

85. Van Meteren, _op. cit._, p. 365.

86. M.D. de Weerd and J.K. Haalebos, "Schepen voor het Opscheppen", _Spiegel Historiael_ (Bussem), nos. 7-8 (1973), pp. 386-397.

87. Tacitus, _Annals_, II, 5-6; II, 23-24.

Chapter Seven

1. The main works I have consulted are: William Bourne, The arte of shooting in great ordnaunce (London, 1587); Alessandro Capo Bianco, Corona e palma militare di artiglieria (Venice, 1602); Girolamo Cataneo, Dell' arte militare... con l'essamini de' bombardieri (Brescia, 1571); Luis Collado, Platica manual de Artilleria (Milan, 1592); Leonhardt Fronsperger, Kriegsbuch (Nuremburg, 1573); Eugenio Gentilini, Instruttioni de' bombardieri (Venice, 1592); Cyprian Lucar, Tartaglia's Colloquies and Lucar Appendix (London, 1588); Tomaso Moretti, Trattato del artiglieria, English translation by J. Moore (London, 1683); Robert Norton, The gunner (London, 1628); Pietro Sardi, L'Artiglieria di P. Sardi (Venice, 1621); Diego Prado y Tovar, Encyclopaedia de fundición de artillería y su plática manual (1603).

2. The most important collections, from the point of view of this study, are those in the Museo del Ejército, Madrid; the Museu Militar, Lisbon; the Museo Storico Navale, Venice, and the Tower of London.

3. Michael Lewis, Armada guns (London, 1961).

4. I.A.A. Thompson, "Spanish Armada guns", Mariner's Mirror, 61 (1975), pp. 355-371.

5. Norton, op. cit., p. 8.

6. Guilmartin, Gunpowder and galleys, Appendix 2, pp. 277-283.

7. Ibid., pp. 279-281.

8. Ibid., p. 282.

9. J.G. Benton, A course of instruction in ordnance and gunnery... (New York, 1862), Figure 31.

10. Guilmartin, op. cit., pp. 282-283.

11. An extreme case is that of the so-called "Queen Elizabeth"s pocket pistol", a Dutch bronze basilisk given to Henry VIII in 1545, which is 58 calibres long. See H.L. Blackmore, The Armouries of the Tower of London, vol. 1 (Ordnance) (London, 1976), pp. 48-49 and plates 10 and 11.

12. Bourne, op. cit., p. 13.

13. The drawing was dispatched with a covering letter from Juan de Acuña Vela to Philip II on 25 July 1587, AGS GA 199/52.

14. John Greaves, Miscellaneous Works (vol. 2, London, 1737), quoted by Charles Ffoulkes, The gunfounders of England (Cambridge, 1937), p. 97.

15. D.M. Desoutter, All about aircraft (London, 1954), Figure 2 on page 6.

16. Collado, op. cit., f. 53.

17. The Life of Benvenuto Cellini, written by himself, (English translation by John Addington Symonds, London, 1949), pp. 362-369.

18. Lewis, op. cit., pp. 208-216.

19. Relación of guns aboard the five ships from Sicily, 26 September 1587, AGS GA 221/39. "Pesos de Italia" was no doubt an understandable vagueness on the part of the Spanish inventorist, who presumably simply copied down the weights marked on the pieces without further calculation. There was no single Italian weight unit; Lewis (op. cit., p. 218) cites eight Italian pounds in common use during the sixteenth century, with a range of 301-891 grams.

20. Lewis, op. cit., p. 208.

21. The piece was weighed with the generous co-operation of the Londonderry Port and Harbour Commissioners on a public weighbridge, which had previously been checked for accuracy under the supervision of Roger Morgan of the New University of Ulster. Maximum error for the weighing was computed by Dr. Morgan as 28 lbs (12.7 kg), and a similar degree of accuracy has been assumed for the sixteenth century weighing (a beam balance, or stater, is likely to have been at least as accurate as a modern commercial weighbridge, especially if the apparatus was set up, as in this case, in a royal gunfoundry). The weight given by the weighbridge was 5429 lbs (2463 kg), from which the following calculation emerges:

gun weight-unit $= \frac{5429}{5316}$ lb $= 1{\cdot}0213$ lb ≈ 463g.

since the maximum error over both weighings is

$$\pm\sqrt{(28)^2 + (28)^2} = \pm 39.6 \text{ lb}$$

so unit error $\approx \frac{39{\cdot}6}{5316}$ lb $= .0074$ lb $= 3$g

and sixteenth century unit $= 1.0213$ lb $\pm .0074$ lb, or $463\text{g} \pm 3\text{g}$.

22. Lewis, op. cit., p. 218.

23. Collado, op. cit., ff. 16-17.

24. Thomas Binning, A light to the art of gunnery (London, 1676), pp. 42-53.

25. R.W. Adye, The bombardier and pocket gunner (London, 1827).

26. Diagram with memorandum by Juan de Acuña Vela, 20 January 1590, AGS M y P, V-20.

27. Chambers Encyclopedia (1930 edition), vol. IX, p. 570.

28. Sydney Wignall, "The Armada shot controversy", in D.J. Blackman (Ed.), Marine Archaeology, Colston Papers, 23 (London, 1973), pp. 463-481.

29. P. Henrard, "Documents pour servir à l'histoire de l'artillerie en Belqique: Les fondeurs d' artillerie", *Annales de l'Academie d'Archéologie de Belgique*, 45 (1889), pp. 254-255.

30. The techniques of gun founding are described by Vannoccio Biringuccio, *The Pirotechnica* (Venice, 1540); see also the translation and commentary by Cyril S. Smith and Martha T. Gnudi (New York, 1943). Melvin H. Jackson and Carel de Beer, *Eighteenth century gunfounding* (Newton Abbot, 1973), should also be consulted for a fascinating series of detailed sketches which shows each stage of the casting process. The techniques were essentially the same as those used in the sixteenth century.

31. Lucar, *op. cit.*, Appendix.

32. Collado, *op. cit.*, f. 9.

33. Biringuccio, *op. cit.*, (ed. Smith and Gnudi), p. 227.

34. Prado y Tovar, *op. cit*.

35. Examination of Baltasar López del Arbol at Drogheda, 13 October 1588 (OS), PRO SP 63/137/16.

36. See Biringuccio, *op. cit.*, pp. 246-248.

37. The sawing off of the gun-head - a bulbous extension of the muzzle which was provided in the mould to ensure adequate pressure in the main casting - was a laborious task which could take up to thirty hours. See Jackson and de Beer, *op. cit.*, p. 131.

38. AGS M y P, V-18, sent with covering letter from Juan de Acuña Vela to Philip II, 25 July 1587, AGS GA 199/52.

39. Its weight mark coincides with that recorded for the missing *Valencera* gun, AGS CS 2a/280 unfol., Lists and receipts of issues to *La Trinidad Valencera*. The weight-marks on the two *cañones de batir* we have recovered - 5260 and 5316 - can be identified in the same document.

40. For the development of the royal gunfoundry at Malines, see Henrard, *op. cit.*, and G. Van Doorslaer, *L'ancienne industrie du cuivre à Malines* (Malines, 1910).

41. Their locations are noted by Santa Cruz in his 1586 planning document, Duro, *Armada Invencible*, vol. 1, p. 288.

42. Guns and munitions issued to Bertendona's squadron, 14 May 1588, AGS GA 221/156.

43. Inventory of the *San Salvador*, 24 August 1588 (OS), Laughton, *Spanish Armada*, vol. 2, p. 156.

44. *Relación* of artillery aboard the ships of Oquendo's

squadron, 31 October 1587, AGS GA 221/41.

45. George Wodloke to Alexander Brywer, Mayor of Waterford, 10 September 1588 (OS), State Papers (Ireland), pp. 36-37.

46. Sir George Carew to Sir William Fitzwilliam, 22 June 1587 (OS), Carew Papers, 618, p. 25.

47. Informacion by Archibald Miller... 20 November 1683, see note 28 to Chapter Four.

48. Relación of artillery in the munition house at Malaga, 20 January 1587, AGS GA 214/90.

49. The variation works out at plus or minus 1.5 percent - less than the variation, for instance, recorded on the individual propellor blade castings of the White Star liner Oceanic, built in 1899 (information from Alec Crawford).

50. Summary relación of guns aboard the ships from Naples, Sicily, and Andalusia, 26 September 1587, AGS GA 221/39.

51. Unsigned and undated relación (probably June 1591), which includes the N.S. del Rosario's 1588 armament, AGS GA 347.

52. AGS CMC 2a/773.

53. See notes 50 and 51 above.

54. AGS M y P, V-19 (see note 38 above).

55. Lord Archibald Campbell, Armada cannon (London, 1899).

56. Javier Cortés, Royal Armoury of Madrid (Tourist Guide), (English edition, Madrid, 1967), pp. 29-30 and pp. 65-66.

57. One of the ships involved in the Terceira operation of 1583 (her identity is uncertain) had six bronze guns - two medias culebrinas and four falconetes - which bore the French royal arms, AGS CMC 2a/1234, (account of the ship belonging to Estéphano de Nicolo Nacache).

58. See note 19 above.

59. Biringuccio, op. cit., p. 247, Figure 31.

60. Ruggiero Romano, "Economic aspects of the construction of warships in Venice in the sixteenth century", in B. Pullan (Ed.), Crisis and change in the Venetian economy in the sixteenth and seventeenth centuries (London, 1968), p. 61, n. 1.

61. O.F.G. Hogg, Artillery: its origin, heyday, and decline (London, 1970), p. 266. His formulae for calculating the weights of guns are:
3(D L - d l) if bronze
2.5(D L - d l) if iron

where D = mean external diameter in inches
d = calibre in inches
L = overall length in feet
l = internal length in feet

62. Guns aboard the ships of Oquendo's squadron, 31 October 1587, AGS GA 221/41.

63. Laughton, Spanish Armada, vol. 2, p. 156.

64. Inventory of the Nuestra Señora del Rosario at Dartmouth, 28 August 1588 (OS), ibid., vol. 2, p. 191.

65. See note 56 above.

66. John F. Guilmartin, "The cannon of the Batavia and the Sacramento: early modern cannon founding reconsidered", International Journal of Nautical Archaeology, 11.2 (1982), pp. 133-144.

67. See note 50 above.

68. See note 51 above.

69. The specification is signed by Juan de Acuña Vela, AGS M y P, V-16.

70. Duro, Armada Invencible, vol. 2, p. 289.

71. Relación of artillery issued to Gomez de Medina's squadron, 14 May 1588, AGS GA 221/147.

72. See Jackson and de Beer, op. cit., pp. 82-85 for the method of setting the escutcheon and other decoration on a gun mould.

73. Acuña Vela to Philip II, 10 April 1588, AGS GA 223/24.

74. Two gunners aboard the hulk San Salvador were killed this way during the fighting on 2 August 1588, off Portland Bill, Relación of Pedro Coco Calderón, State Papers (Spanish), p. 442.

75. Norton, op. cit., pp. 67-68.

76. Bourne, op. cit., pp. 45-48.

77. AGS M y P, V-17 (see note 38 above).

78. See note 50 above.

79. See note 51 above.

80. Biringuccio, op. cit., p. 253.

81. Ibid., p. 247.

82. Ffoulkes, op. cit., p. 116.

83. Ivo Petricioli, "Brod kod Gnalića: sidra i topovi", Vrulje, 1 (1970), pp. 9-15.

84. Information from Philip Burton of Teignmouth.

85. See note 50 above.

85. See note 71 above.

86. Carlo M. Cipolla, Guns and sails in the early phase of European expansion, 1400-1700 (London, 1965), pp. 52-53.

88. Ibid., p. 52, n. 2.

89. Ibid., pp. 58-59.

90. As, for example, on the wreck of the Dutch East India Company ship Vergulde Draeck: Jeremy N. Green, 'The VOC jacht Vergulde Draeck, wrecked Western Australia, 1656', British Archaeological Reports Supplementary Series 36 (2 vols., Oxford, 1977), vol. 1, p. 271.

91. Cipolla, op. cit., p. 61, n. 1.

92. Howard, Sailing ships of war, pp. 145-150.

93. See note 71 above.

94. Sténuit, Treasures of the Armada, Appendix III, p. 272.

95. Cf. the large group specified individually by weight of shot aboard the squadron of Castile, 14 May 1588, AGS GA 221/148.

96. Norton, op. cit.

97. Ibid.

98. Bourne, op. cit.

99. Monson, Naval Tracts, vol. IV, pp. 92-93.

100. Sir Richard Hawkins, Observations... in his voyage into the South sea, in the year 1593, C.R. Drinkwater Bethune (Ed.) (London, 1847), p. 206.

101. Ibid.

102. Norton, op. cit.

103. Relación of guns on the ships of Oquendo's squadron, 31 October 1587, AGS GA 221/41.

104. Artillery aboard the four galleasses and two naves from Naples, 9 July 1587, Duro, Armada Invencible., vol. 1, p. 389.

105. See note 51 above.

106. See note 19 above.

107. See note 51 above.

108. Summary of guns aboard the 28 _urcas_, 26 September 1587, AGS GA 221/39.

109. _Relación_ of guns aboard the squadron of Castile, 14 May 1588, AGS GA 221/148.

110. See note 51 above.

111. _Ibid_.

112. _Relación_ of guns aboard the ships of Antonio Hurtado de Mendoza's squadron, 14 May 1588, AGS GA 221/155.

113. Petricioli, _op. cit_., p. 15 (Adriatic wreck); information from Philip Burton (Teignmouth wreck).

114. Capa Bianco, _op. cit_., opposite p. 8.

115. Moretti, _op. cit_., p. 37.

116. Mainwaring, Seaman's Dictionary, p. 189.

117. Cataneo, _op. cit_.

118. See note 42 above.

119. See note 103 above.

120. See note 50 above.

121. Sténuit, _op. cit_., Appendix III, p. 272.

122. See note 104 above.

123. _Ibid_., p. 390.

124. Anon., "The Armada Ship in Tobermory Bay", _Pall Mall Magazine_, 36:149 (1905), pp. 372-376. The gun is now in the school museum at Charterhouse, Godalming, and I am indebted to the Curator, Dr. Ian Blake, for allowing me to examine it.

125. See note 103 above.

126. An important group of these guns has been recovered from the sea off the Danish island of Anholt, in the Kattegat: see F.V. Nielsen, _Conservation of iron recovered from the sea_ (Copenhagen, 1966), pp. 11-18. Some of the guns are thought to derive from a wreck of _c_. 1570. The Spaniards used them extensively on the trans-Atlantic _flotas_ in the sixteenth century, as a group of wrecks from the 1556 fleet, recently discovered off Texas, has demonstrated. See

Dorris L. Olds, Texas Legacy from the Gulf (Austin, 1976), pp. 63-75, and J. Barto Arnold III, The nautical archaeology of Padre Island (London, 1978), pp. 243-250.

127. See note 107 above.

128. Information from Margaret Rule.

129. AGS M y P, XVIII, 48 and 49 (undated).

130. Sardi, op. cit., p. 130.

131. Information from Margaret Rule.

Chapter Eight

1. Fleet muster at Lisbon, 14 May 1588, Duro, Armada Invencible, vol. 2, pp. 77-81.

2. Williams, Brief discourse, in Evans, Works of Sir Roger Williams, p. 20.

3. Parker, Army of Flanders, p. 165.

4. The theoretical establishment of a Spanish infantry company in Flanders was 250, consisting of either 11 officers, 219 pikemen and 20 musketeers, or 11 officers, 224 arquebusiers, and 15 musketeers. In a tercio of twelve companies there would be two arquebusier companies and ten of pikemen (Parker, Army of Flanders, Appendix B, p. 214). In his analysis of the four Spanish tercios in the Netherlands on 12 May 1571 (ibid., p. 276), Professor Parker shows that the average company size was 150, comprised of (in overall percentages, and excluding officers): musketeers, 8.5%; arquebusiers, 21.5%; pikemen, 70%. The proportion of corresponding weapons carried by the Armada were: muskets, 5.5%; arquebuses, 39%; pikes, 55.5%. It may be that the unusually large number of arquebusiers - almost double the normal establishment - reflects the expected suitability of such troops for close-quarter naval action of the kind the Spaniards wished to precipitate. All of the battle-stations allocated to the San Martín's 300-odd soldiers were for musketeers (100) and arquebusiers (202), so it would seem that aboard the flagship at least there were no pikemen at all (Duro, op. cit., vol. 2, pp. 44-45). The double-strength establishment of the tercios (26 companies instead of 12) further hint that the Armada's military component may have been adapted to the specific needs of the campaign.

5. Several comparable weapons survive in the Museo del Ejército, Madrid. See Jose M. Martínez-Hidalgo, Lepanto: La Batalla, la Galera Real; recuerdos, reliquías y trofeos, (2 vols., Barcelona, 1971), vol. 2, Catálogo, pp. 85, 89, and 97.

6. In his planning document of 1586 Santa Cruz states that all the arquebuses were to come from Milan, Duro, op. cit., vol. 1, 7, p. 295.

7. Williams, op. cit., p. 37.

8. Medina Sidonia's General Orders, May 1588, Duro, op. cit., vol. 2, p. 30.

9. Relación of Pedro Calderón, State Papers (Spanish), p. 445.

10. Medina Sidonia to Philip II, 11 July 1588, Duro, op. cit., vol. 2, p. 174. The duke uses the word "frasco" for the powder flask.

11. Thomas Digges, An Arithmetical warlike treatise named Stratioticos (London, 1590), p. 97.

12. There are some closely comparable examples in the Museo Militar, Barcelona. Martínez-Hidalgo, op. cit., vol. 2, p. 121.

13. Bashford Dean, Helmets and body armour in modern warfare (Yale, 1920), pp. 135-136.

14. For example, on the tiled murals showing famous Spanish soldiers at the Palace de Viso del Marques, near Almuradiel, reproduced in Graham, The Spanish Armadas, p. 219.

15. Parker, op. cit., p. 276.

16. Williams, op. cit., p. 39.

17. Duro, op. cit., vol. 1, pp. 296-297.

18. A repostero belonging to Don Luis de Requesens is preserved in the Palau Menor, Barcelona. Martínez-Hidalgo, op. cit., vol. 2, pp. 135-136.

19. Fleet muster at Lisbon, 14 May 1588, Duro, op. cit., vol. 2, p. 82. The zapatos, according to Santa Cruz in his 1586 planning document, would be provided by Naples, while the alpargatas would come from Valencia (ibid., vol. 1, p. 283).

20. Ibid., vol. 2, p. 81: "sacos y mochilas de angeo". They were to come from Seville.

21. Ibid., vol. 2, 109, p. 82: "botillas de cuero para vino y agua". Naples, Seville, and Lisbon were the sources. Very similar bottles are still in use in rural Spain today: see Diccionario ilustrado de la Lengua Española (Madrid, 1927), p. 298.

22. Hieronimo Lippomano to the Doge and Senate, 6 February 1588, State Papers (Venetian), p. 336.

23. Fleet muster at Lisbon, 14 May 1588, Duro, op. cit., vol. 2, p. 82.

24. Relación of guns on board the seven naves and four pataches of Oquendo's squadron 31 October 1587, AGS GA 221/41; additions to the squadron, 14 May 1588, AGS GA 221/153.

25. Equipment loaded on the ships of Bertendona's squadron, 14 May 1588, AGS GA 221/156.

26. Pietro Sardi, L'Artiglieria (Venice, 1621), p. 74, Figure 13.

27. Collado, Plática Manual, p. 21.

28. _Ibid_., p. 21.

29. _Ibid_., p. 22.

30. Sardi, _op. cit_., pp. 68, 74, and 81, Figures 12, 13 and 14.

31. See note 25 above.

32. Entry of Emperor Charles into Munich in 1530, reproduced in Max Geisberg, _The German single-leaf woodcut: 1500-1550_, revised and edited by Walter L. Strauss (4 vols., New York, 1974), vol. 1, pp. 273-277.

33. See note 20 above.

34. Reports of deserters, 3 August 1588 (OS), Laughton, _Spanish Armada_, vol. 2, pp. 78-82.

35. _Relación_ of _navios_, 16 February 1588, AGS GA 221/64.

36. General Sir Garnet J. Wolseley, _The Soldier's Pocket-Book for Field Service_ (4th edition, London, 1882), p. 55, gives the draught capacity of a horse as 10-12 hundredweight on a fair road in flat country, a capacity halved in steep or rough conditions. Five hundredweight seems a reasonable estimate for the purposes of the Armada campaign.

37. Van Meteren, _Hakluyt's Voyages_, _op. cit_., pp. 365-366.

38. _Relación_ of _El Gran Grifón_ survivor, Duro, _Armada Invencible_, vol. 2, pp. 286-287.

39. Information from Margaret Rule.

40. Peter Padfield, _Guns at Sea_ (London, 1973), p. 60.

41. "120 libras de cobre batado para cargadores", AGS GA 221/156.

42. Sardi, _op. cit_., p. 90, figure 16.

43. Duro, _op. cit_., vol. 1, 7, p. 284.

44. Information from Margaret Rule.

45. Duro, _op. cit_., vol. 1, pp. 299-305.

46. Fleet muster at Lisbon, 14 May 1588, Duro, _op. cit_., vol. 2, p. 82.

47. Leonhardt Fronsperger, _Kriegsbuch_ (Nuremburg, 1573), part III, clxxii.

48. Summary _relación_ of Lisbon muster, 14 May 1588, Duro, _op. cit_., p. 83.

49. Medina Sidonia's General Orders, May 1588, Duro, op. cit., vol. 2, pp. 31-32: "The artificial fire should be entrusted to the most experienced men... if this is not confided beforehand to men who understand the management of it great damage may result."

50. They were issued for redistribution among the squadron to the Anunciada [73], and are shown in the stores list of 14 May 1588, AGS GA 221/156.

51. Cyprian Lucar, Tartaglia's Colloquies and Lucar Appendix (London, 1588), p. 74.

52. One has been found on what appears to be the wreck of a sixteenth century galley of Mediterranean origin off Teignmouth in Devon (information from Philip Burton), while another has been identified on a Venetian wreck in the Adriatic (information from Dr. Pieter van der Merwe).

53. Santa Cruz's 1586 planning document mentions Lisbon as the source for the fleet's projected 6,000 alcancías, Duro, op. cit., vol. 1, p. 305.

54. See note 41 above.

55. Lucar, op. cit., p. 97. See also Cataneo, Tratto... de' Bombardieri, lib. 2, p. 33, and Collado, Plática Manual, f. 85.

56. J. Decavele, Eenheid en Scheiding in de Nederlanden, 1555-1585 (Ghent, 1976), pp. 233-234; Cat. 484.

57. What seems to be a pole-mounted shear hook is shown in an illustration purporting to represent "strange weapons taken from the Spaniard which were provided to destroy the English" (captured from the Nuestra Señora del Rosario, perhaps?). A packe of Spanish lyes (novelty card pack, 1588). The card concerned is the ace of spades.

58. Duro, op. cit., pp. 52-53.

59. Pierre Chaunu, "La tonelada espagnola au XVI et XVII siècles" in Le Navire et l'économie maritime du XV au XVIII siècles, Travaux du Colloque d'Histoire Maritime, 1956 (Paris, 1957), pp. 75-80. See also F.C. Lane, "Tonnages, Medieval and Modern", Economic History Review, 2nd series, 27 (1964), pp. 213-233.

60. Colin J.M. Martin, "Spanish Armada pottery", International Journal of Nautical Archaeology, 8.4 (1979), pp. 279-302.

61. A hundred campaign tents, says Santa Cruz in his 1586 proposals, would be needed for "supplies and other things connected with the operation of the army", Duro, Armada Invencible., vol. 1, p. 282. Sixteen were allocated to the field hospital (ibid., p. 285). All the tentage was to come from Milan. The Trinidad Valencera, when she sailed,

carried two tiendas de campagna, AGS GA 221/156.

62. Parker, Army of Flanders, pp. 166-167. Lucas Cranach the Younger's 1542 woodcut of the Siege of Wolfenbüttel, reproduced in Geisberg, German single-leaf woodcut, vol. 2, pp. 640-647, contains excellent representations of such structures.

63. Parker, op. cit., p. 177. See also Digges, op. cit., pp. 80-81 "...when any new soldier is entered into [the Spanish] bands, he is presently received into some one fellowship among them called Camarades, where the old soldiers instruct him of his duty, and if he erre or commit any faults, they friendly reprove him, and admonish him; if he be bare in apparell, they furnish him out of their own purses, because he should not be a dishonour to their Nation..."

64. Duro, op. cit., vol. 1, p. 283.

65. Martin, "Spanish Armada Pottery", pp. 279-302.

66. W.L. Schurz, The Manila galleon (New York, 1939). See also E.P. von der Porten, Drake and Cermeno in California: sixteenth century Chinese ceramics (Point Reyes, 1973).

67. Warrant under the Privy Signet for the transportation of various domestic utensils, musical instruments, etc., for the use of the duke of Medina Sidonia, Westminster, 8 February 1583 (OS), Salisbury Mss., vol. 3, p. 25.

68. Charles Welsh, History of the Worshipful Company of Pewterers (2 vols., London, 1902), vol. 1, pp. 155-156.

69. List of aventureros who sailed with the Armada, Fleet muster at Lisbon, 14 May 1588, Duro, op. cit., vol. 2, 109, p. 68. His death is recorded in Hamilton, State Papers (Ireland), p. 59.

70. Sténuit, Treasures of the Armada, p. 264.

Chapter Nine

1. It is best expressed by Mattingly, Defeat of the Spanish Armada, pp. 273-275.

2. Parma to Philip II, 31 January 1588, State Papers (Spanish), pp. 199-201: "...as they are Frenchmen the less they are trusted the better... it appears, however, that so far, although they have caused anxiety, they have not obstructed the carrying out of the enterprise." For a counterfactual study of what might have happened, see Geoffrey Parker, "If the Armada had landed", History, 61 (1976), pp. 358-368. Professor Parker developed this theme with a paper delivered to the History and Naval Culture section of the Spanish Admiralty at Madrid in September 1982, and I am grateful to him for allowing me to draw on his conclusions.

3. This was the conclusion of Michael Lewis, Armada Guns (London, 1961). Few of Professor Lewis's observations on Spanish gun policies and technicalities can now be sustained, although in fairness to him it should be pointed out that on the guns of the anti-Armada fleet, towards which his main research was directed, he remains the prime authority.

4. See I.A.A. Thompson's comparative estimates on the gun strengths of the two fleets in Appendix 4.

5. Lewis, op. cit., pp. 192-193.

6. Medina Sidonia's diario, Duro, Armada Invencible, vol. 2, p. 244.

7. Ibid., vol. 2, p. 237.

8. Relación of Alonso Vanegas, ibid., vol. 2, p. 373.

9. Medina Sidonia's battle-orders, ibid., vol. 2, p. 46.

10. Ibid., pp. 44-45.

11. Mainwaring, Seaman's Dictionary, p. 119: "The fashion of those carriages we use at sea are much better than those of the land; yet the Venetians and Spaniards and divers others use the other in their shipping"; Monson, Naval Tracts, vol. 5, p. 147: "they [the Spaniards] carry their great ordnance upon field carriages, which makes them the more dangerous and unservicable, for their piece, so lying, cannot be traversed from side to side but must be shot off directly forward as they lie."

12. Monson considered that unsatisfactory gun mountings constituted a major hazard aboard Spanish ships (ibid.): "...if the shipwrecks of the King of Spain's galleons were certainly known, which is impossible, they would confess, if a man had escaped to make a report of them, the breaking

loose of their ordnance was the occasion of their destruction."

13. Don Jorge Manrique to Philip II, Dunkirk, 19 August 1588, AGS GA 226/8.

14. Medina Sidonia's General Orders, Duro, op. cit., vol. 2, p. 31.

15. Philip II's instructions to Medina Sidonia, 1 April 1588, Duro, op. cit., vol. 2, pp. 9-10.

16. Quoted by P. Holck, Notes, in Mariner's Mirror, 19 (1933), p. 282.

17. Quoted by L.G. Carr Laughton, "Gunnery, Frigates, and Line of Battle", Mariner's Mirror, 14 (1928), pp. 339-363, at page 340.

18. AGS CMC 2a/942/109.

19. AGS CMC 2a/460/162-167.

20. AGS CMC 2a/773/133.

21. Arthur Coke Burnell (Ed.), The Voyage of John Huyghen van Linschoten to the East Indies (from the English translation of 1598), (2 vols., London, 1885), vol. 2, pp. 268-269.

22. Philip II's instructions to Medina Sidonia, 1 April 1588, Duro, op. cit., vol. 2, p. 10.

23. Second examination of Giovanni de Manona, 15 September 1588 (OS), PRO SP 63/136/41v.

24. Testimony of Marko Petrov of Ragusa, quoted by Veselin Kostić, "The Tobermory Galleon", Blackwood's Magazine, 326 (1979), pp. 152-162 at page 156.

25. William Thomas to Burghley, 30 September 1588 (OS), Laughton, Spanish Armada, vol. 2, pp. 258-260.

26. Lewis, op. cit., pp. 177-187.

27. Bourne, Arte of shooting, introduction, iii.

28. Peter Whitlock, "King Henry VIII's Mary Rose - 1511-45. An outline of the project and its progress", Mariner's Mirror, 66 (1980), pp. 344-348.

29. For a discussion on the evolution of shipboard gun-drills, and the date recoil loading was introduced, see Carr Laughton, op. cit., and Padfield, Guns at Sea, pp. 57-69.

30. Anonymous picture-map of the investment of Smerwick in south-west Ireland, 1580, PRO MPF 75. I am indebted to Tom

Glasgow, Jr. for drawing my attention to this detail.

31. Indenture for the delivery of ordnance to Drake, 17 July 1585 (OS), J.S. Corbett, Spanish War, 1585-1587 (London, 1898), pp. 27-32.

32. Bourne, op. cit., pp. 52-57.

33. Howard to Walsingham, 28 January 1587, Laughton, Spanish Armada, vol. 1, pp. 50-52.

34. Howard to Burghley, 21 February 1587, ibid., vol. 1, pp. 79-80.

35. Howard to Burghley, 9 March 1587, ibid., vol. 1, pp. 96-102.

36. Howard to Burghley, 29 February 1587, ibid., vol. 1, pp. 83-86.

37. Medina Sidonia's diario, Duro, Armada Invencible, vol. 2, p. 230.

38. See note 31 above.

39. Calculated from an assessment of the guns recorded, by type and shot-weight, aboard the Castile squadron, 14 May 1588, AGS GA 221/148.

40. Relación of Pedro Coco Calderón, State Papers (Spanish), p. 443.

41. The San Juan's full armament in 1588 is recorded in an unsigned and undated relación (probably of June 1591), AGS GA 347. The guns are recorded by type and shot-weight.

42. For an account of Recalde's seamanship in Blasket Sound see Martin, Full Fathom Five, pp. 23-56.

43. Monson, Tracts, vol. 4, pp. 66-70.

44. Medina Sidonia's General Orders, Duro, Armada Invencible, vol. 2, pp. 29-31.

45. Monson, op. cit., vol. 4, p. 64.

46. Medina Sidonia's General Orders, Duro, op. cit., vol. 2, p. 25.

47. John Hampden (ed.), Francis Drake, Privateer, Contemporary Narratives and Documents (London, 1972), 3. Narrative of the voyage: John Cooke, pp. 219-38, p. 235.

48. Seymour to Walsingham, 23 June 1588, Laughton, op. cit., vol. 1, pp. 222-224.

49. 10,000 were veterans, the rest were "vineyard workers,

shepherds, and the like." Deposition of Jan Henricx and Jacob Cornelis, 11 August 1588 (OS), Salisbury Mss., p. 344.

50. Recalde to Philip II, 11 July 1588 (postscript), Duro, op. cit., vol. 2, p. 172.

51. Medina Sidonia to Philip II, 19 July 1588, Duro, op. cit., vol. 2, p. 205.

52. Philip II to Medina Sidonia, 21 May 1588, AGS Estado 166/188.

53. Sealed instructions from Philip II to Parma, which Medina Sidonia was to hand him when he landed in England, Duro, op. cit., vol. 2, pp. 16-18.

54. Montgomery, Censuria Literaria, v, 139.

55. Howard to Walsingham, 21 July 1588 (OS), Laughton, op. cit., vol. 1, pp. 288-289.

56. Relation of proceedings, Laughton, op. cit., vol. 1, p. 12.

57. Medina Sidonia's diario, Duro, op. cit., vol. 2, pp. 245-246.

58. Perhaps they were. As we have seen, the two cañones de batir from La Trinidad Valencera were, unlike the other guns, unloaded when found, while the Venetian ambassador in France reported that when the Nuestra Señora del Rosario was captured she contained "a great quantity of field artillery which had been used as ballast" (Giavanni Mocenigo to the Doge and Senate, 19 August 1588, State Papers (Venetian), p. 377. The San Juan of Castile [28] also carried guns in her hold, as the testimony of her commander confirms (Relación of Marcos de Aramburu, Duro, op. cit., vol. 2, p. 324).

Appendix 1

1. AGS GA 223/28.

2. C. Fernández Duro, Disquisiciones Nauticas (Madrid, 1881), V, p. 152.

3. Joseph de Veitia Linage, Norte de la Contratación de las Indias Occidentales (Seville, 1672), XV: 8-13, pp. 183-184. The value of the Castilian vara in 1852, as published in the metric conversions of that year, was 835.9 mm. That the sixteenth century unit was in all essence the same is confirmed by a 1587 drawing from Simancas (AGS M y P, V-17; see Figure 38) on which a Castilian palma is drawn at full scale (4 palmas = 1 vara). It measures 209 mm.

4. F.C. Lane, "Tonnages, medieval and modern", Economic History Review, second series, 27 (1964), pp. 213-233. See also P. Chaunu, "La Tonelada Espagnole aux XVIe et XVIIe siècles", in M. Mollat (Ed.), Le navire et l'économie maritime du XVe au XVIIIe siècles (Paris, 1957), and J.S. Corbett, Drake and the Tudor navy, vol. 2, pp. 452-456.

5. I have assessed the Lavia's keel length as 53/65ths of her esloría figure - this being the ratio cited by Veitia Linage (op. cit., XIV: 14, p. 172) in his specification of a 700-ton galeón.

6. Although the six Armada ships in the document under discussion were rated according to the "three percent" formula, some of the others may have been assessed by the later "five percent" method. Such seems to have been the case with the Andalusian San Juan de Gargarín [46], whose esloría (47 3/4 codos), manga (14 codos), and puntal (14 1/3 codos) dimensions only square with the resultant figure of 569 toneladas if the later formula is used (AGS CMC 2a/1012).

Appendix 2

1. There are three in the Tower of London collections; see Blackmore, The Armouries of the Tower of London, nos. 295, 296, and 297, pp. 187-188 and plate 78.

2. J.G. Mann, "The Gunner's Stiletto", The Antiquaries Journal, 11 (1931), pp. 46-50.

3. Cataneo, Dell' arte militare....

4. Gentilini, Instruttioni de' bombardieri, p. 4.

5. Capo Bianco, Corona e palma militare..., p. 3.

6. Mann, op. cit., p.

7. Blackmore, op. cit., Marcello Terenzi, Stiletto da Bombardiere (Rome, 1962).

8. Lewis, Armada guns, p. 218.

9. Medina Sidonia's General Orders to the fleet, State Papers (Spanish), p. 291.

10. Monson, Naval Tracts, vol. IV, p. 86.

11. Duro, Armada Invencible, vol. 1, p. 390.

Appendix 3

1. The guns carried by the Rosario are listed in an unsigned and undated document, probably of 1591, which cites the armament of three ships of the 1588 Armada as a guide to future planning (AGS GA 347, unfol.). The English inventory of this ship was enclosed with a letter from John Gilberte and George Cary to the Council on 29 August 1588 (OS), and is published by Laughton, Spanish Armada, vol. 2, pp. 190-194. Spanish sources for the San Salvador's guns are the relación of guns on board the ships of Oquendo's squadron, 31 October 1587 (AGS GA 221/41) and the additions recorded in AGS GA 221/153 on 14 May 1588. After her capture in the Channel her guns were inventoried at Weymouth by George Trenchard and Francis Hawley on 24 August 1588 (OS), Laughton, op. cit., vol. 2, pp. 154-158.

2. Bourne, Arte of Shooting in Great Ordnaunce, p. 13.

3. Philip II to Medina Sidonia, 14 March 1588, Duro, Armada Invencible, vol. 1, pp. 435-437. Don Pedro had asked the king for some of the bigger guns which were being cast at the Lisbon foundry. Many of these new guns were pedreros, and so it seems that Don Pedro got his way.

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Contaduría del Sueldo (CS), 2ª época (2ª)	280/1460 280/1931
Contaduría Mayor de Cuentas (CMC), 2ª época (2ª)	460/162-67 773/133 942/109 1012/5 1200 1234
Guerra Antigua (GA)	187/157 199/52 214/90 219/36 220/61 221/2 221/39-41 221/49 221/64 221/147-48 221/153-56 223/24 223/28 237/88 347
Mapas y Planos (MyP)	V, 16-20 XVIII, 48-49
Secretería de Estado (<u>Estado</u>)	166/188 431/70 431/135 590/22 592/135

Bodleian Library, Oxford, Rawlinson manuscripts, A 189

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618/84

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Maps, Plans and Figures (MPF)	75
State Papers (SP)	12/202/20 63/136/4/v 63/136/57 63/137/15-16

Scottish Record Office, Edinburgh (SRO)

Admiralty Court (AC)	7/37/450-710 8/398 9/1182 9/1203(Warrants
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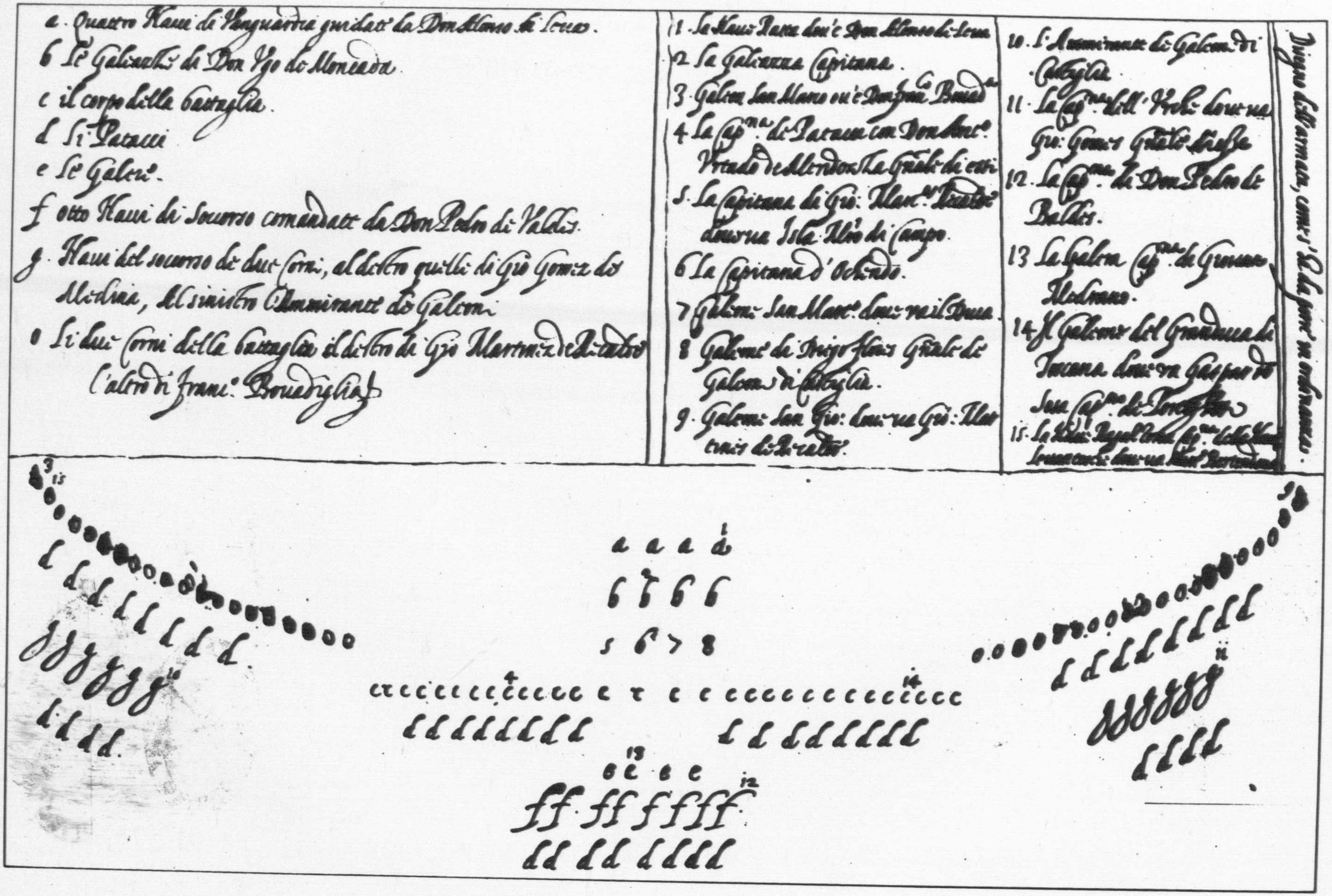


Disegno dell'armata, come s'ha da porre in ordinanza.
a. Quattro Navi di Vanguardia guidate da Don Alonso de Leiva.
b Le Galeazze di Don Ugo de Moncada
c il corpo della battaglia
d Li Patacci
e Le Galere.
f otto Navi di Soccorso comandate da Don Pedro di Valdes.
g. Navi del soccorso de due corni, al destro quelli di Gio Gomez de Medina, al sinistro l'Ammirante de' Galeoni
o Li due Corni della battaglia il destro di Gio Martinez de Recalde l'altro di Franc.° Bovadiglia.
1. La Nave Rata dov'è Don Alonso di Leiva
2 La Galeazza Capitana.
3 Galeon San Marco ov'è Don Fran.co Bovad.a
4 La Cap.na di Patacci con Don Ant.o Urtado de Mendoza Generale di essi
5. La Capitana di Gio: Mart.z Recalde dove va Isla Mro di Campo.
6 La Capitana d'Ochendo.
7 Galeone San Mart.o dove va il Duca
8 Galeone di Diego Flores Generale de Galeoni di Castiglia.
9. Galeone San Gio: dove va Gio: Martinez di Recalde.
10. L'Ammirante di Galeoni di Castiglia.
11. La Cap.na dell'Urche dove va Gio: Gomez Generale di esse
12. La Cap.na di Don Pedro di Valdes.
13 La Galera Cap.na di Giovanni Medrano.
14. Il Galeone del Granduca di Toscana dove va Gaspar de Sosa Cap.no di Toscana
15. La Nave Regazona Cap.na della [illegible] dove va [illegible]
a a a a
b b b b
5 6 7 8
c c c c c c c c c c c c c c c c c c c c c c c c c c c c c c c c c
d d d d d d d d d d d d d d d d d d d d d d d
e e e e
f f f f f f f f f
d d d d d d d d d
g g g g g g

FIGURE 1


32°
24°
16°
8°
0°
8°
60°
56°
52°
48°
44°
40°
36°
ICELAND
Zuniga (on 26 Aug)
Faroes
Shetland
Fair Isle
Orkney
St Kilda
Rockall Bank
Anstruther
SCOTLAND
Edinburgh
English fleet breaks off
IRELAND
ENGLAND
Blaskets
London
Scillies
Antwerp
Malines
Dunkirk
Calais
NETHERLANDS
THE EMPIRE
Metz
Rostock
Wismar
Lübeck
Hamburg
Bremen
Danzig
POLAND
Paris
Franche Comte
SWISS CONFED
AUSTRIA
HUNGARY
FRANCE
Charolais
Savoy
Piedmont
Milan
Venice
OTTOMAN EMPIRE
San Sebastian
Santander
Bilbao
Bayonne
Corunna
Nájera
Burgos
Matute
Simancas
Escorial
Madrid
Toledo
ARAGON
PORTUGAL
CASTILE
Lisbon
Seville
Cadiz
Malaga
Cartagena
Genoa
Leghorn
Florence
Papal States
Ascoli
Ragusa
Rome
Naples
KINGDOM OF THE TWO SICILIES
Palermo
Messina
MALTA
APPROXIMATE TRACKS
THE ARMADA : 28 May - 9 Aug
NORTH ABOUT : 10 Aug - Sept/Oct
SAN JUAN de CASTILLA (ARUMBURU) : 25 Aug - 14 Oct
EL GRAN GRIFON : 4/28 Sept
LA TRINIDAD VALENCERA : 4/13 Sept
POSSESSIONS OF PHILIP II

FIGURE 2

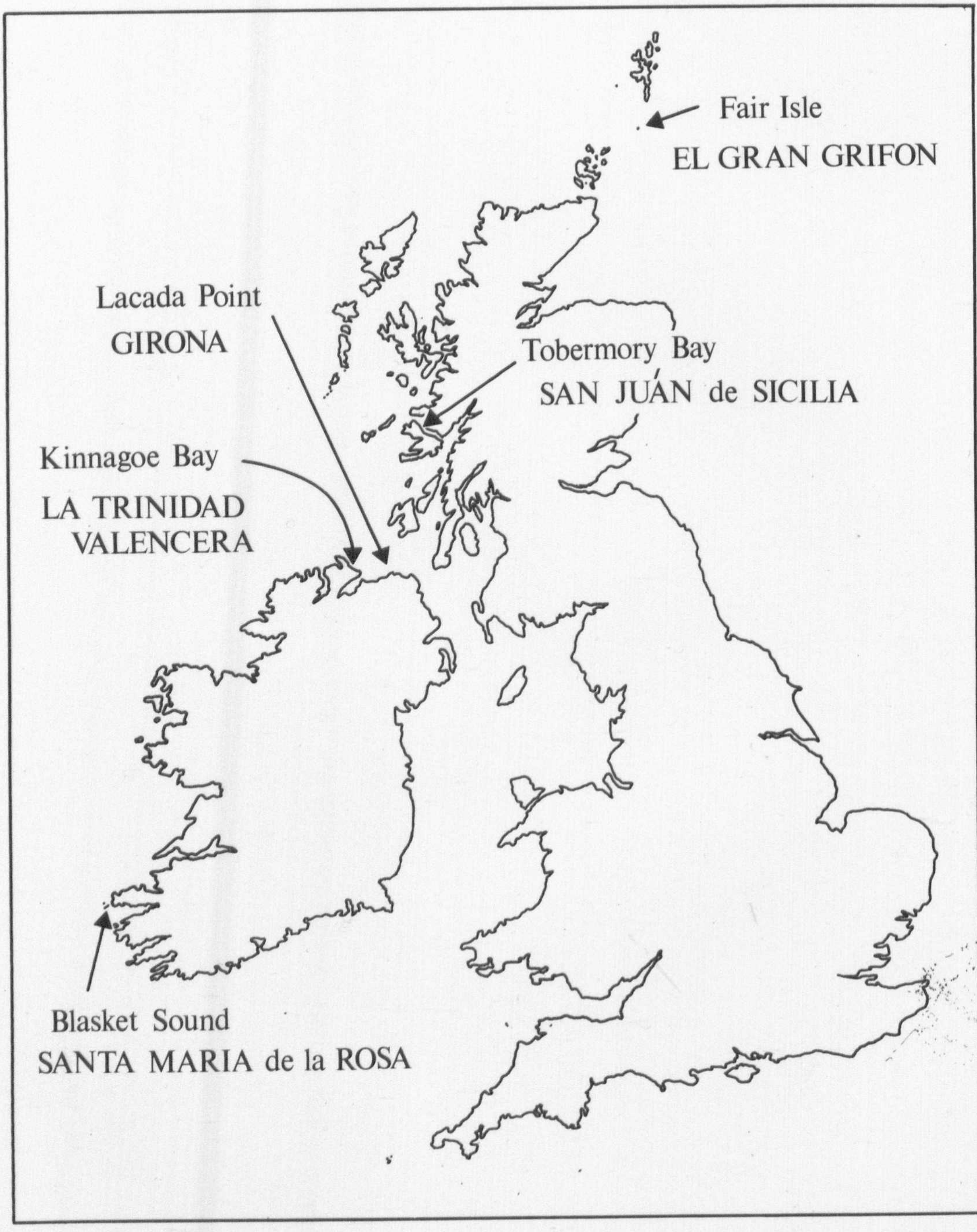

Fair Isle
EL GRAN GRIFON
Lacada Point
GIRONA
Tobermory Bay
SAN JUÁN de SICILIA
Kinnagoe Bay
LA TRINIDAD
VALENCERA
Blasket Sound
SANTA MARIA de la ROSA

FIGURE 3

FIGURE 4

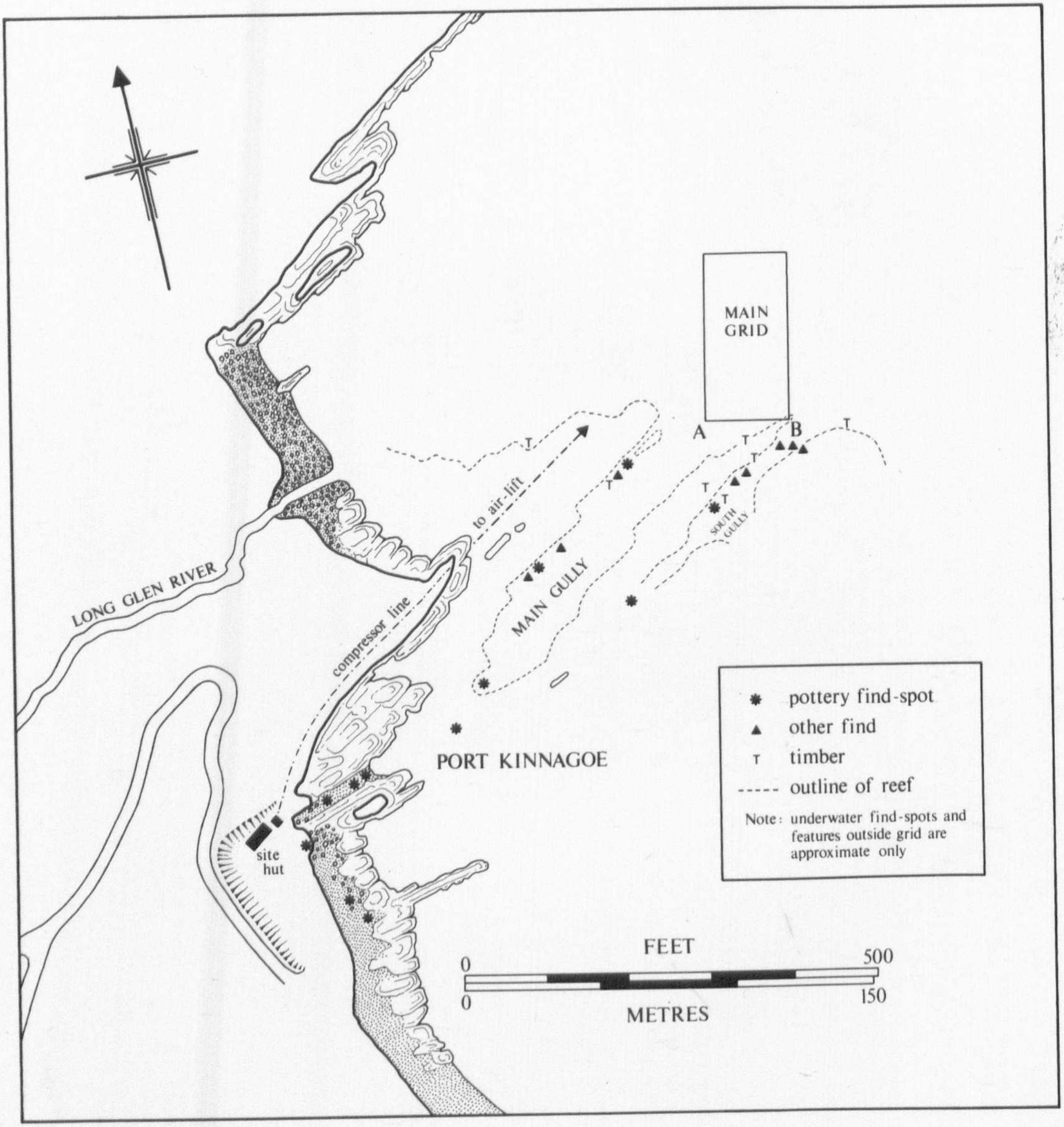
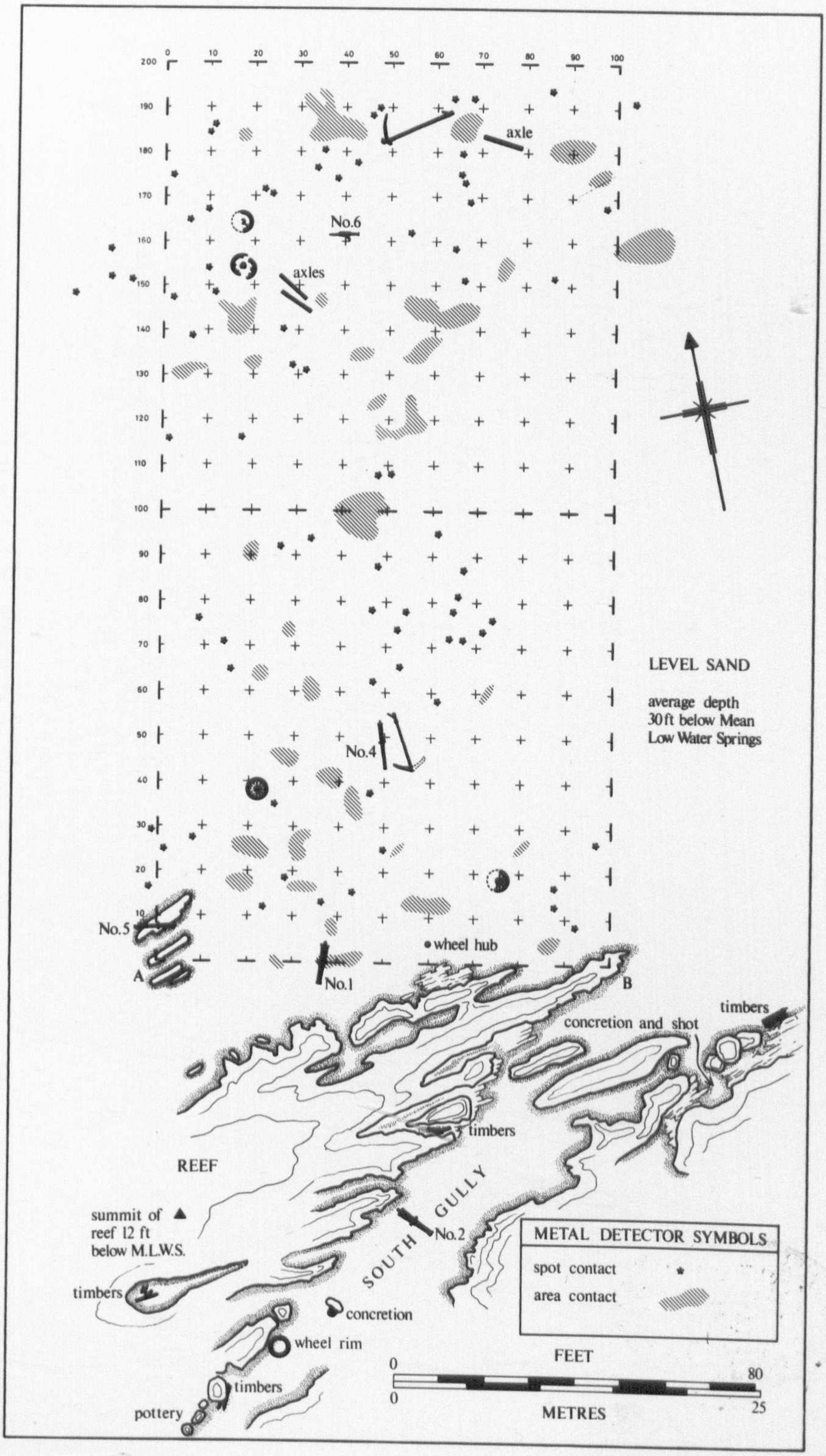

MAIN GRID
A
B
T
to air-lift
compressor line
MAIN GULLY
SOUTH GULLY
LONG GLEN RIVER
PORT KINNAGOE
site hut
pottery find-spot
other find
timber
outline of reef
Note: underwater find-spots and features outside grid are approximate only
FEET
0
500
0
150
METRES

FIGURE 5



axle
No.6
axles
LEVEL SAND
average depth
30 ft below Mean
Low Water Springs
No.4
No.5
A
No.1
wheel hub
B
timbers
concretion and shot
timbers
REEF
SOUTH GULLY
summit of
reef 12 ft
below M.L.W.S.
No.2
METAL DETECTOR SYMBOLS
spot contact
area contact
timbers
concretion
wheel rim
timbers
pottery
FEET
0
80
0
25
METRES

FIGURE 6

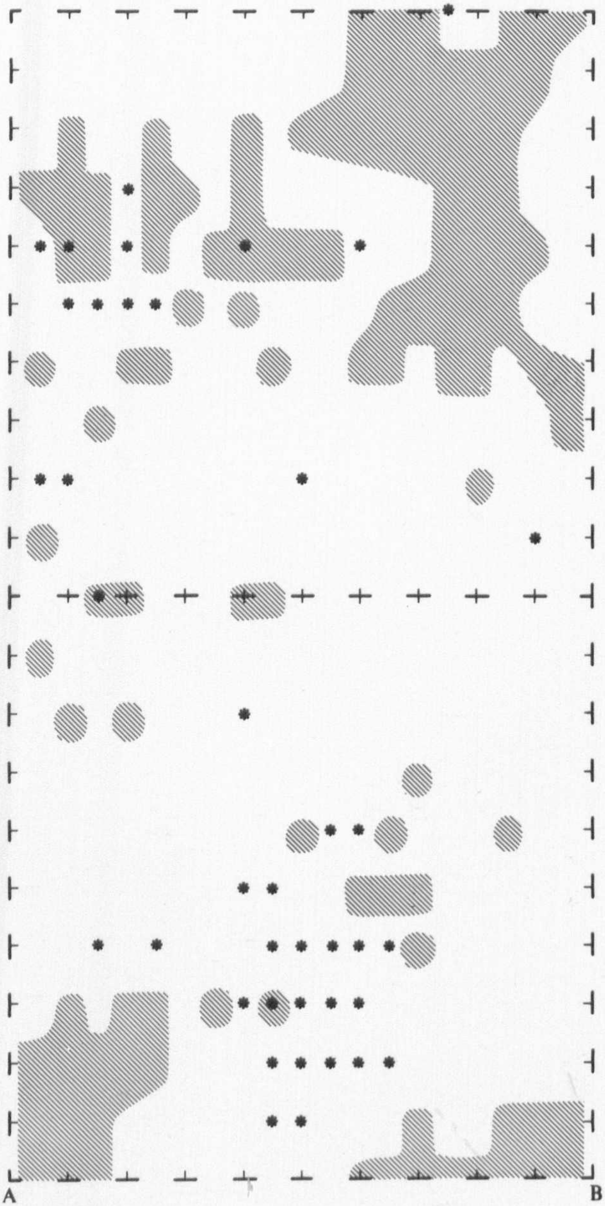
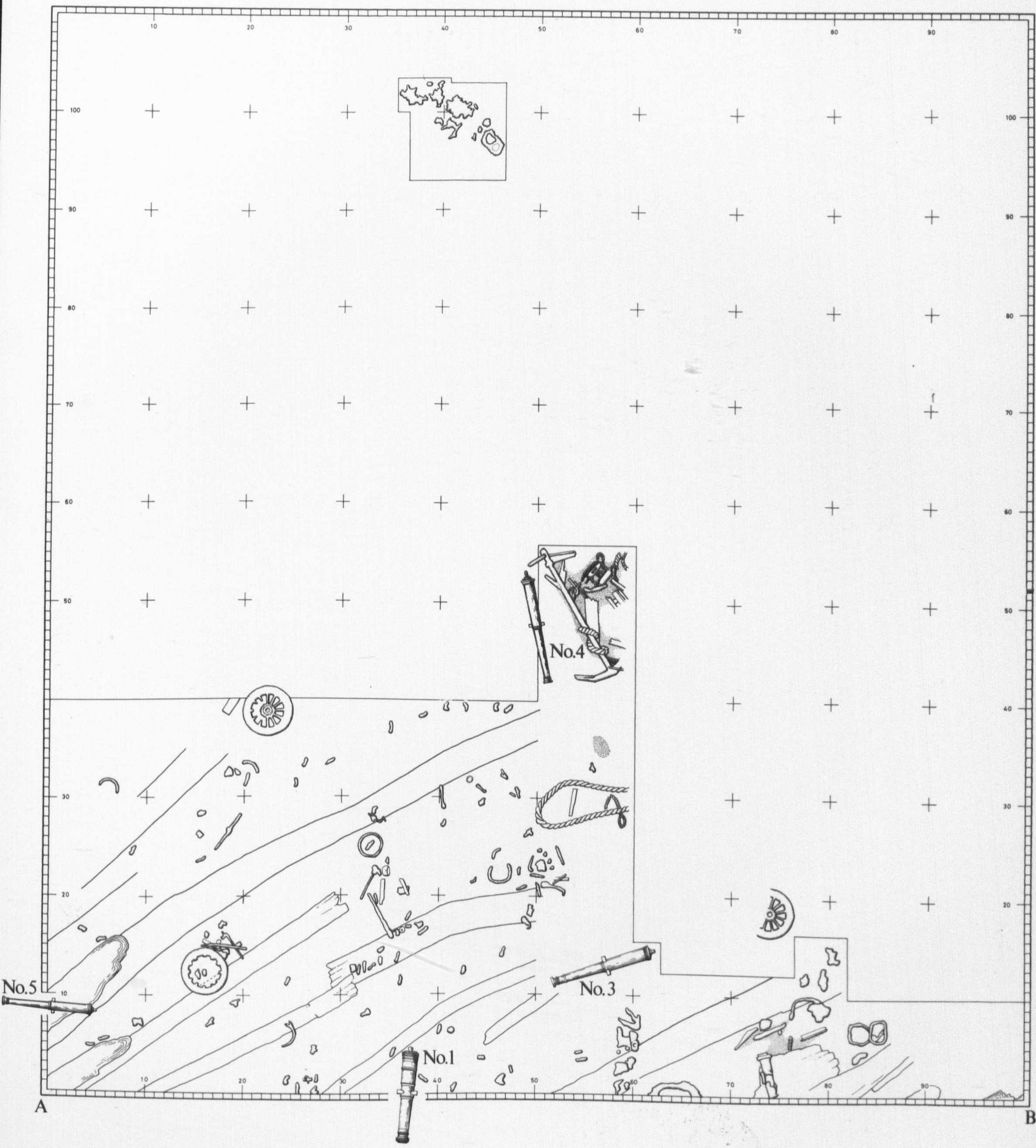
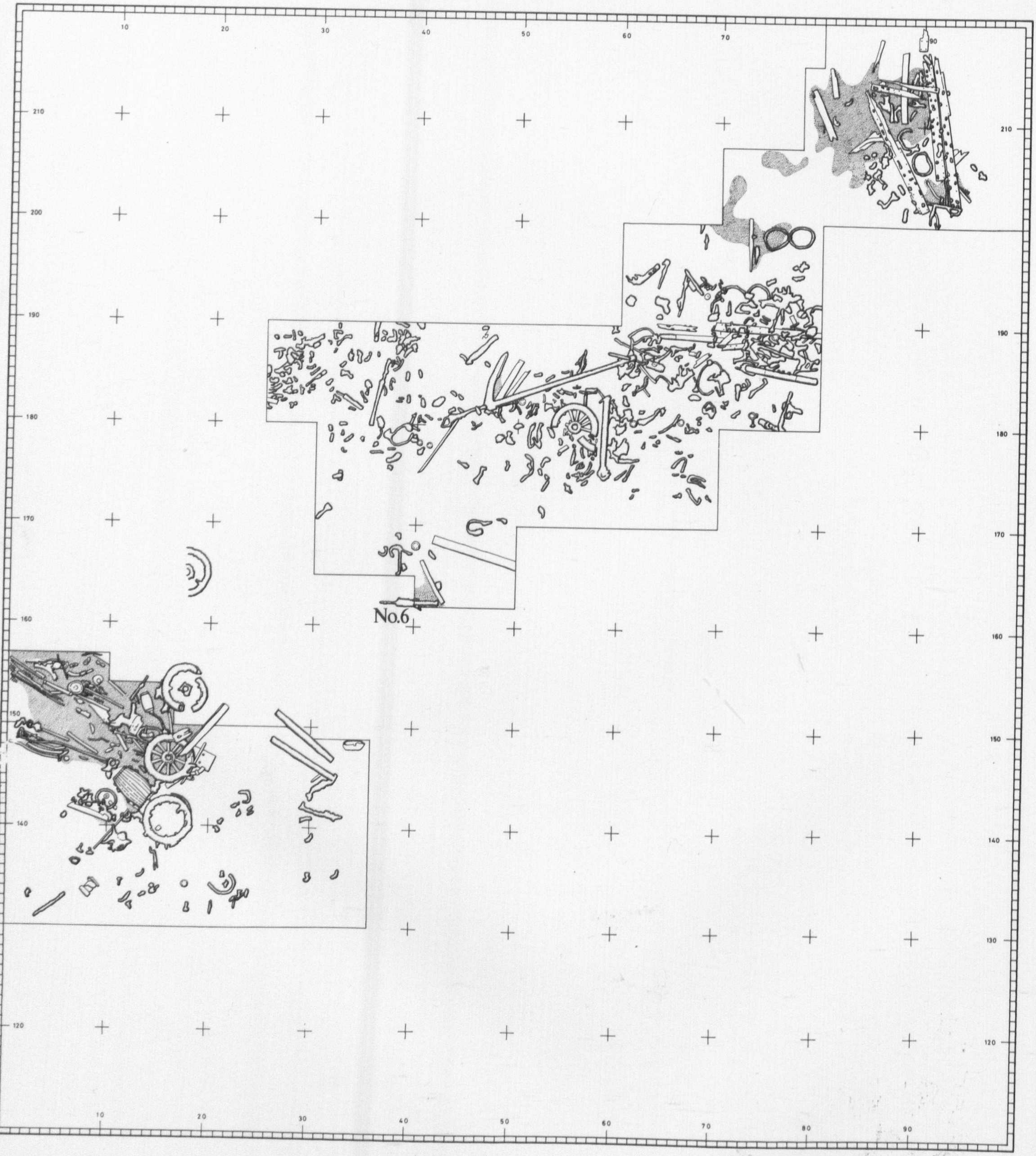


FIGURE 7



SOUTH SECTOR OF GRID

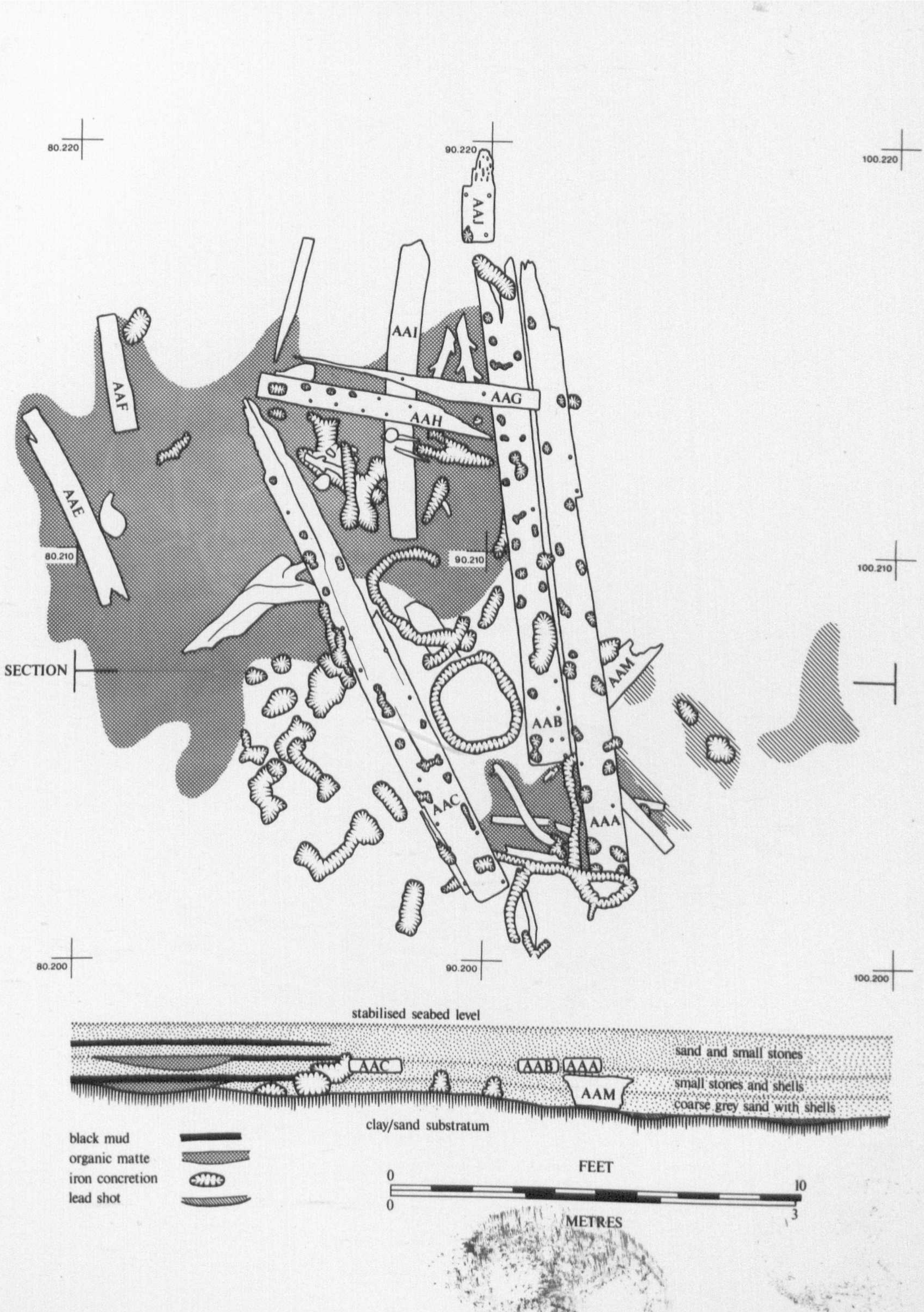
FIGURE 8



NORTH SECTOR OF GRID

Grid scale in feet

FIGURE 9



80.220
90.220
100.220
AAJ
AAI
AAF
AAG
AAH
AAE
80.210
90.210
100.210
SECTION
AAM
AAB
AAC
AAA
80.200
90.200
100.200
stabilised seabed level
sand and small stones
AAC
AAB
AAA
small stones and shells
AAM
coarse grey sand with shells
clay/sand substratum
black mud
organic matte
iron concretion
lead shot
FEET
0
10
0
3
METRES

FIGURE 10

FIGURE 11

FIGURE 12

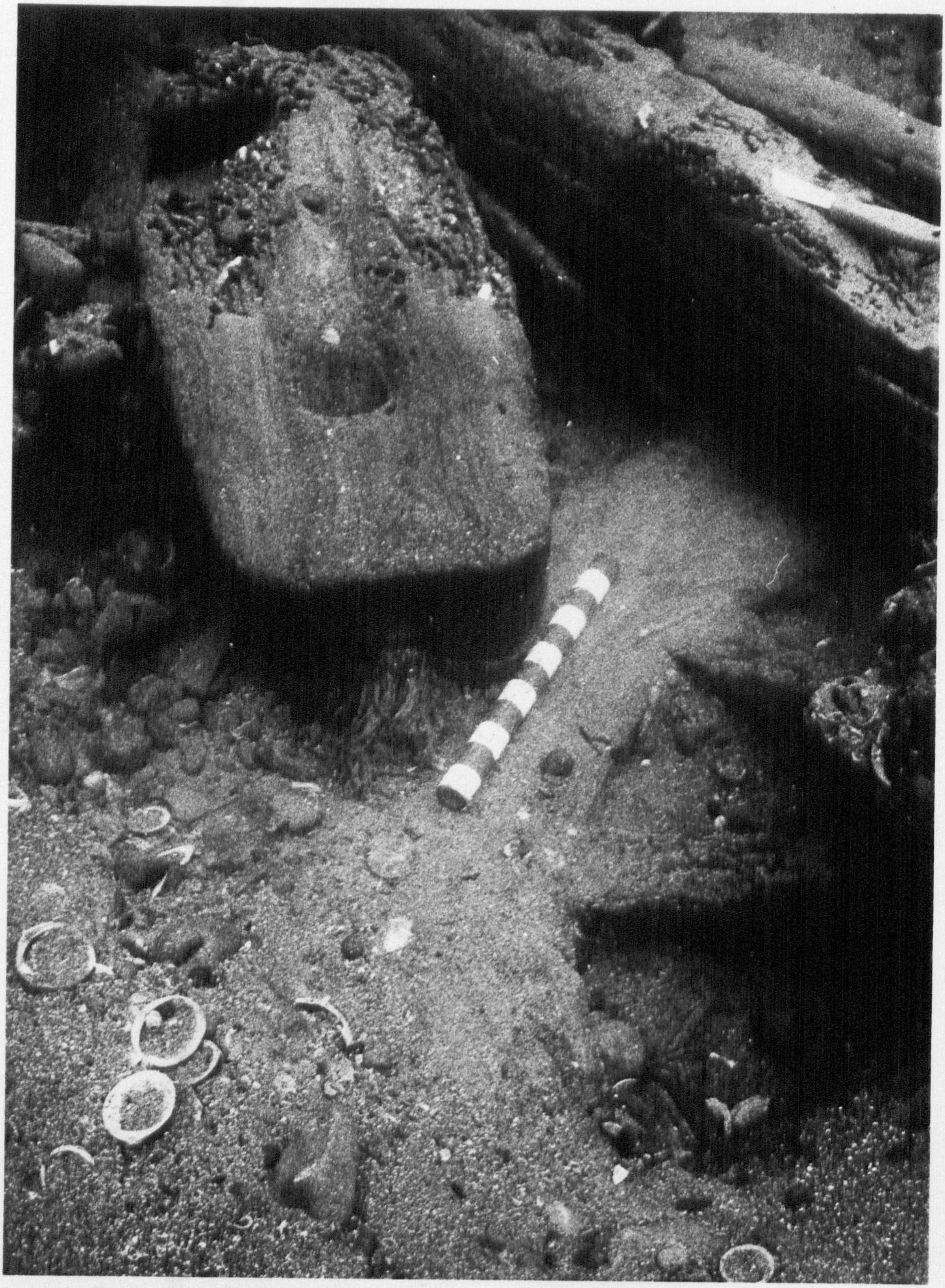


FIGURE 13

FIGURE 14

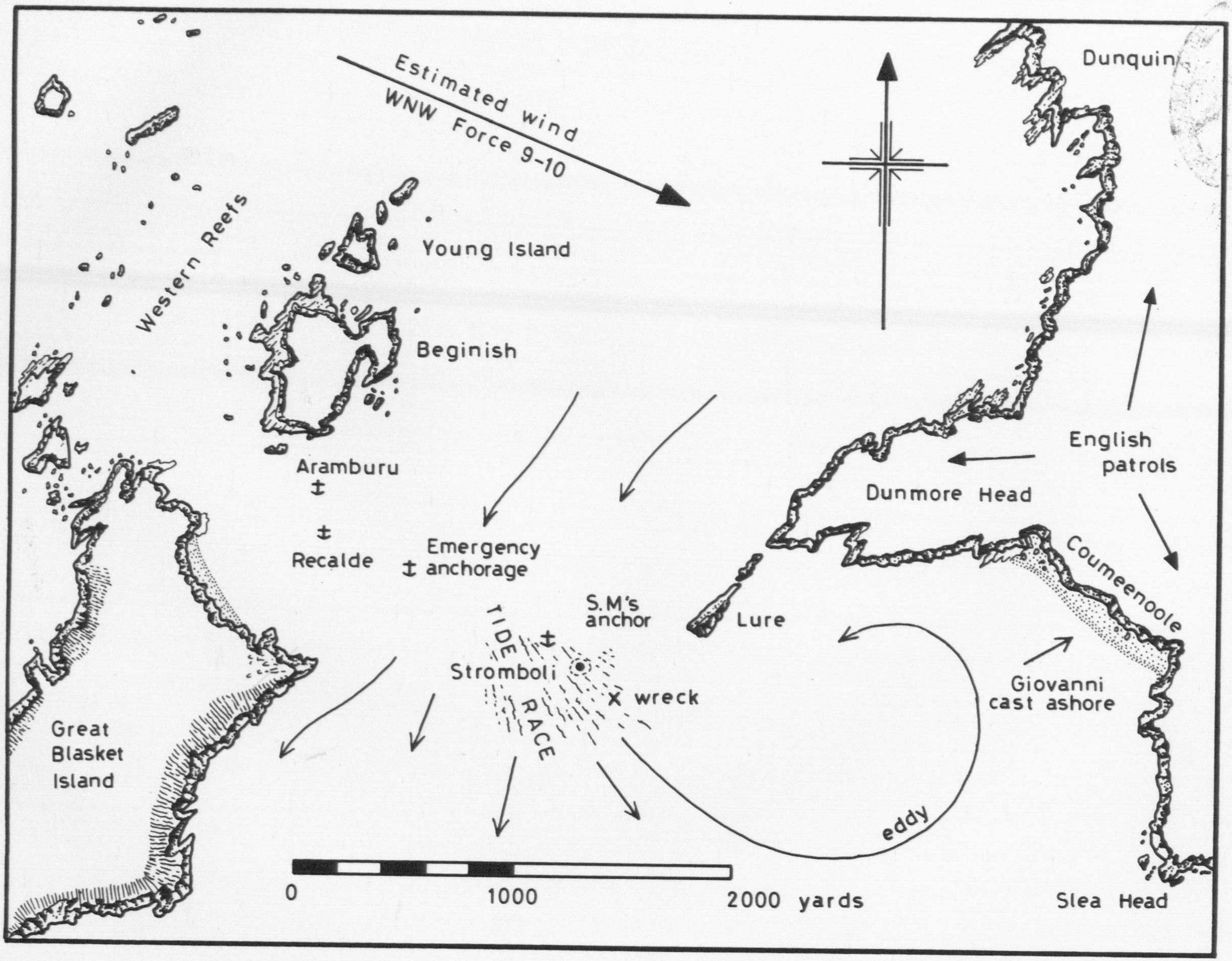

Estimated wind
WNW Force 9-10
Western Reefs
Young Island
Beginish
Aramburu
Recalde
Emergency anchorage
Dunquin
English patrols
Dunmore Head
Coumeenoole
Lure
S.M's anchor
TIDE RACE
Stromboli
wreck
eddy
Giovanni cast ashore
Great Blasket Island
0
1000
2000 yards
Slea Head

FIGURE 15

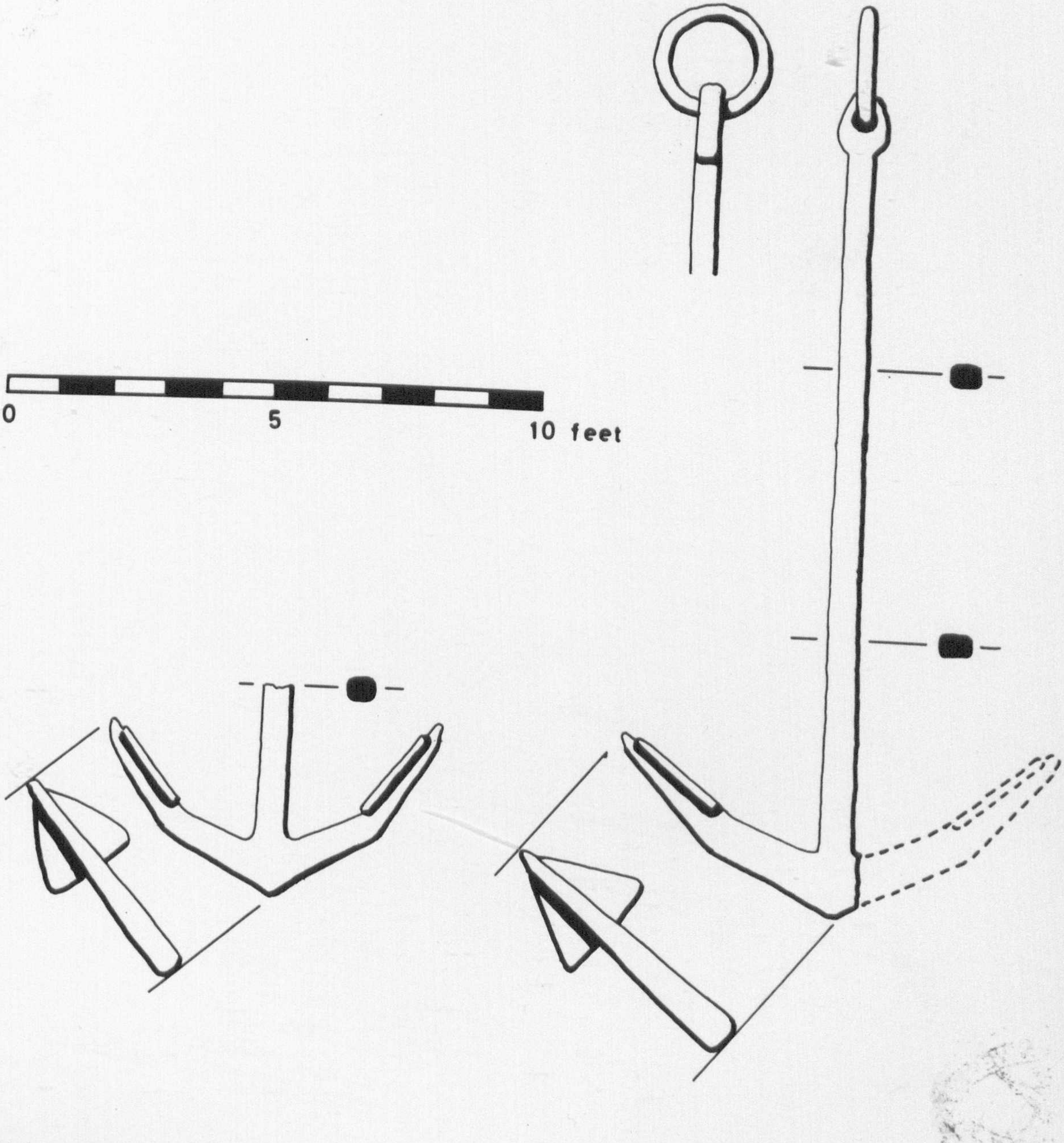


FIGURE 16

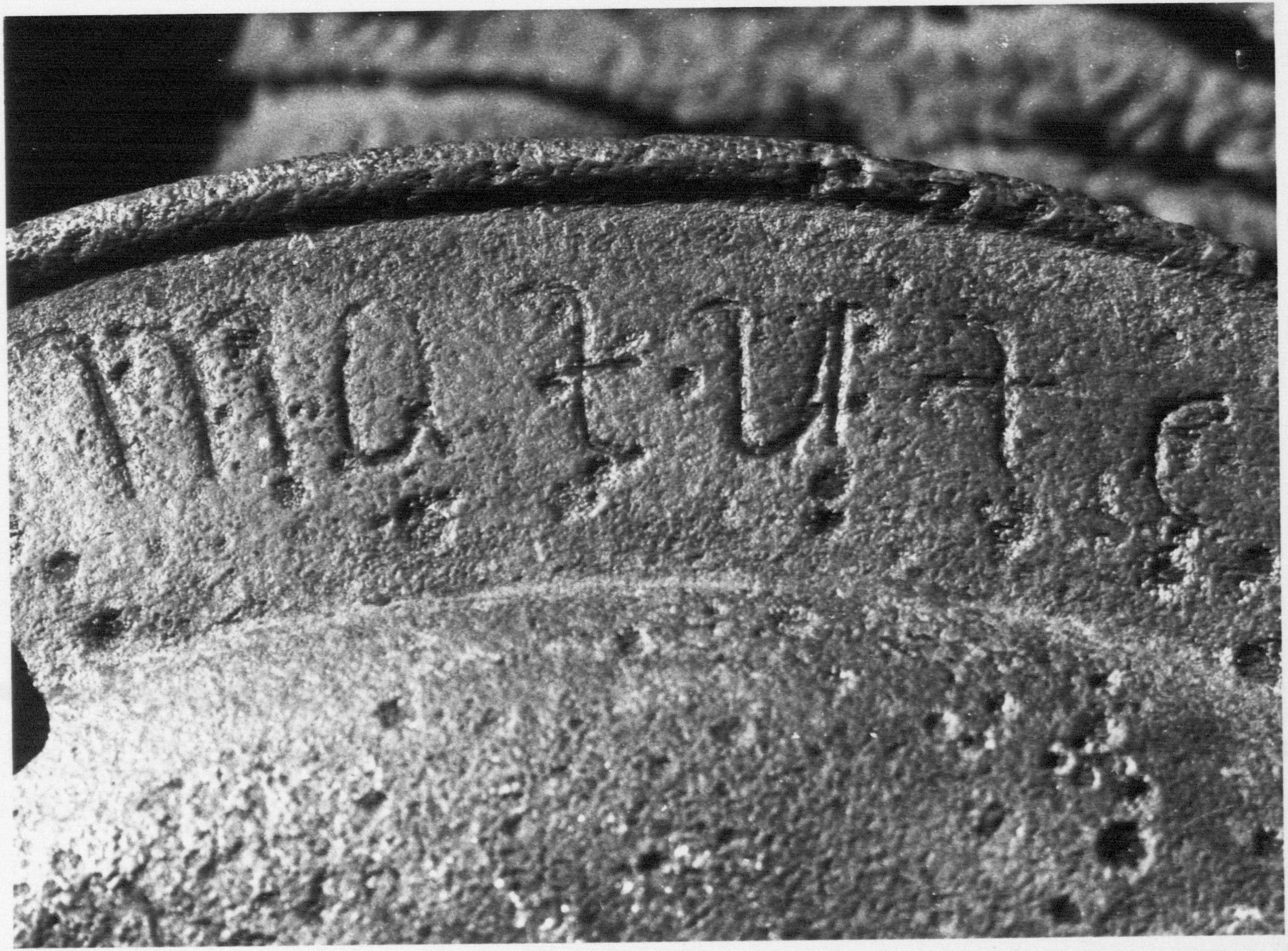


FIGURE 17

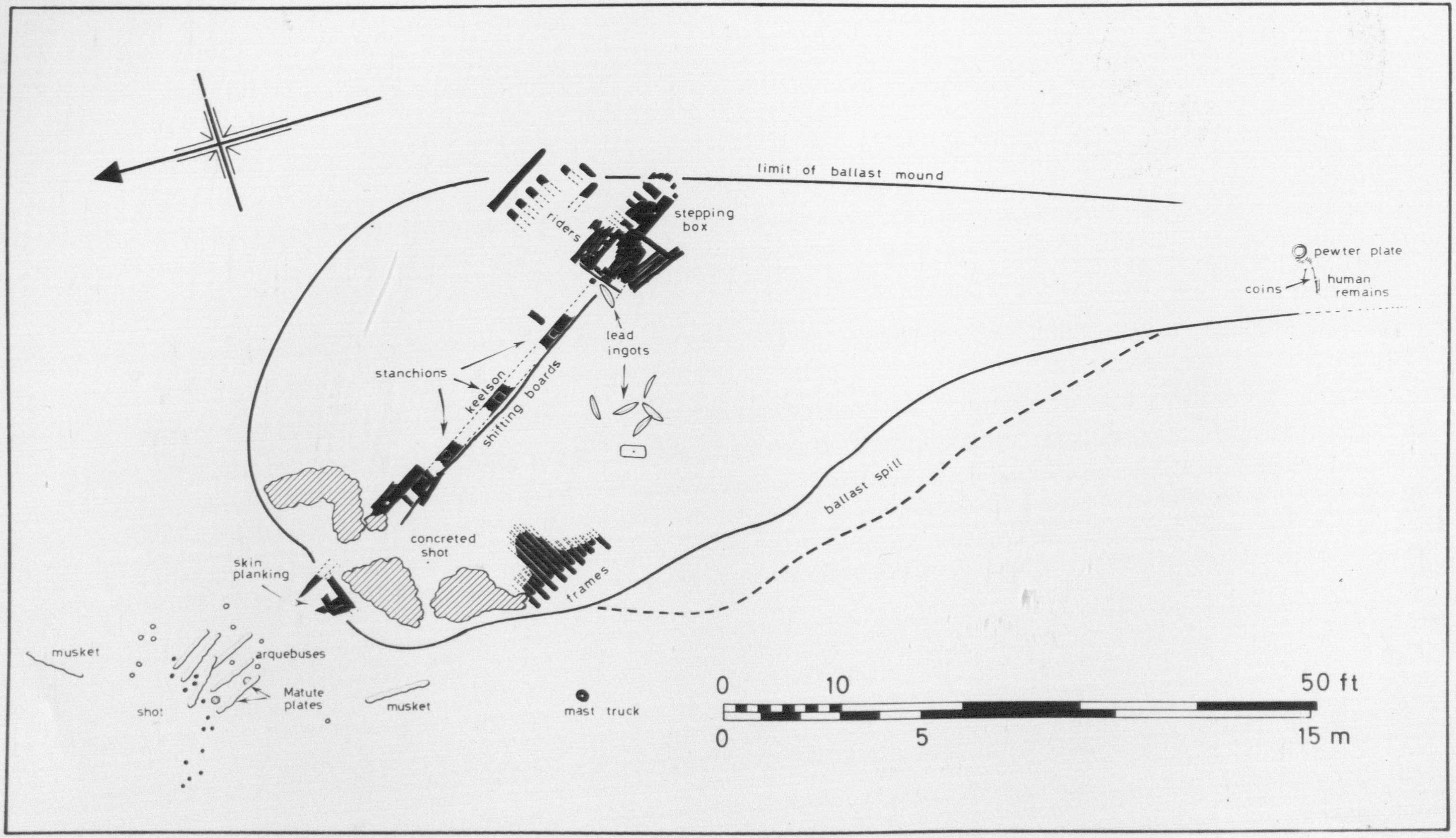
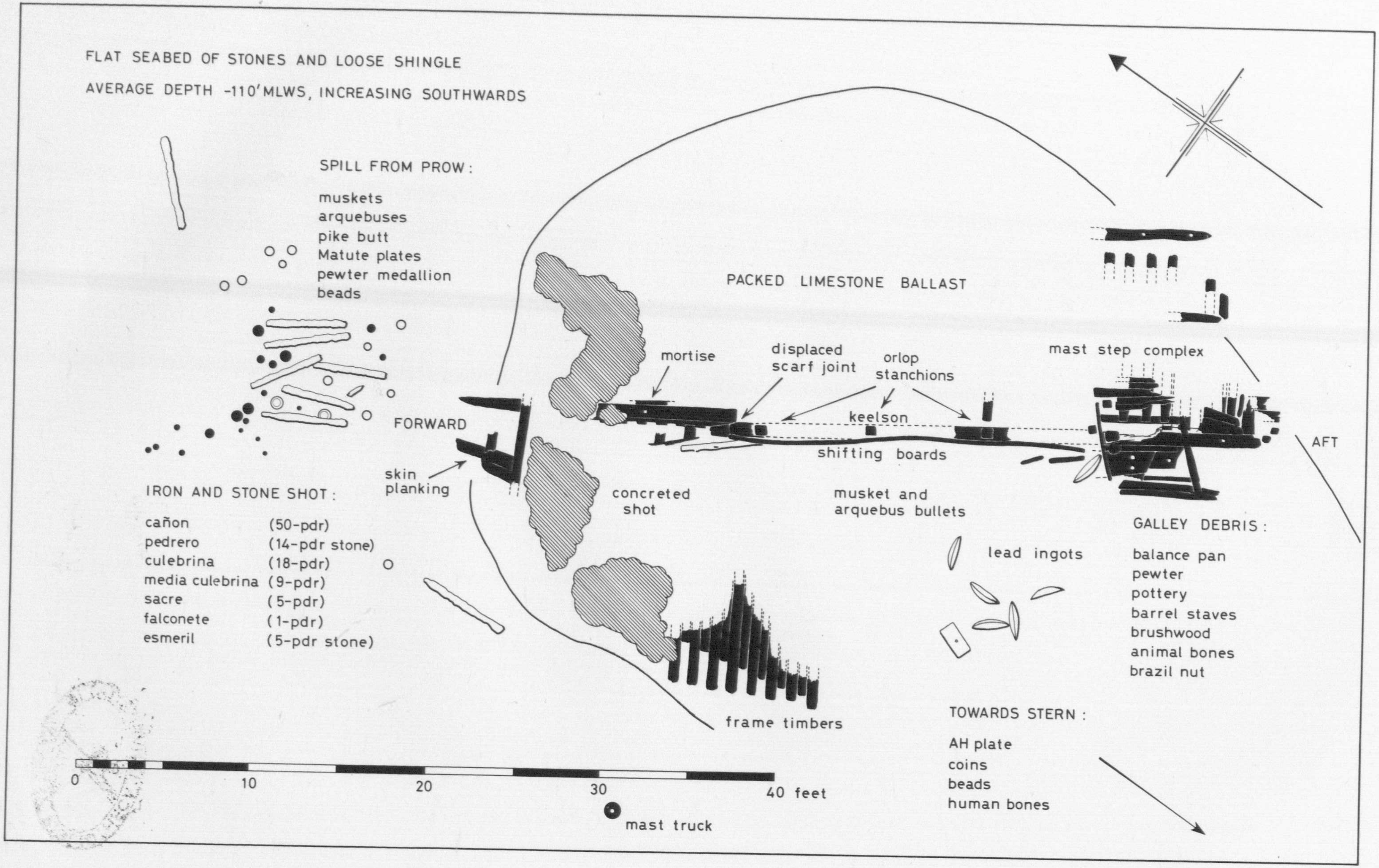

limit of ballast mound
riders
stepping box
pewter plate
coins
human remains
lead ingots
stanchions
keelson
shifting boards
ballast spill
concreted shot
skin planking
frames
musket
arquebuses
Matute plates
shot
musket
mast truck
0
10
50 ft
0
5
15 m

FIGURE 18



FLAT SEABED OF STONES AND LOOSE SHINGLE
AVERAGE DEPTH -110'MLWS, INCREASING SOUTHWARDS
SPILL FROM PROW:
muskets
arquebuses
pike butt
Matute plates
pewter medallion
beads
PACKED LIMESTONE BALLAST
mast step complex
mortise
displaced scarf joint
orlop stanchions
keelson
FORWARD
shifting boards
AFT
skin planking
concreted shot
musket and arquebus bullets
IRON AND STONE SHOT:
cañon (50-pdr)
pedrero (14-pdr stone)
culebrina (18-pdr)
media culebrina (9-pdr)
sacre (5-pdr)
falconete (1-pdr)
esmeril (5-pdr stone)
lead ingots
GALLEY DEBRIS:
balance pan
pewter
pottery
barrel staves
brushwood
animal bones
brazil nut
frame timbers
TOWARDS STERN:
AH plate
coins
beads
human bones
0
10
20
30
40 feet
mast truck

FIGURE 19

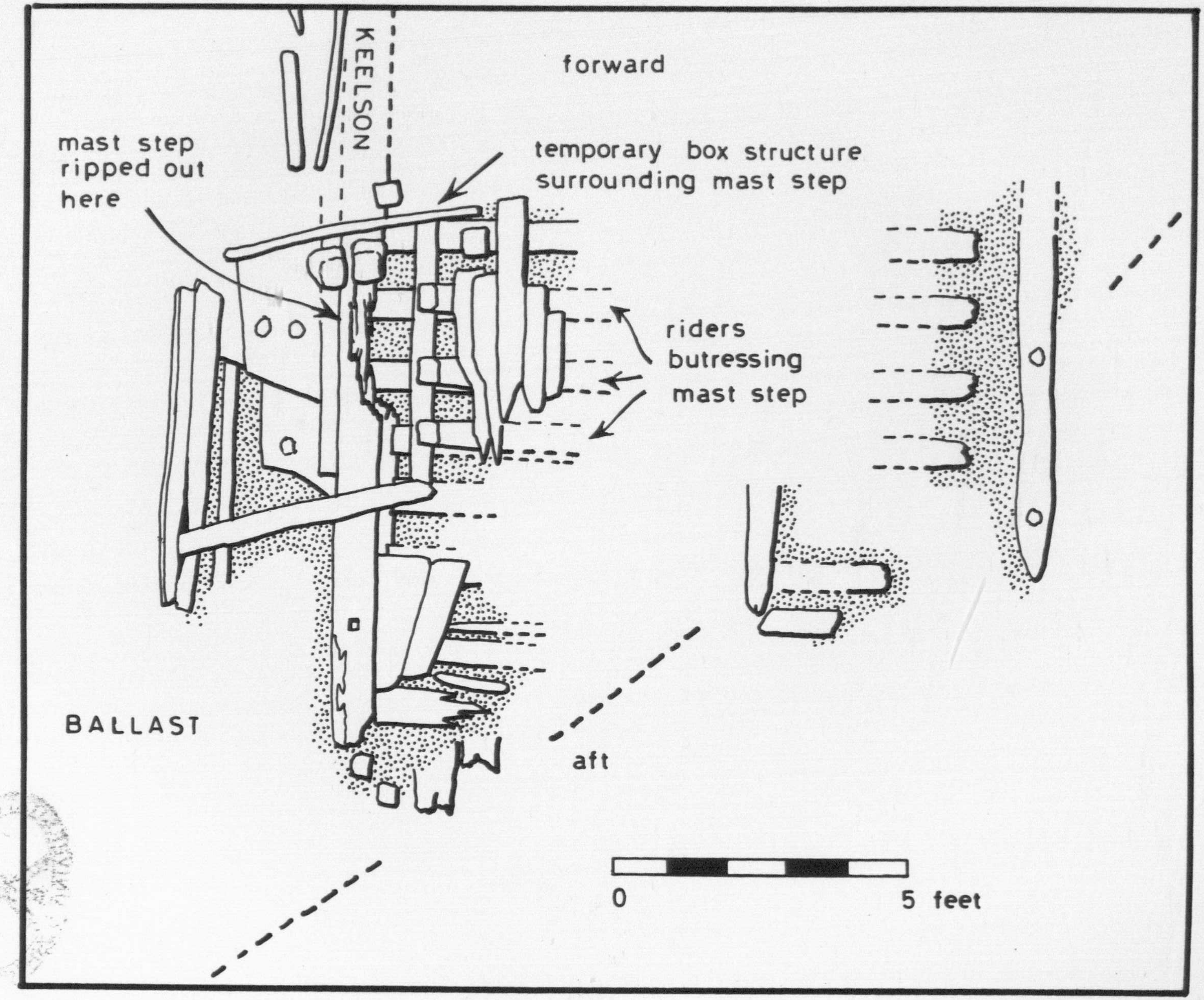
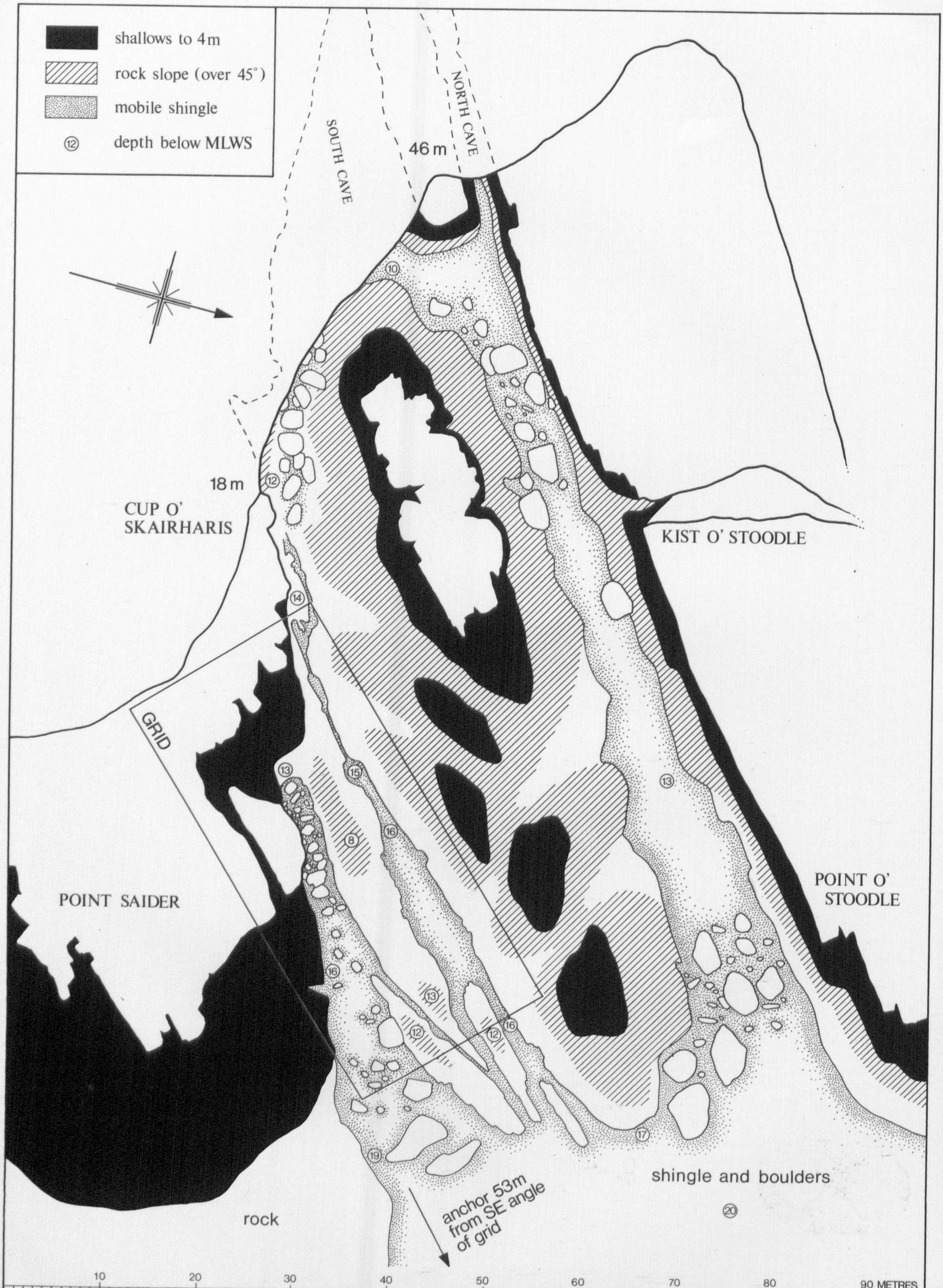

forward
KEELSON
mast step
ripped out
here
temporary box structure
surrounding mast step
riders
butressing
mast step
BALLAST
aft
0
5 feet

FIGURE 20

FIGURE 21

FIGURE 22



shallows to 4m
rock slope (over 45°)
mobile shingle
depth below MLWS
SOUTH CAVE
NORTH CAVE
46 m
18 m
CUP O' SKAIRHARIS
KIST O' STOODLE
GRID
POINT SAIDER
POINT O' STOODLE
shingle and boulders
rock
anchor 53m from SE angle of grid
10
20
30
40
50
60
70
80
90 METRES

FIGURE 23

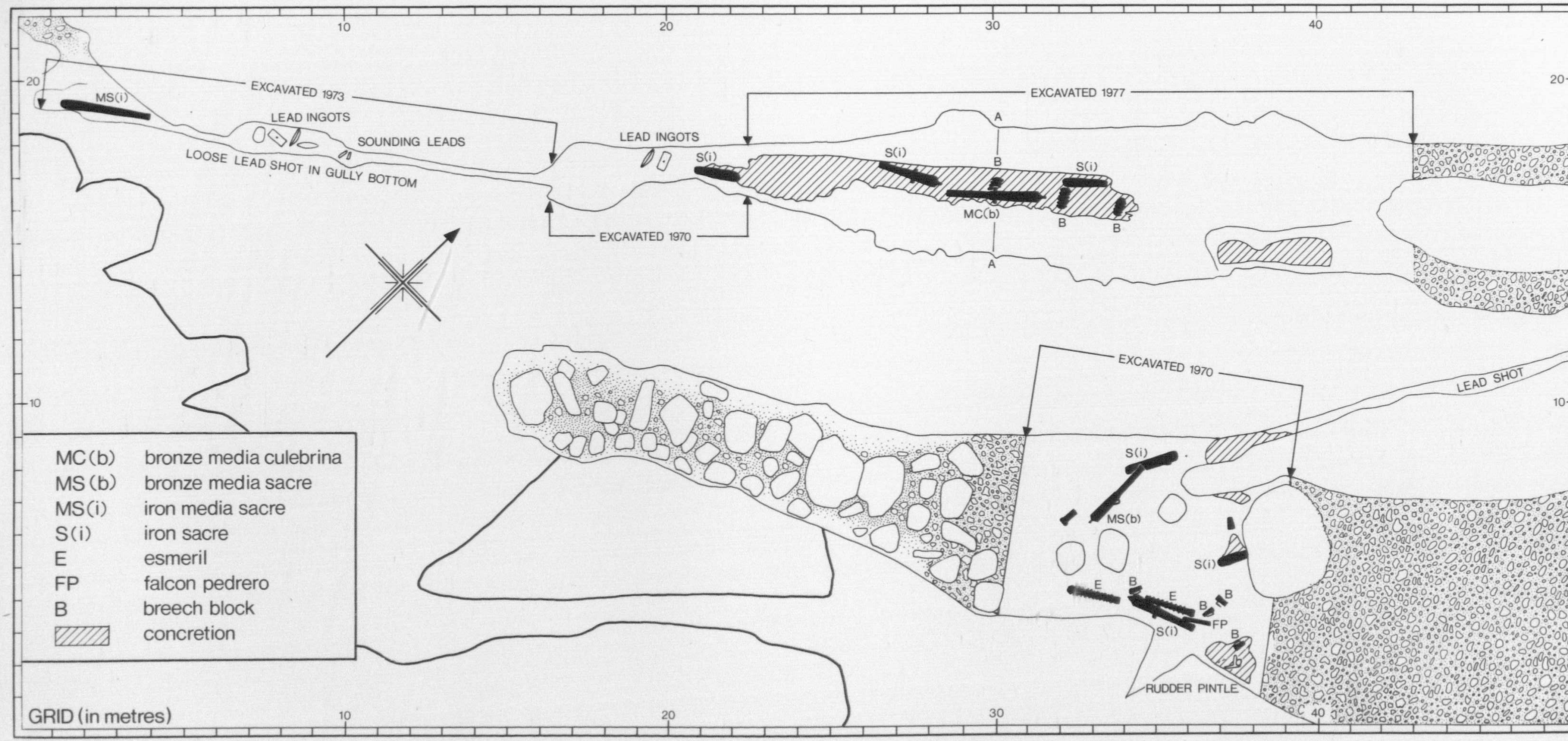

EXCAVATED 1973
MS(i)
LEAD INGOTS
SOUNDING LEADS
LOOSE LEAD SHOT IN GULLY BOTTOM
LEAD INGOTS
S(i)
EXCAVATED 1970
EXCAVATED 1977
A
B
S(i)
MC(b)
S(i)
B
B
A
EXCAVATED 1970
LEAD SHOT
S(i)
MS(b)
S(i)
E
B
E
B
B
FP
S(i)
B
RUDDER PINTLE
MC(b) bronze media culebrina
MS(b) bronze media sacre
MS(i) iron media sacre
S(i) iron sacre
E esmeril
FP falcon pedrero
B breech block
concretion
GRID (in metres)
10
20
30
40

FIGURE 24

FIGURE 25

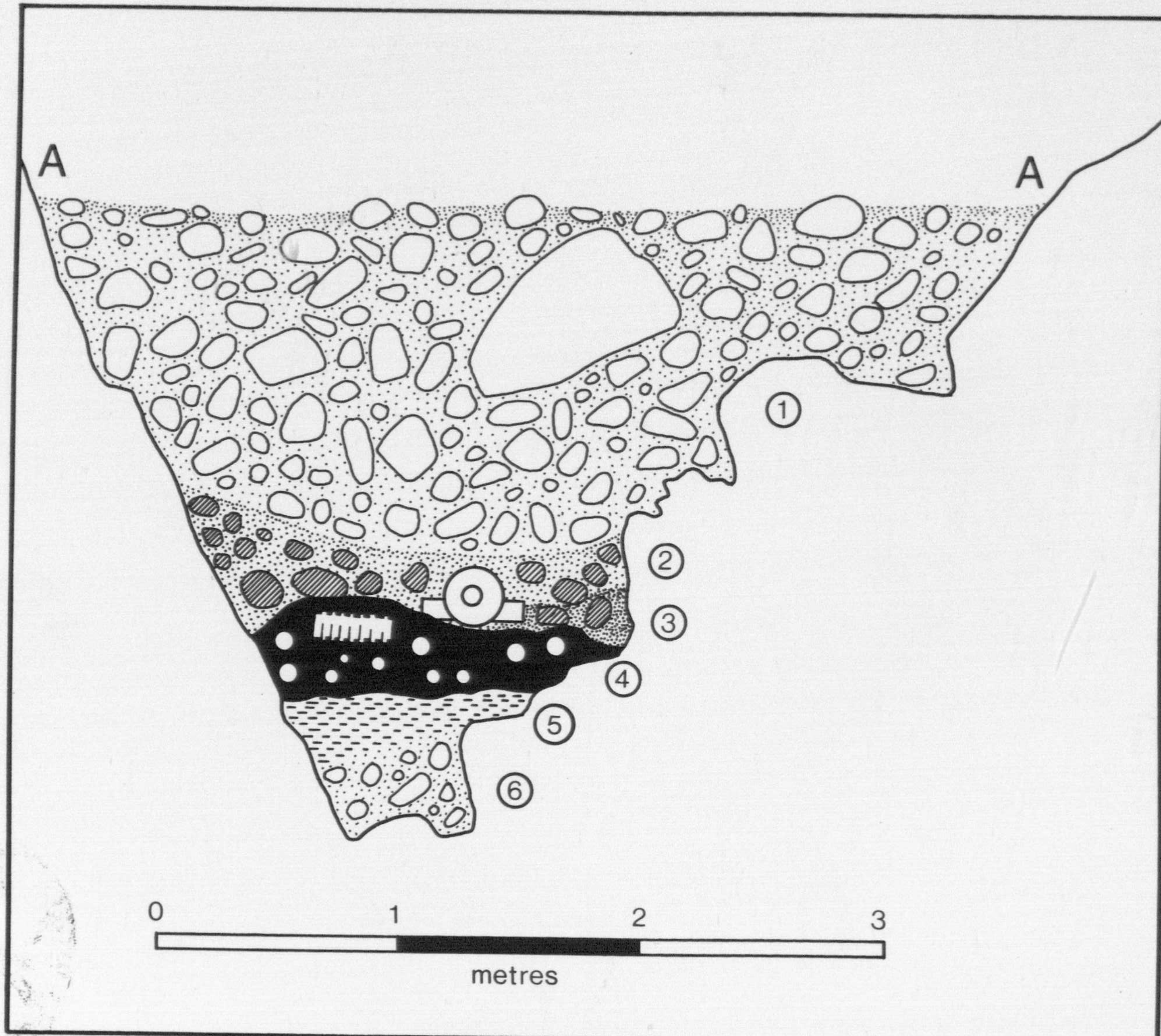


FIGURE 26

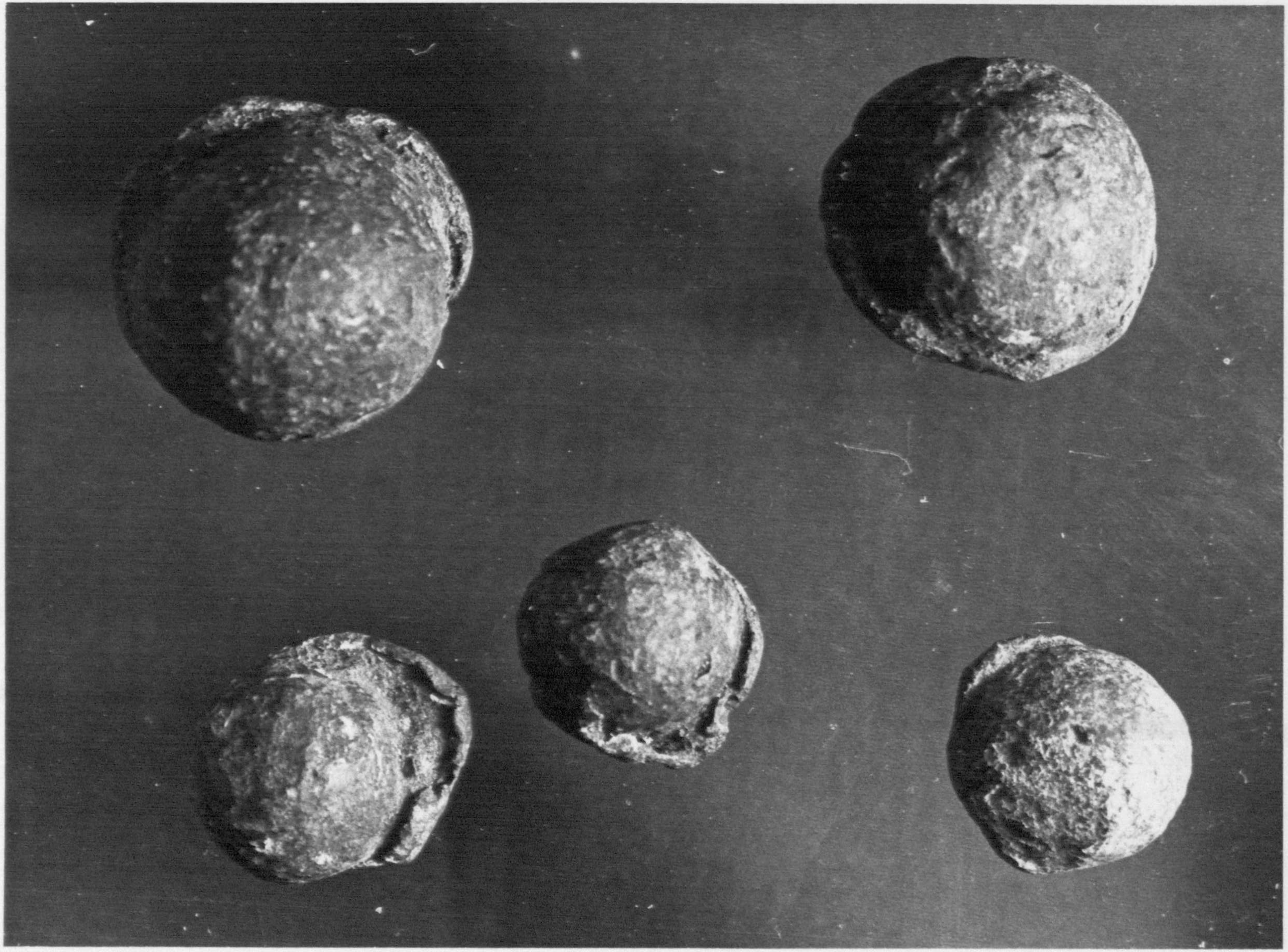


FIGURE 27

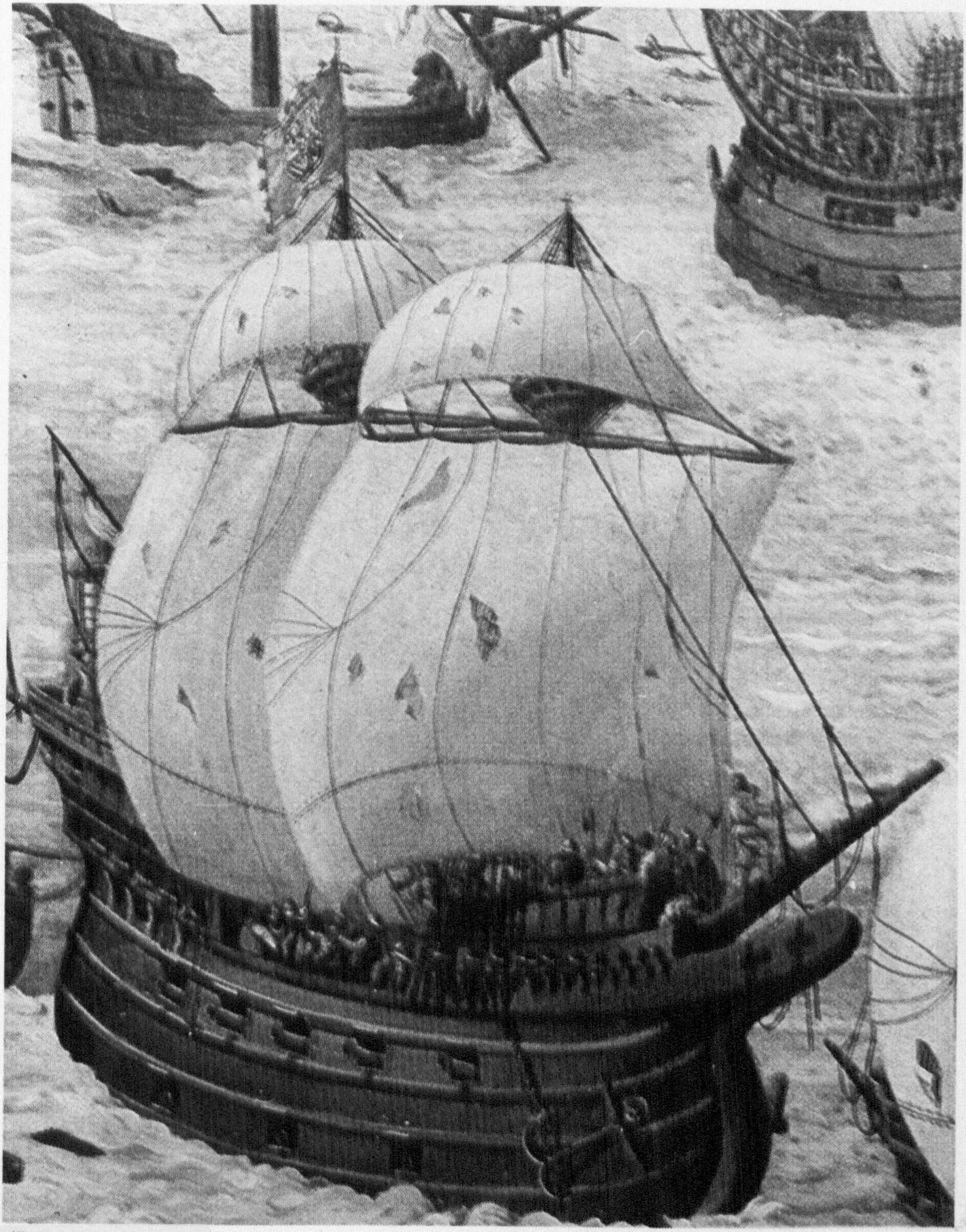
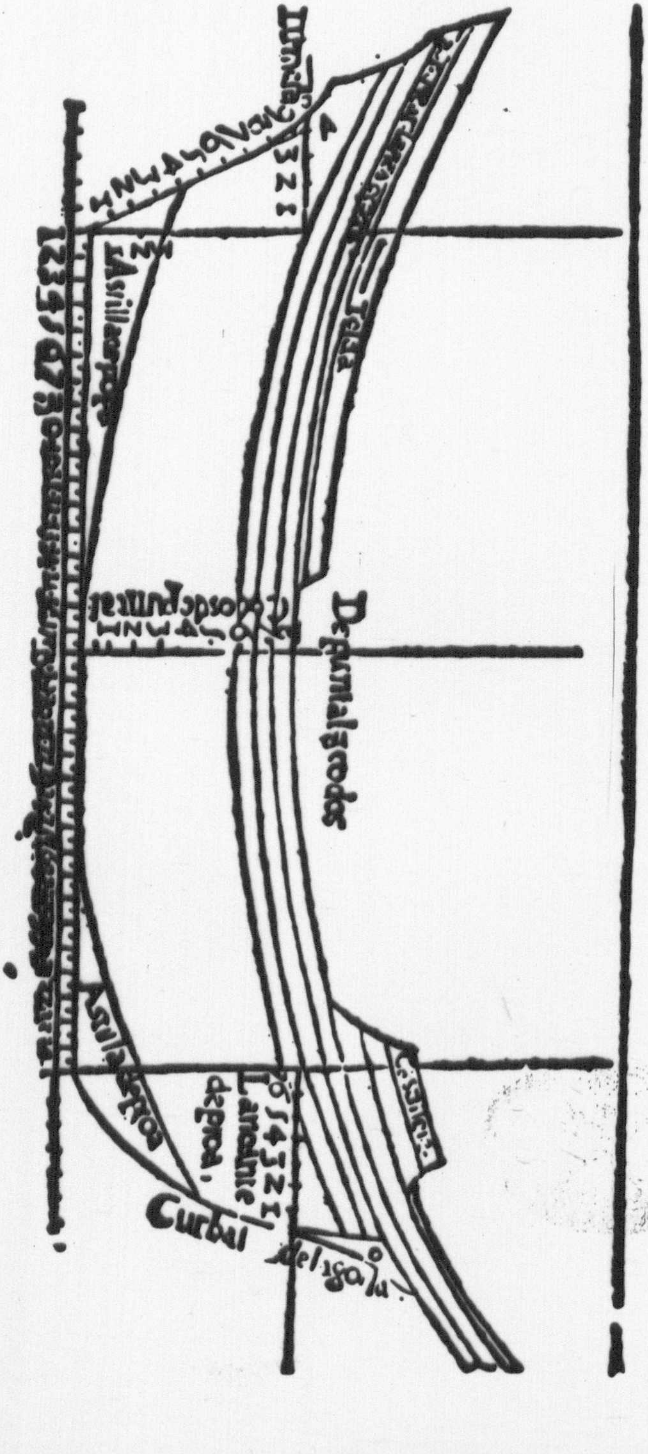


FIGURE 28

FIGURE 29

INSTRVCION NAVTICA.



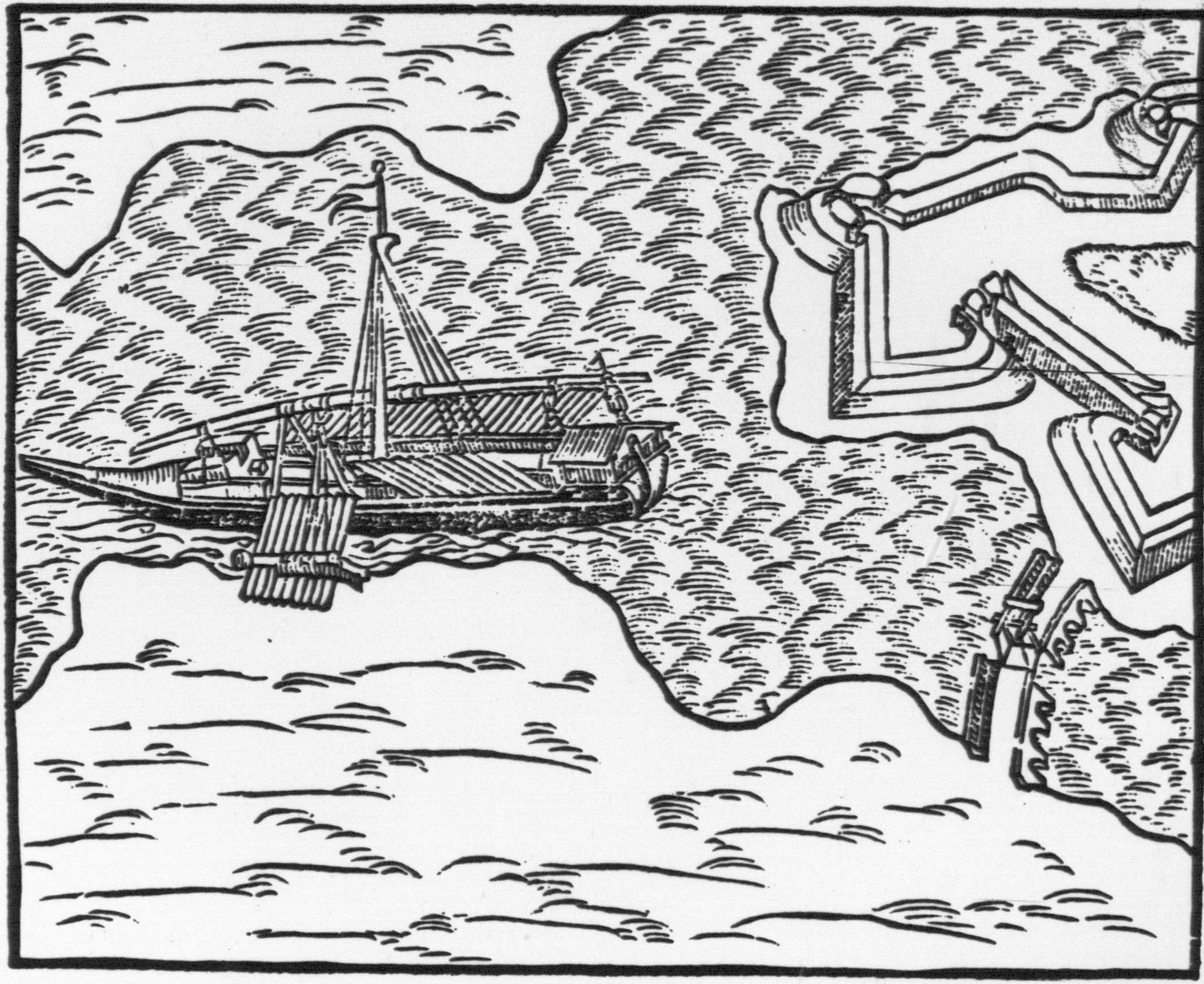


FIGURE 30

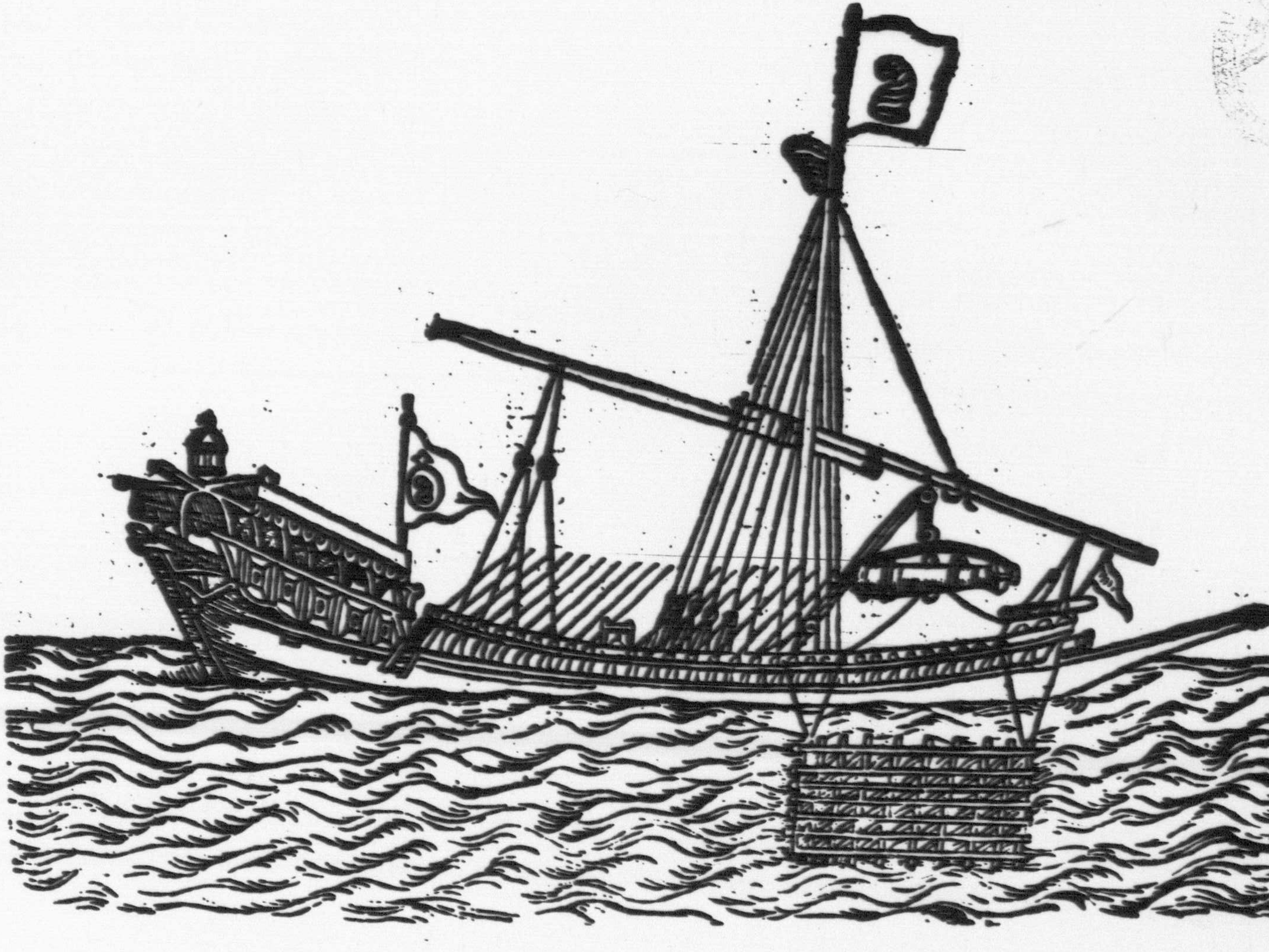


FIGURE 31

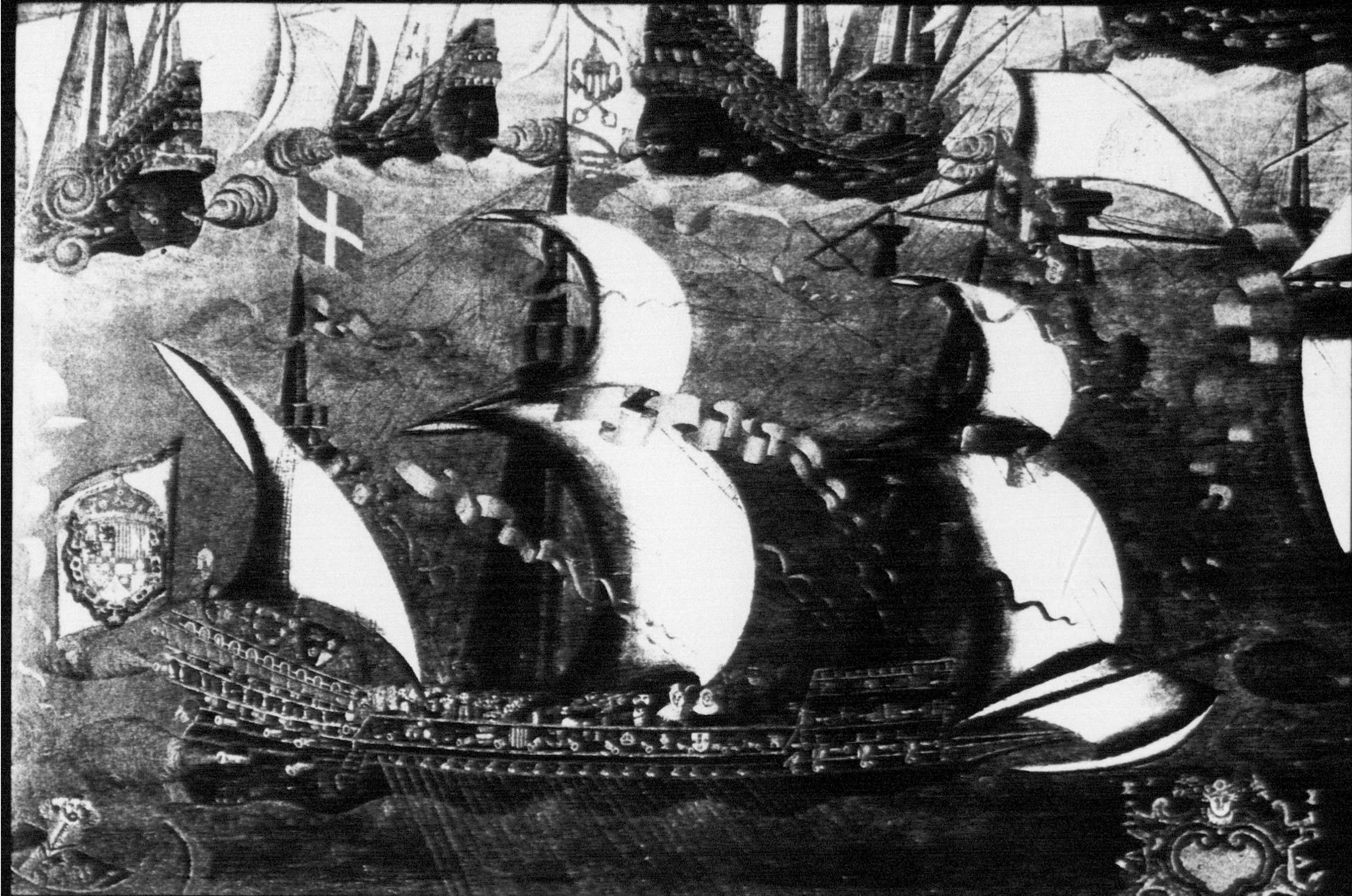


FIGURE 32

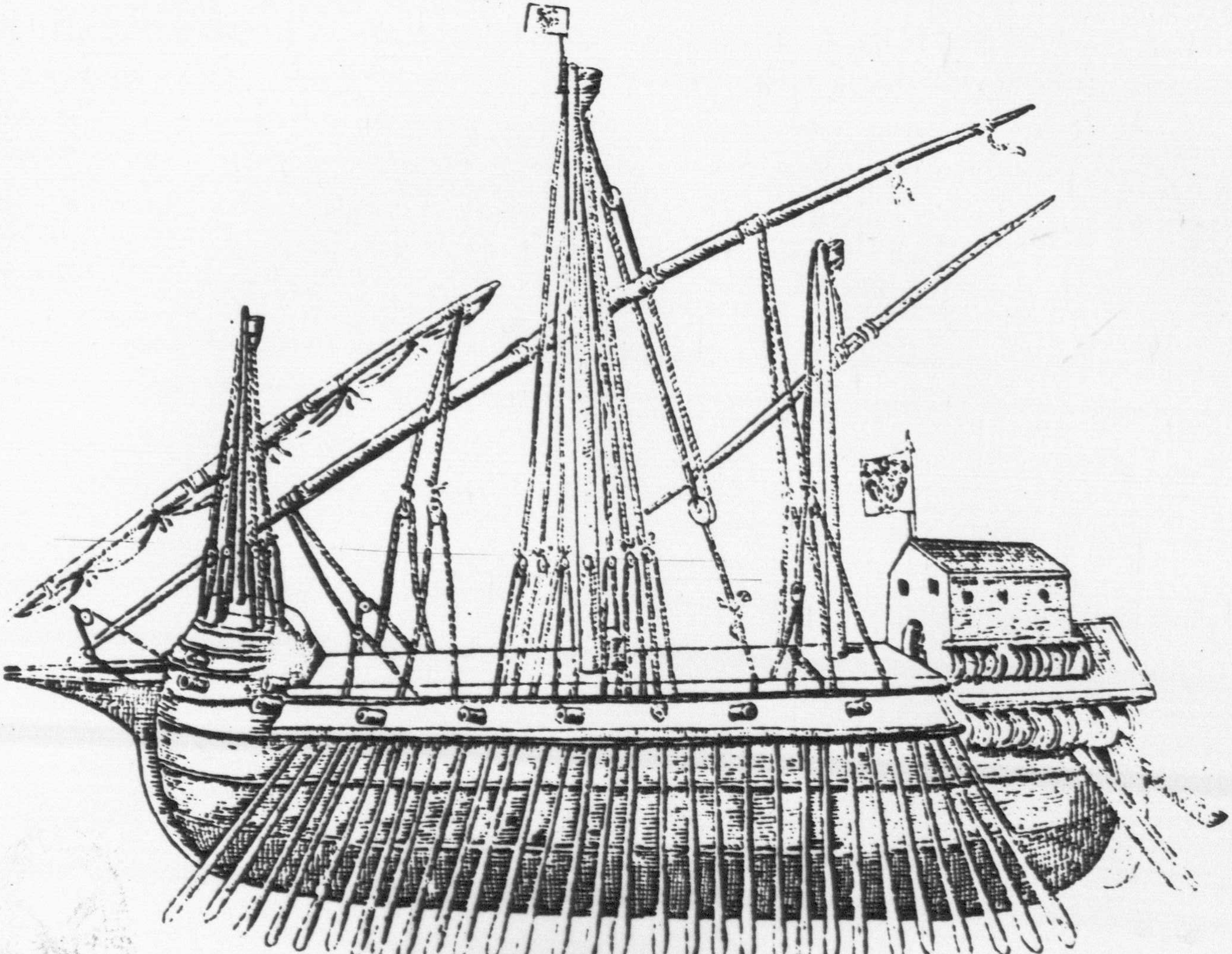


FIGURE 33

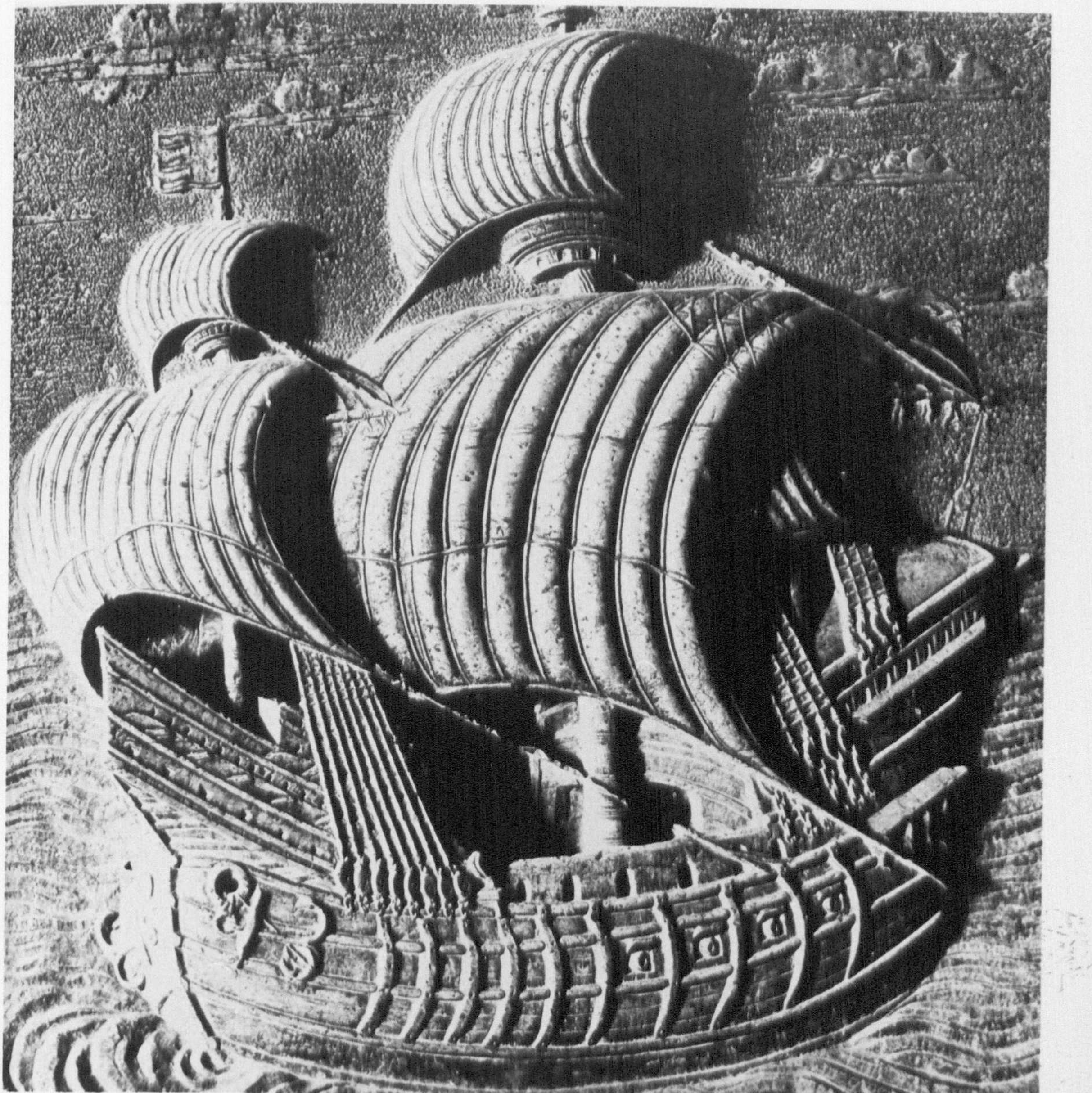


FIGURE 34

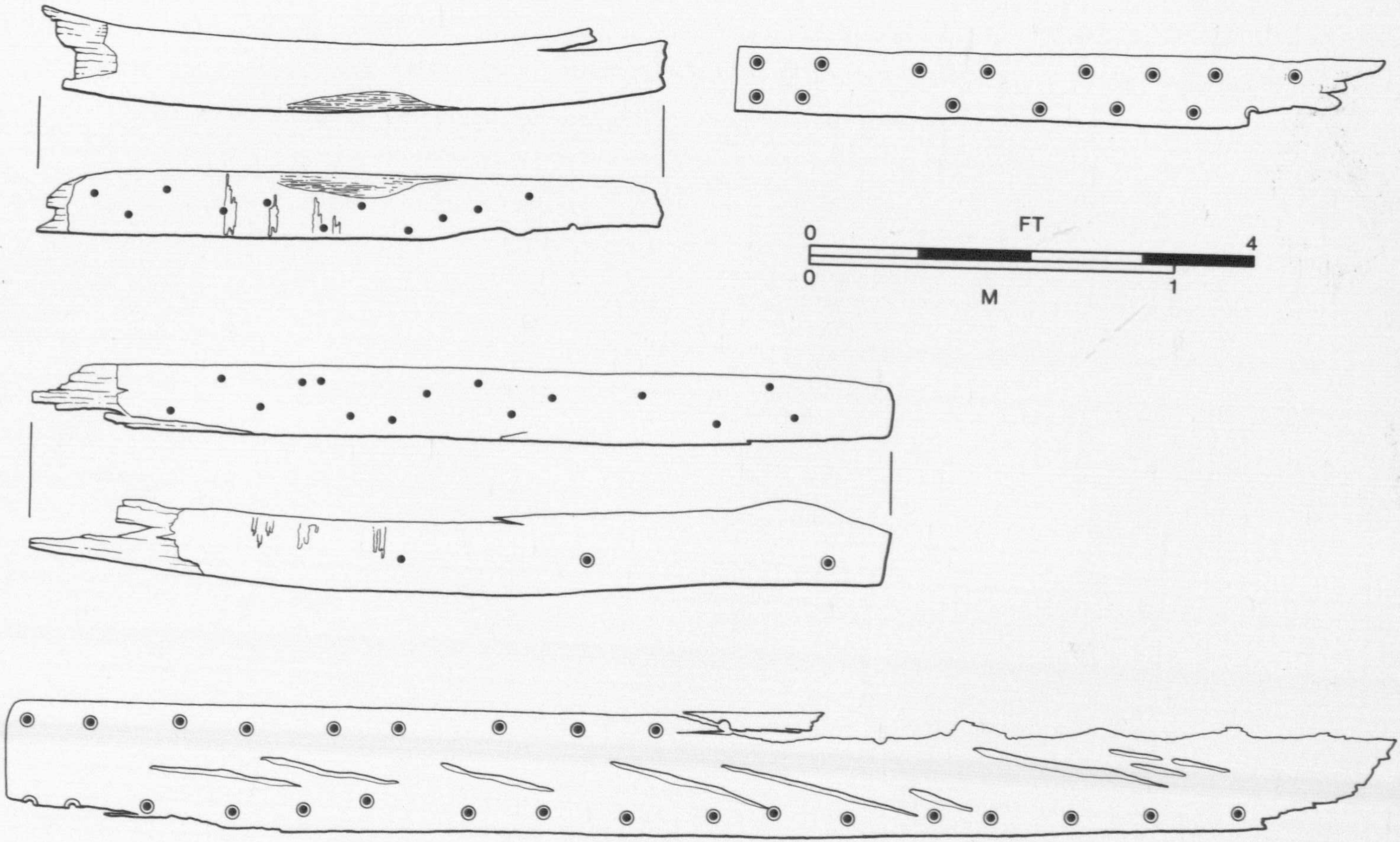


FIGURE 35

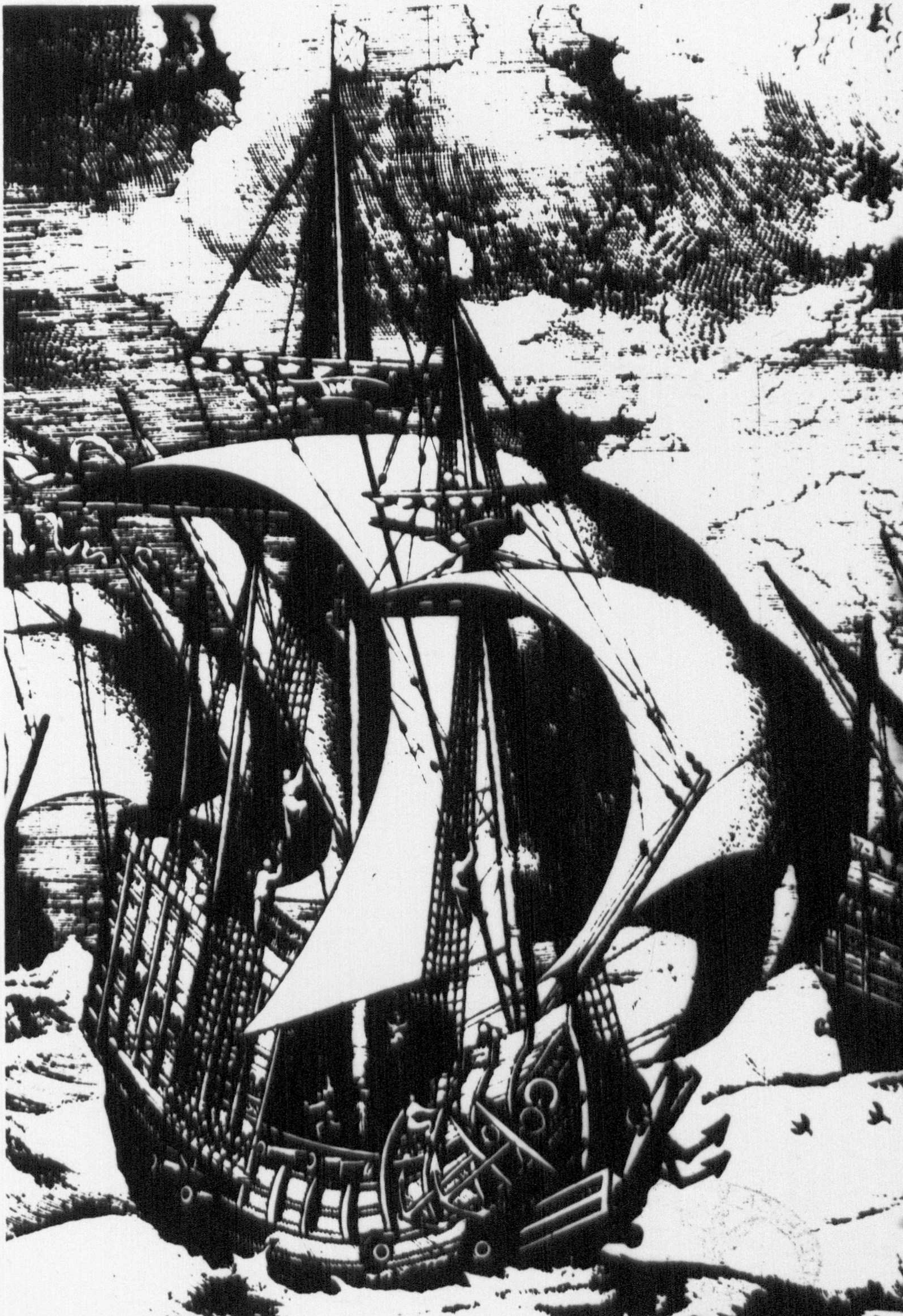
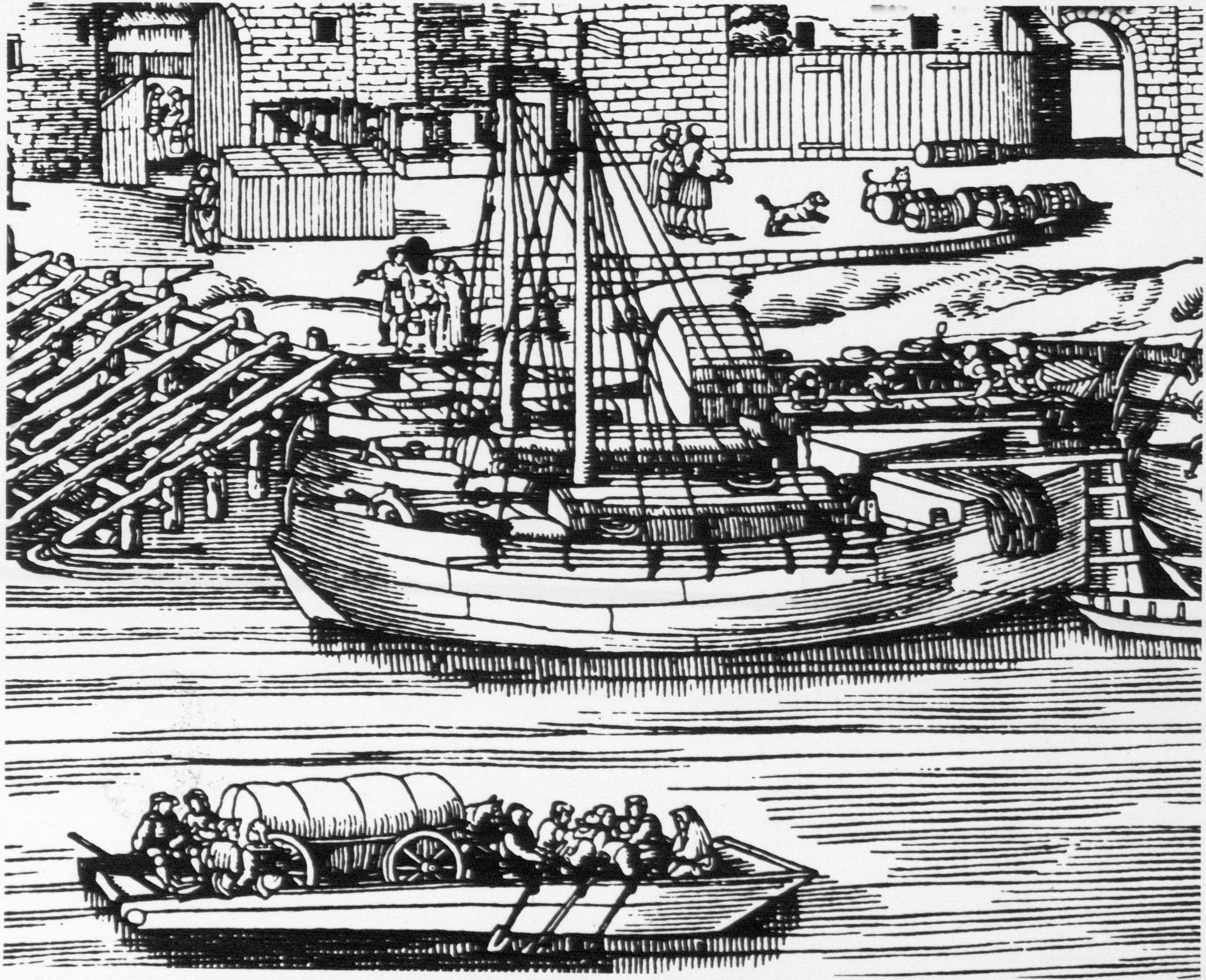


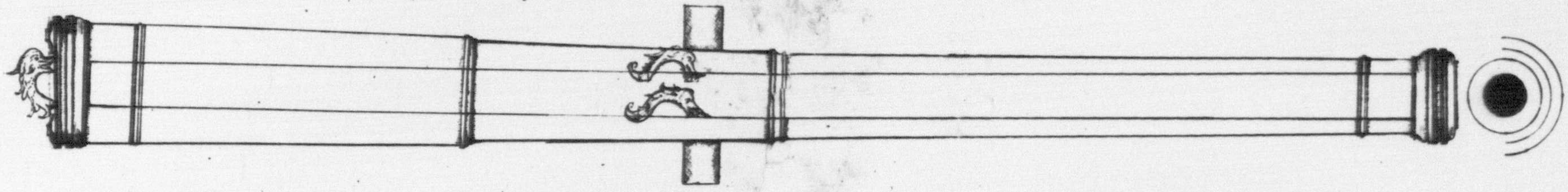
FIGURE 36

FIGURE 37

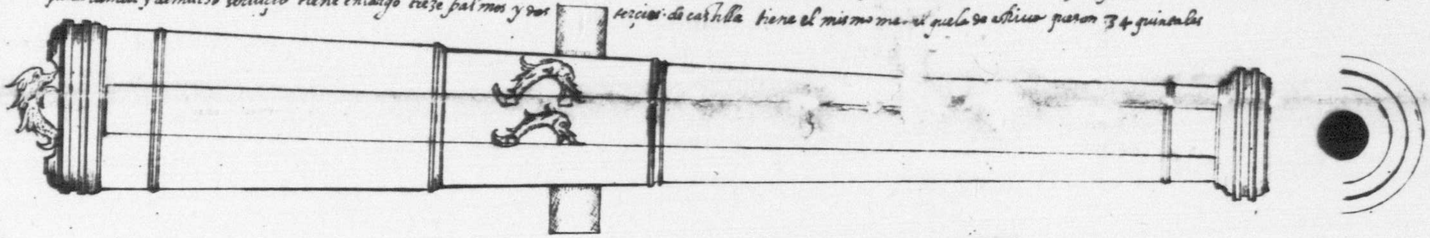


[G A. 199. 1.]

esta media culebrina de 12 libras de bala pesara 34 quintales tiene en largo 33 diametros y en la culata 3 diametros menos dos sesavos y en los muñones dos diametros y en el brocal uno y quatro sestos es muy falta de metal y no puede servir es conforme al metal que el marques de santa cruz dize por su relacion que se le de

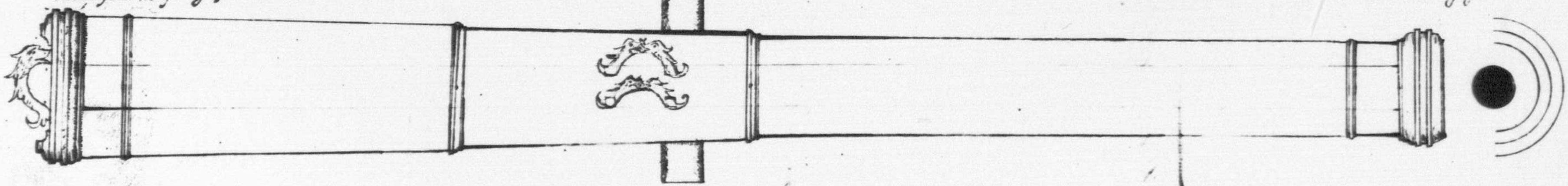


esta media culebrina de 12 libras de bala pesara 34 quintales tiene en largo 25 diametros y en la culata tres diametros y ... en los muñones dos y tres quartos en el brocal dos diametros y pasa 3 es muy buena para lamar y de mucho servicio tiene en largo treze palmos y dos tercios de castilla tiene el mismo metal que la de atras pesaran 34 quintales



palmos de castilla

esta media culebrina de 12 libras de bala pesara 44 quintales castellanos tiene en largo 33 balas y en la culata tres diametros y un quarto en los muñones dos y tres quartos y en el brocal dos y medio y es de las medias culebrinas de gregorio lefer parece que es muy larga para lamar



M. P y D - V - 17

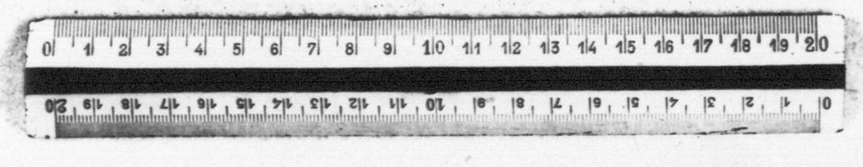


FIGURE 38

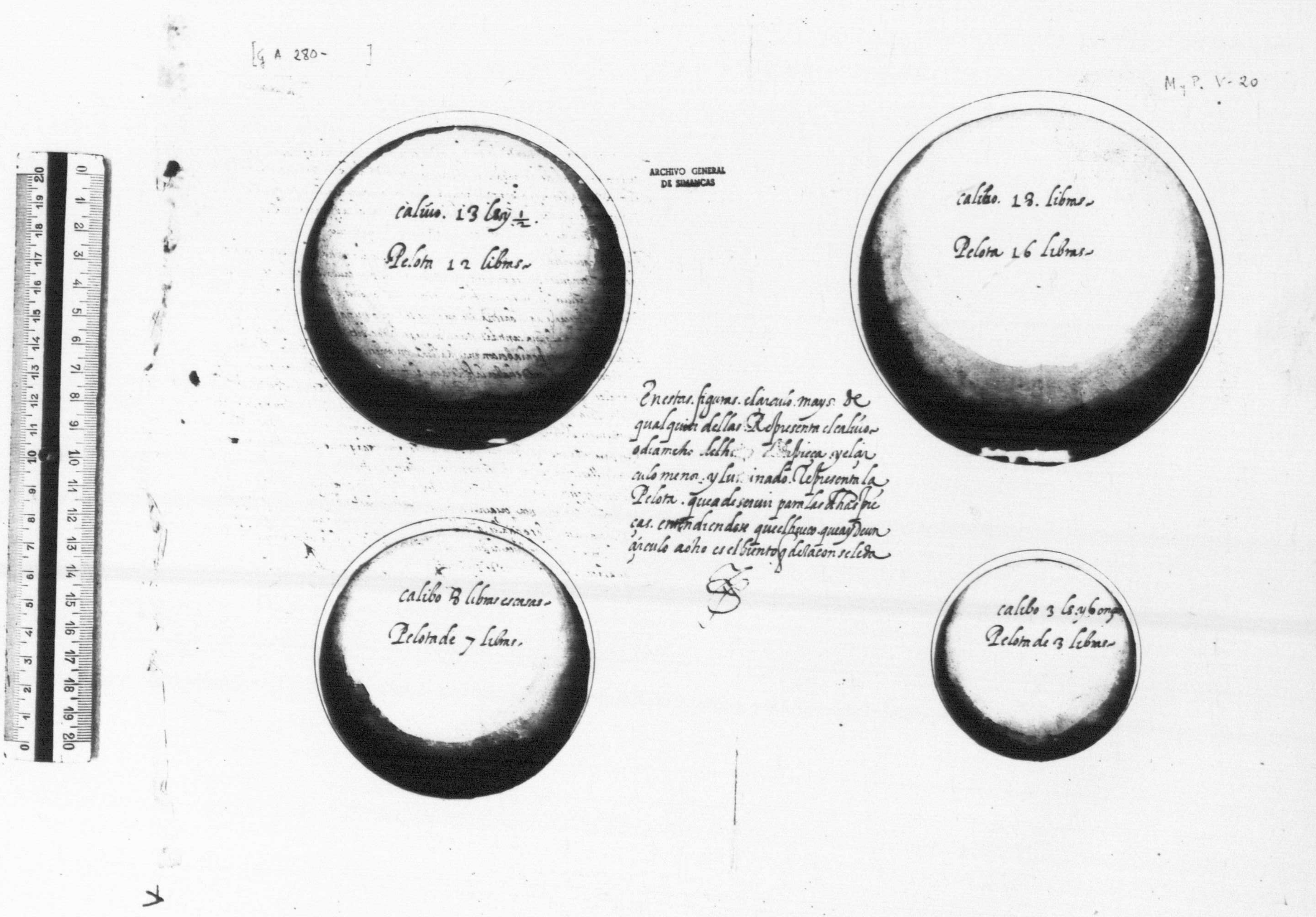
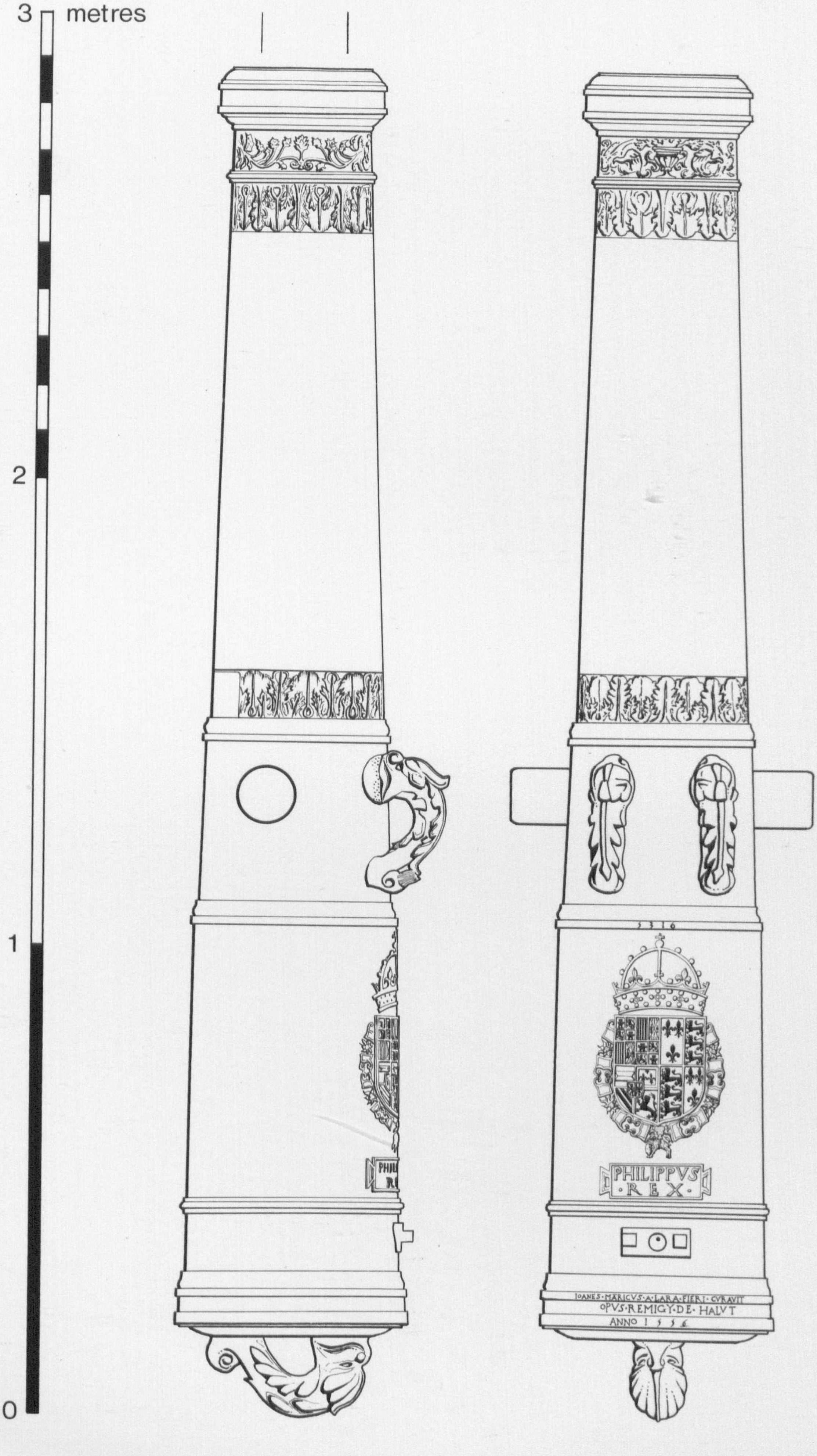

[G A 280-]
My P. V-20
ARCHIVO GENERAL
DE SIMANCAS
caliuo. 13 lasy 1/2
Pelota 12 libras.
calibo. 18. libras.
Pelota 16 libras.
En estas figuras el cerculo mayor de
qualquier dellas representa el calibre
o diametro dello ... la pieça y el çir
culo menor y luminado representa la
Pelota que a de servir para las dichas pie
ças entendiendose que el hueco que ay de un
çirculo a otro es el viento q della con se le da
calibo 8 libras escasas.
Pelota de 7 libras.
calibo 3 ls. y 6 onz
Pelota de 3 libras.

FIGURE 39

FIGURE 40


3
metres
2
1
0
5316
PHILIPPVS
·REX·
IOANES·MARICVS·A·LARA·FIERI·CVRAVIT
OPVS·REMIGY·DE·HALVT
ANNO 1556

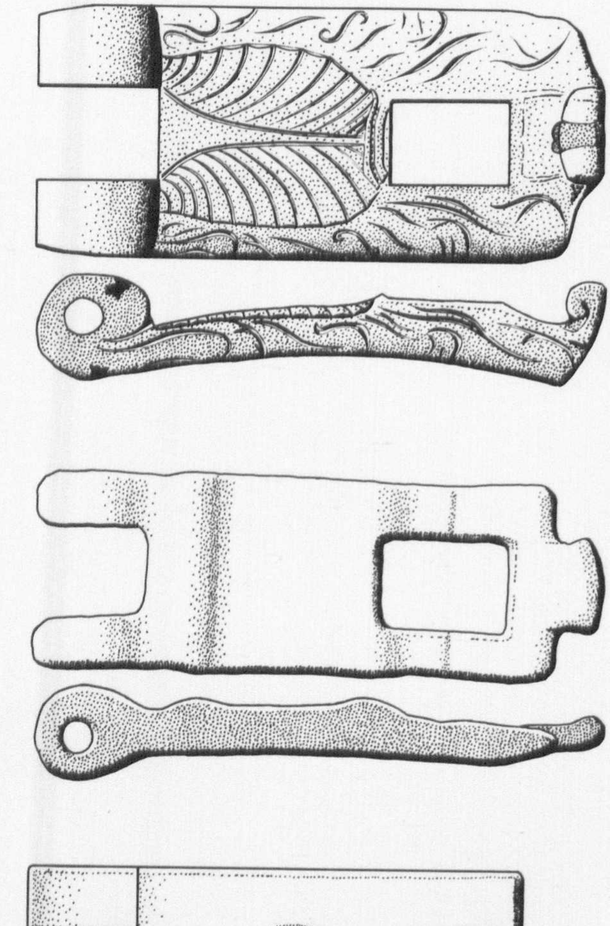


FIGURE 41

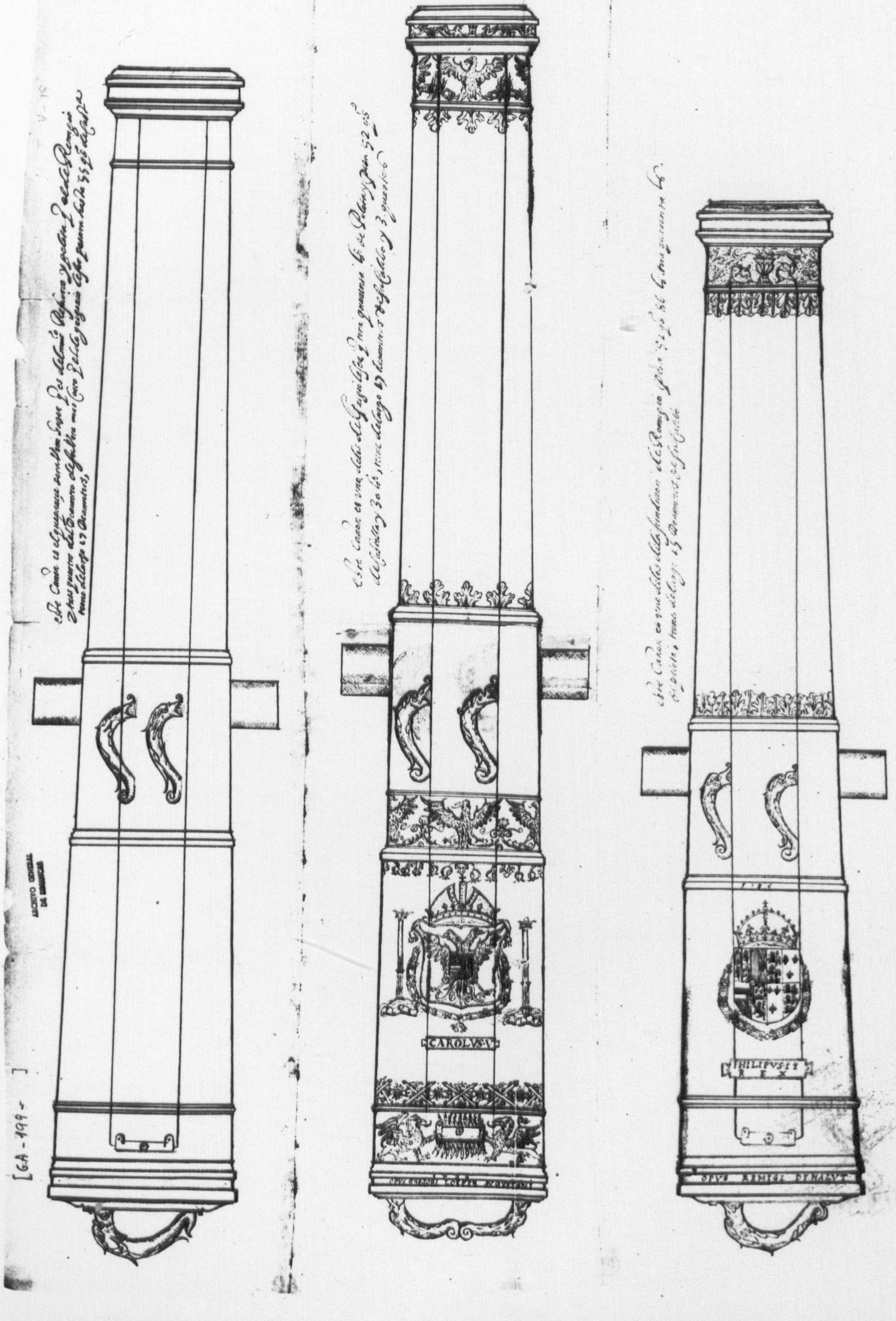
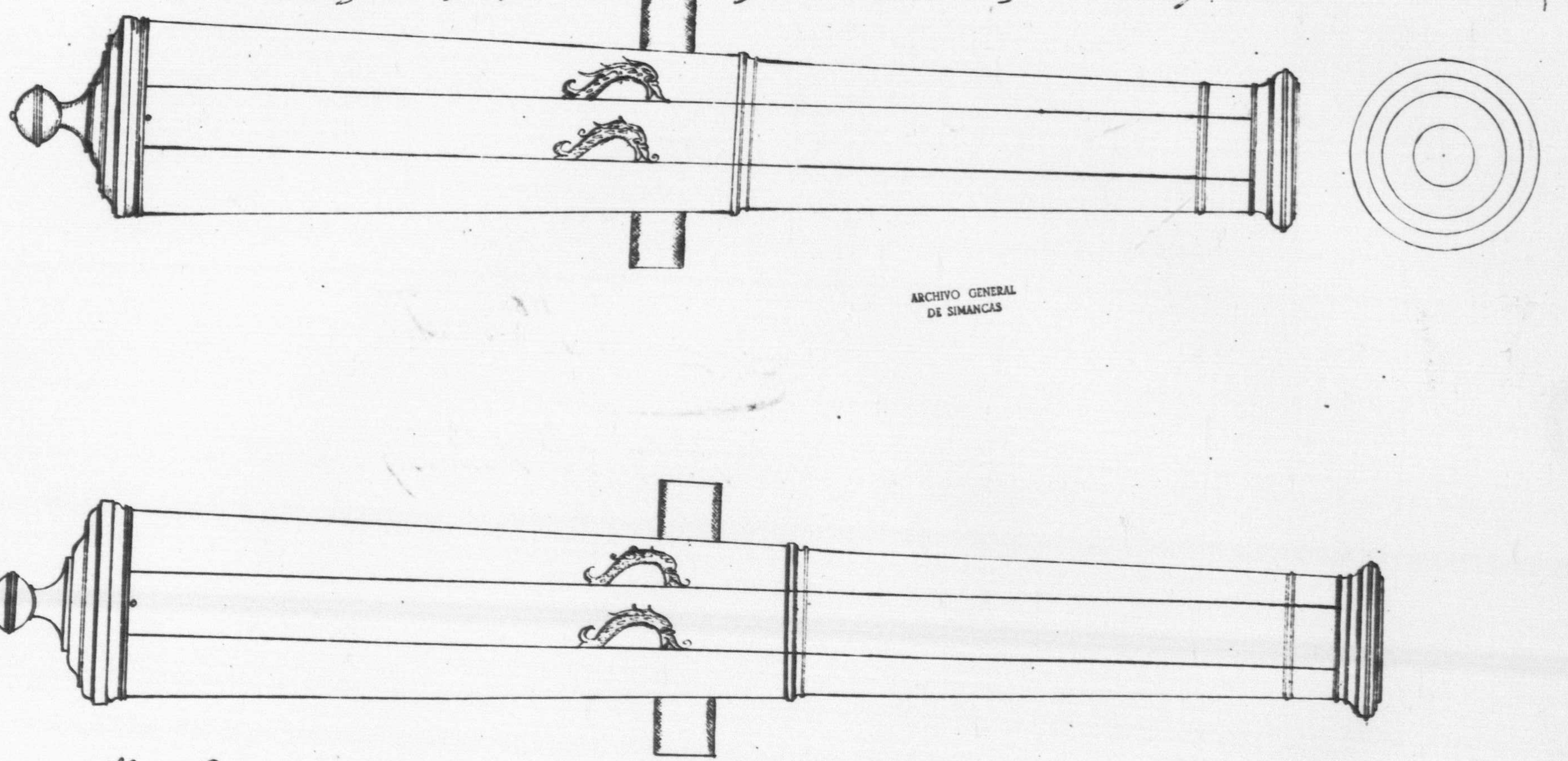


FIGURE 42

G. A. 199-]

Este medio cañones de Veynte libras de pelota peso de Castilla ha de tener diez y medio diametros de su calibo pesara de 35. a 36 qs.

M, P.

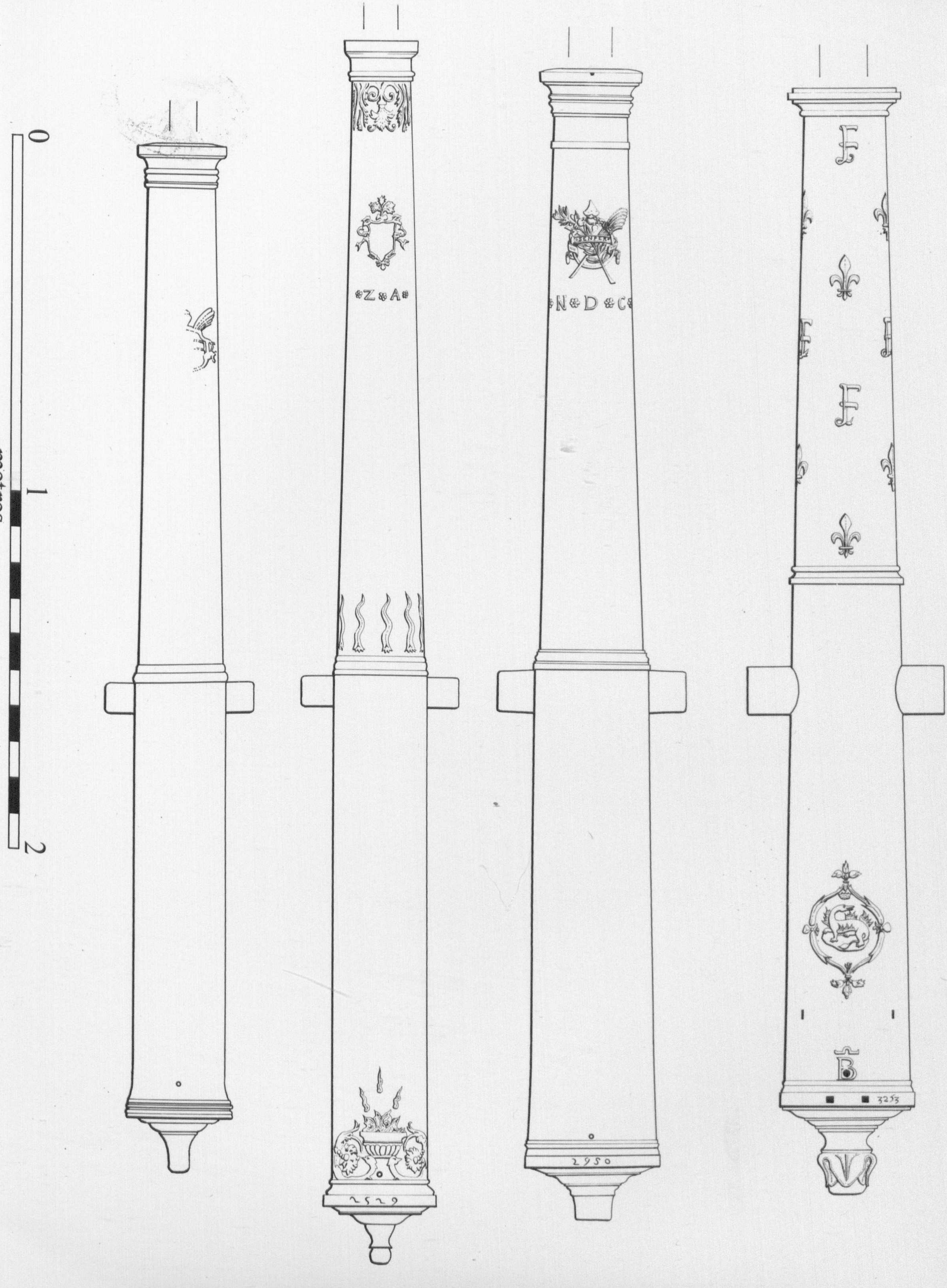


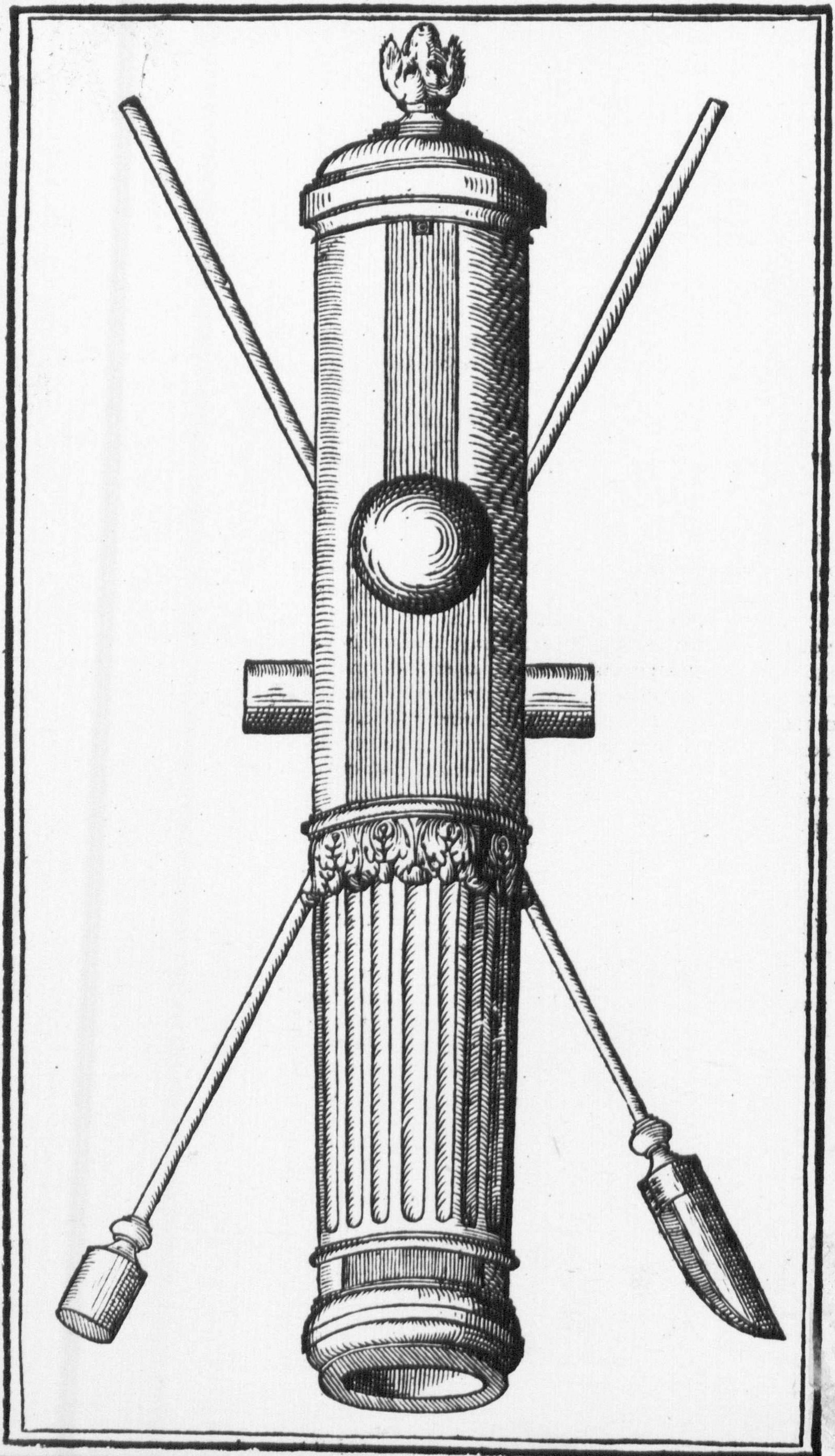
Este medio cañon tiene de pelota Veynte libras peso de Castilla, ha de tener Veynte diametros de su calibo, pesara de Treynta y cinco a Treynta y seys qs.

M. P. y D- V-19

FIGURE 43

FIGURE 44





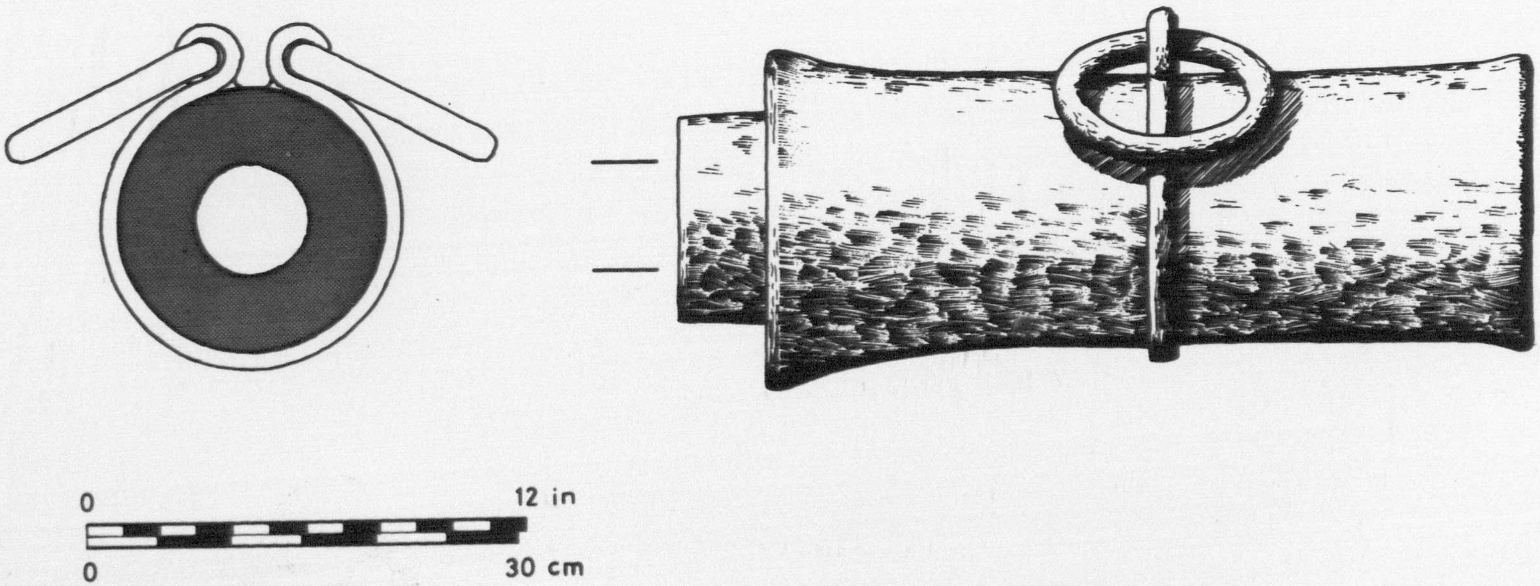


FIGURE 46

[G.A.-1º...

Hanse de saber para la ysla de Canaria quatro culebrinas como la q aqui va deseñada
que tire diez y ocho libras de pelota cada una y ha de tener de largo treynta diametros /

V

La repartition de los miembros q han de llevar ha de ser
en la culata tres diametros y un sexto, en los muño
nes dos diametros y cinco ochavos. en el cuello dos diame
tros y las cintas, y las cintas y molduras y asas de muño
nes y culata se ha de guardar la orden y forma q̃ va
en el dibuxo de la dicha pieça, teniendo advertencia
q̃ las molduras q̃ hubieren de entrar dentro del encavalga
miento no levanten demasiado sino q̃ sean lo menos,
porq̃ no coman la madera del q̃ para que queda, ni dexalle
ancho que sera causa de aniegos. /

Pareçe q̃ esta pieça pesara sessenta quintales de Castilla /
Hanse de poner en ella las armas Reales muy bien
hechas relevadas con la corona, y debaxo del escudo
una forma de retulo de relieves y dentro unas letras de
relieve que digan desta manera, Don Phelippe
y Rey de Spaña. Y en la cinta que esta debaxo
del dicho retulo unas letras labradas hondas con
buril que digan desta manera, Don Joan de
Acuña Su capitan General de la Artilleria
1587 años. y no ha de llevar otro ningun
letrero /

El cobre de que se han de hazer estas culebrinas ha
de ser de Ungria de tableros quadrados o redon
dos, hase de echar de liga de estaño de Ynglaterra
a razon de ocho por ciento peso de Castilla sin
otro ningun genero de metal ni mezcla, procuran
do de comprarlo al mas aventajado precio que
se pudiere /

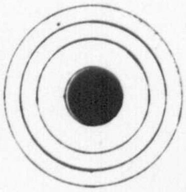
Han de hazer estas quatro culebrinas Joan Mo
rel fundidor de su Mag.d en Sevilla y por la
... a mermar su manifactura y toda costa
se le ha de dar y pagar como mesmo que su Mag.d
da y paga por quintal de lo que para su serv.º
se funde y en la prueba y satisfaçion
della se ha de tener la quenta que con las que se
hazen para su Mag.d y como mismo en lo de los en
cavalgamientos /

Pareçe que cada una destas culebrinas llegara a
ochocientos ducados castellanos /

De manera q̃ las dichas quatro culebrinas costaran
tres mill y seyscientos du.os a lo mas, restan de
los quatro mill y dozientos q̃ su Mag.d tiene hecha
md a aquella ysla seyscientos ducados que ha
de aver en ellos para los quatro encavalgamientos
guarnecidos para cada una de las dichas culebrinas
con sus exes costando cada uno ciento y cinq.ta ducados
y estos los han de hazer los maestros de carpinteria
y herreria que su Mag.d tiene en Sevilla y firmados
... a su ... los ... pagan
... a la misma razon y como se les ha de pagar
en las obras de su Mag.d /

Las dichas pieças se han de hazer acabar y perficio
nar a contento y satisfacion de Don Fran.co
Duarte factor y justicia de la casa de la contra
tacion de Sevilla por su Mag.d. Fecha en
Lisboa a veynte y cinco de Julio 1587.

Don Juan de Acuña



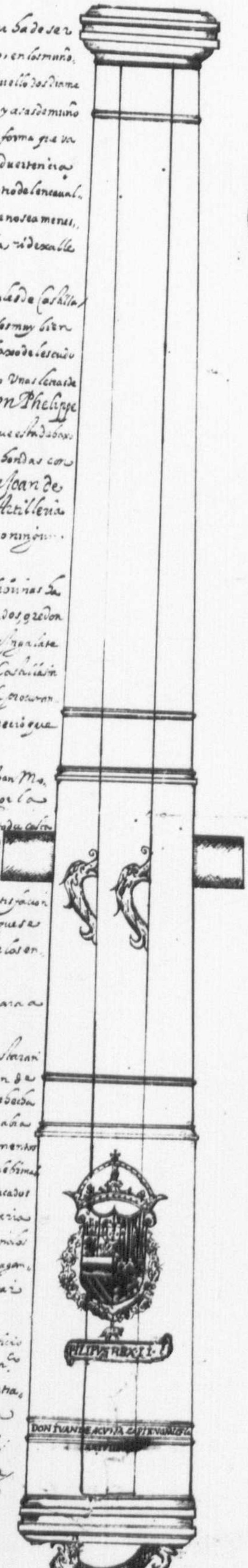


FIGURE 47

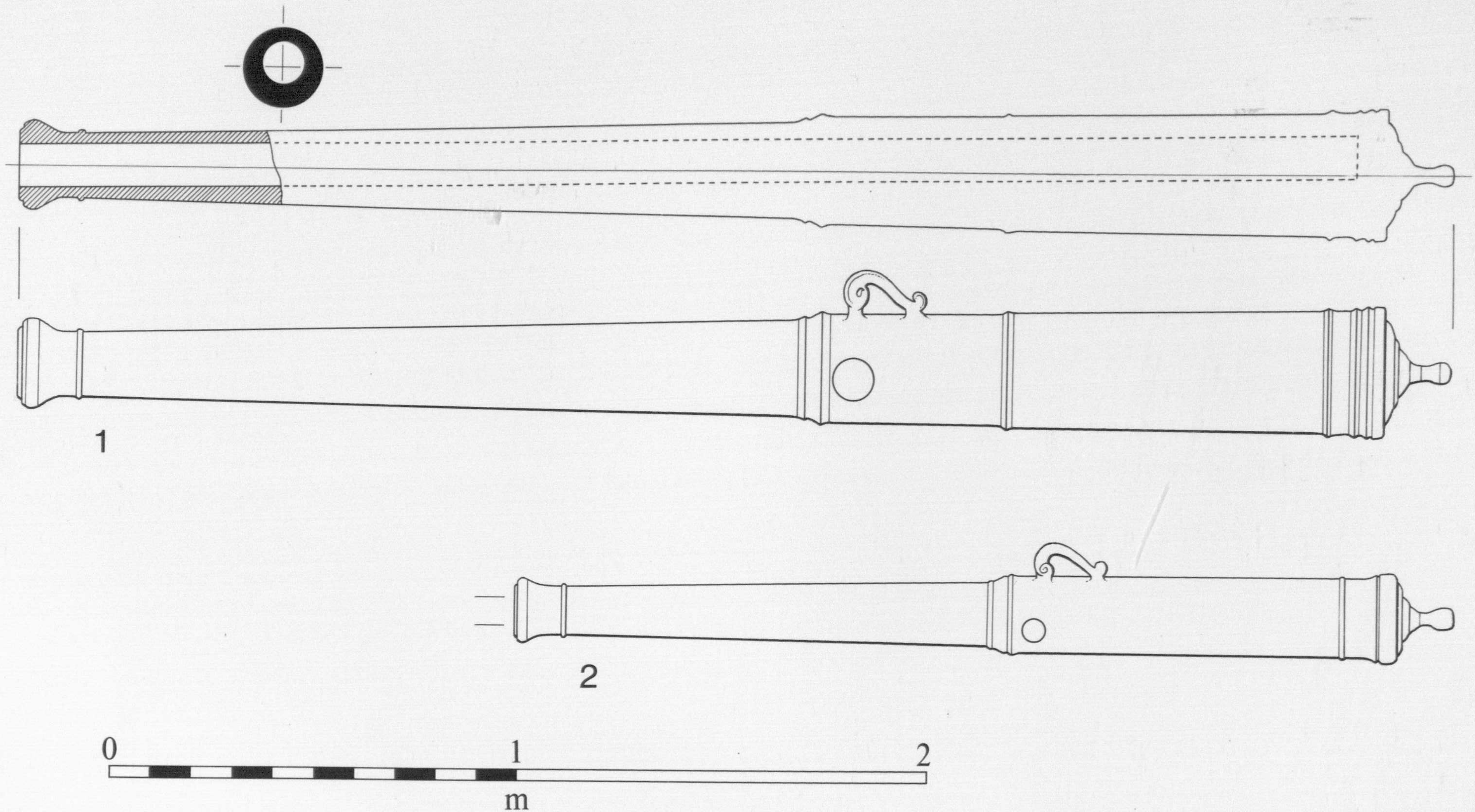


FIGURE 48

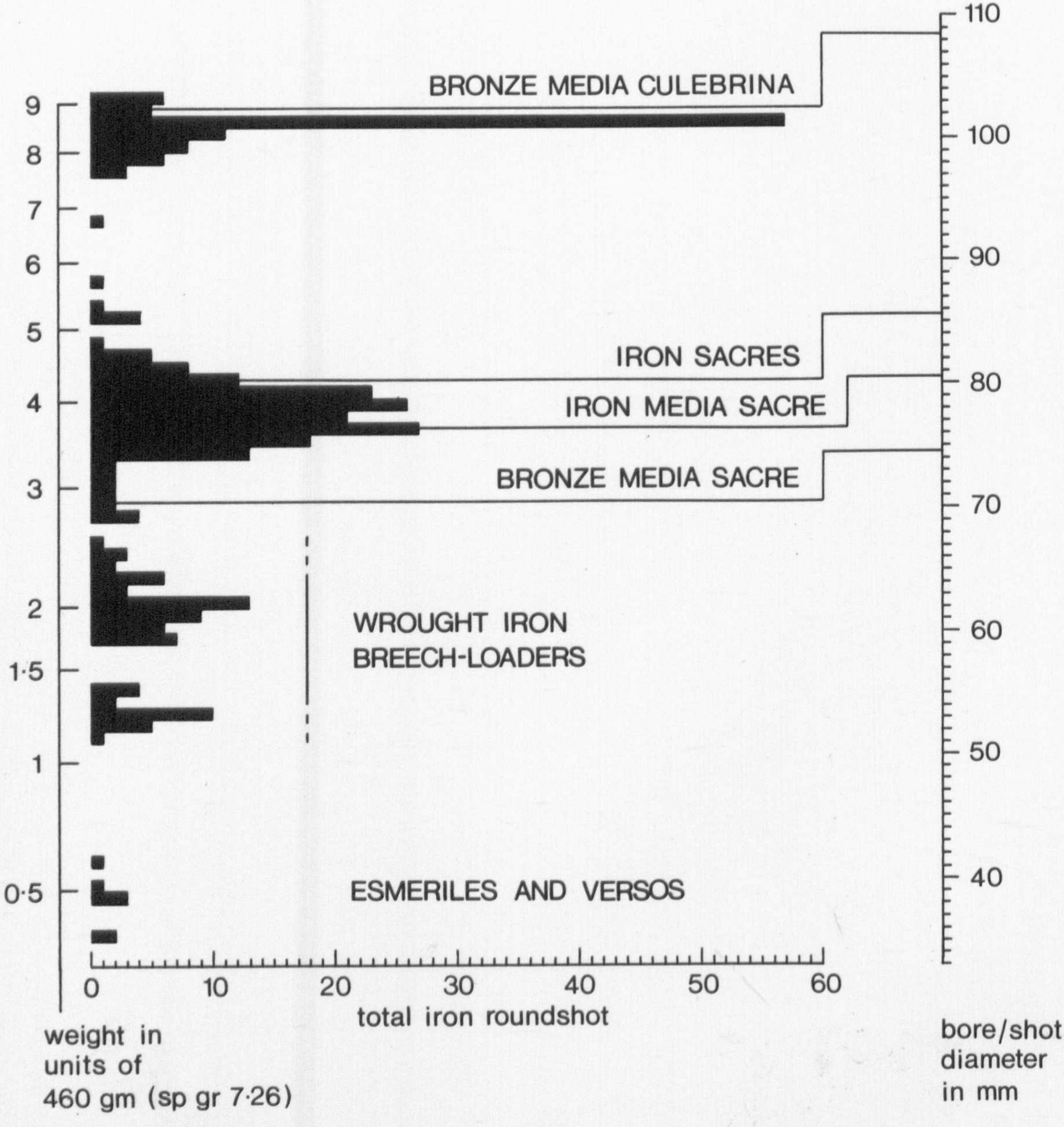

BRONZE MEDIA CULEBRINA
IRON SACRES
IRON MEDIA SACRE
BRONZE MEDIA SACRE
WROUGHT IRON
BREECH-LOADERS
ESMERILES AND VERSOS
9
8
7
6
5
4
3
2
1·5
1
0·5
0
10
20
30
40
50
60
110
100
90
80
70
60
50
40
total iron roundshot
weight in
units of
460 gm (sp gr 7·26)
bore/shot
diameter
in mm

FIGURE 49

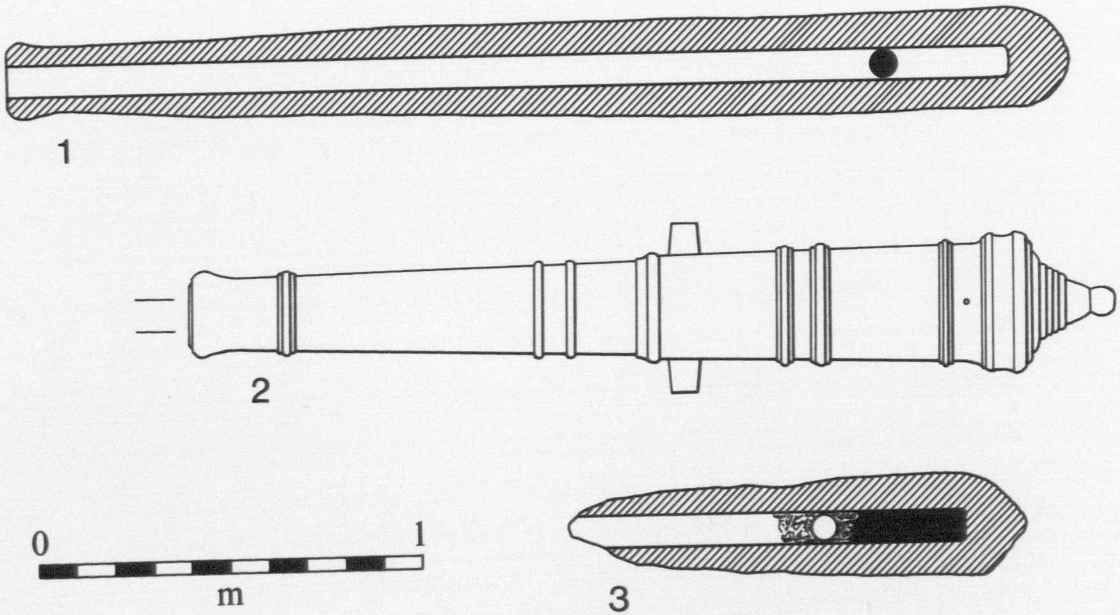


FIGURE 50

FIGURE 51

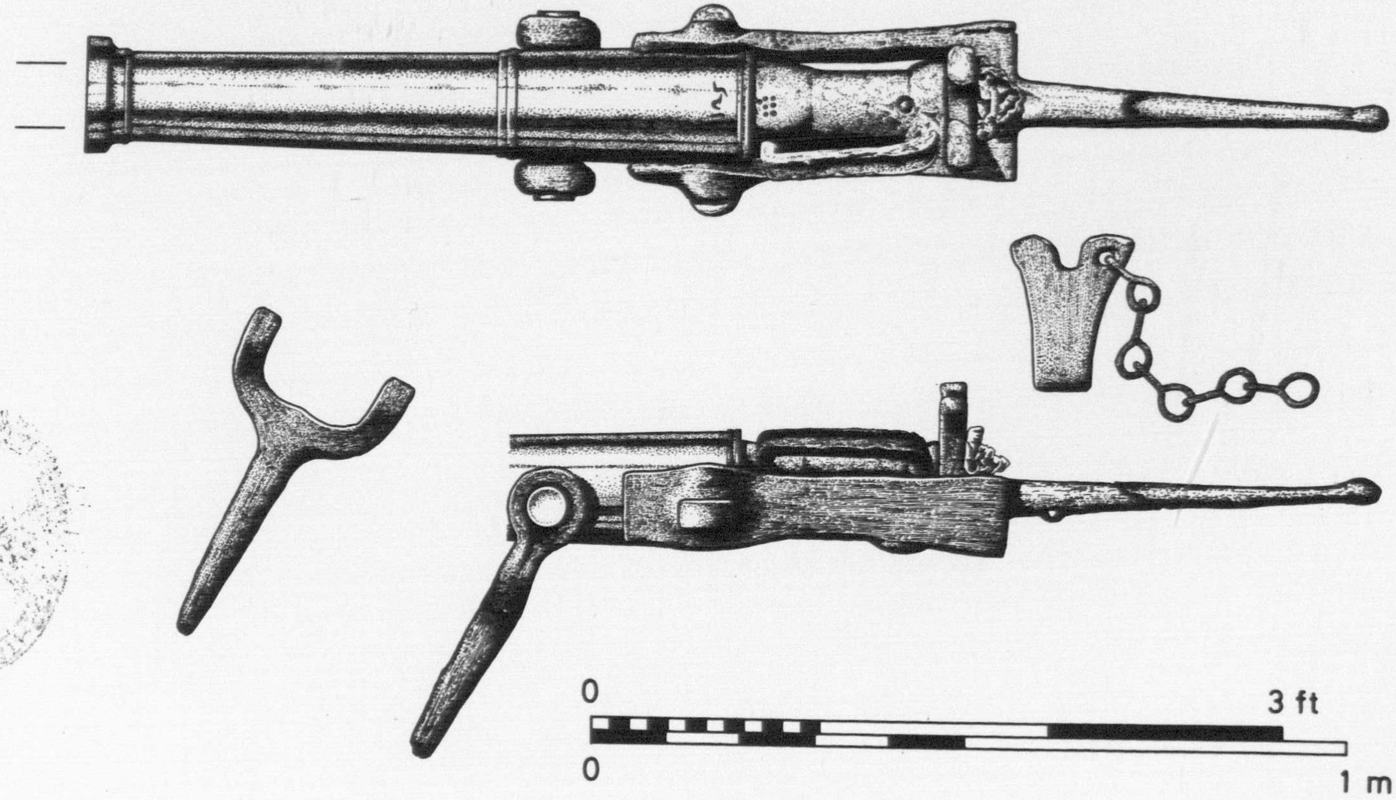


FIGURE 52(a)

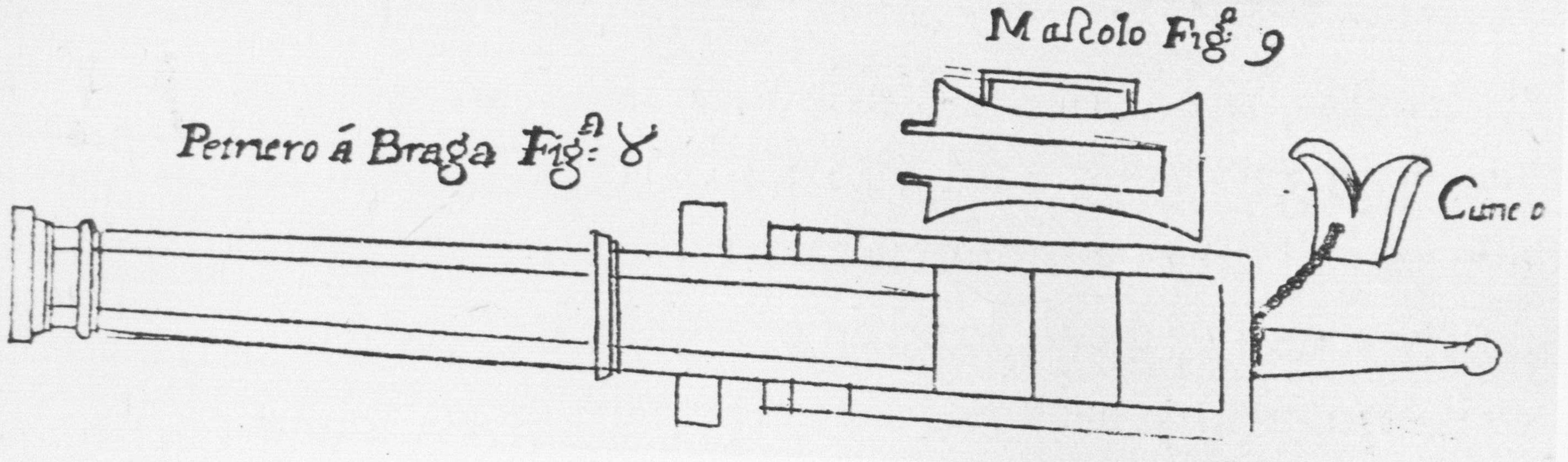


FIGURE 52 (b)

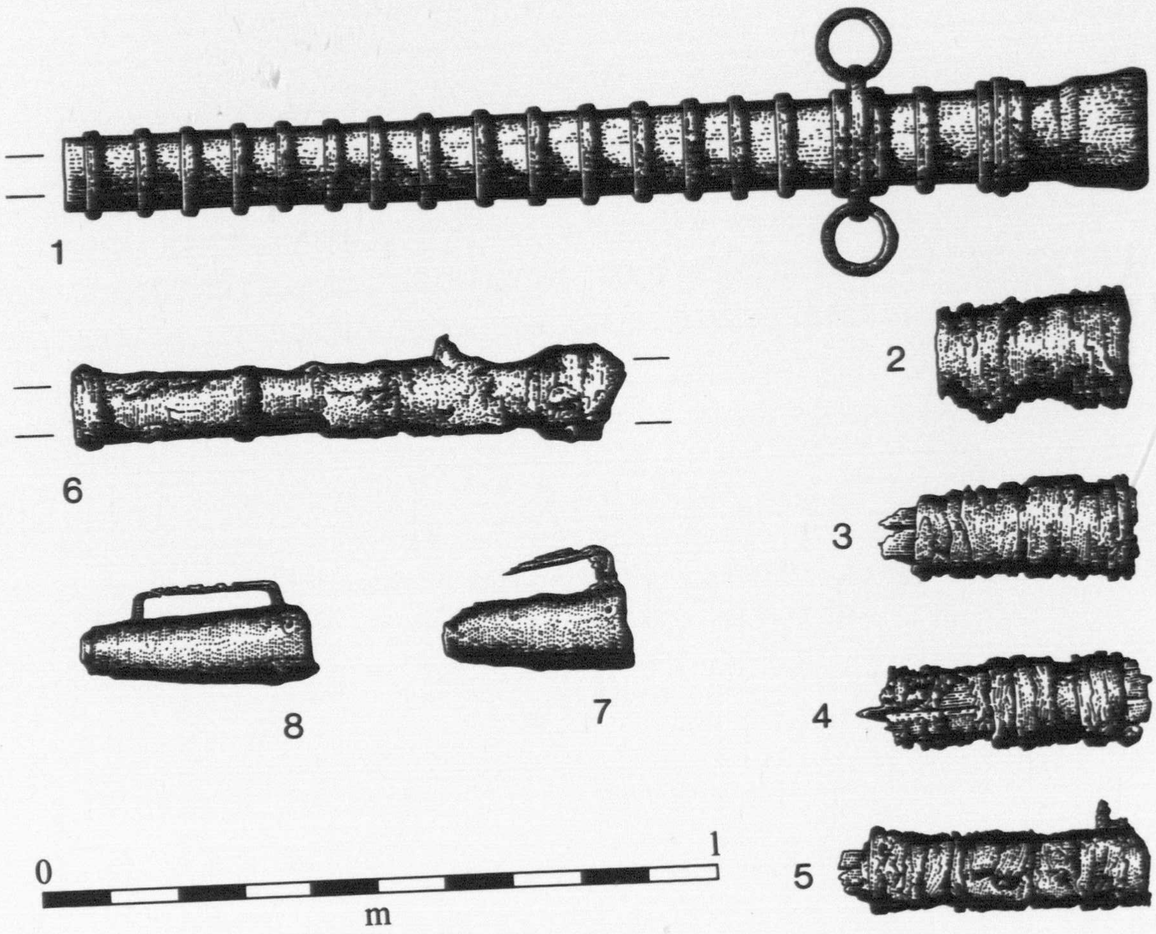


FIGURE 53

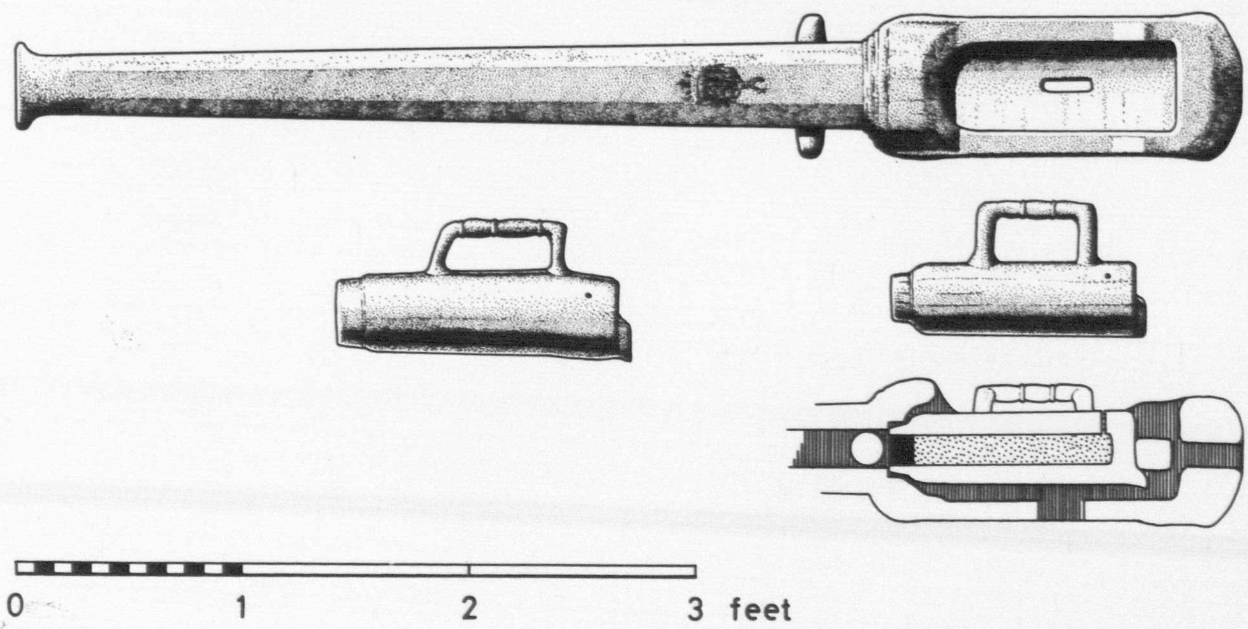


FIGURE 54

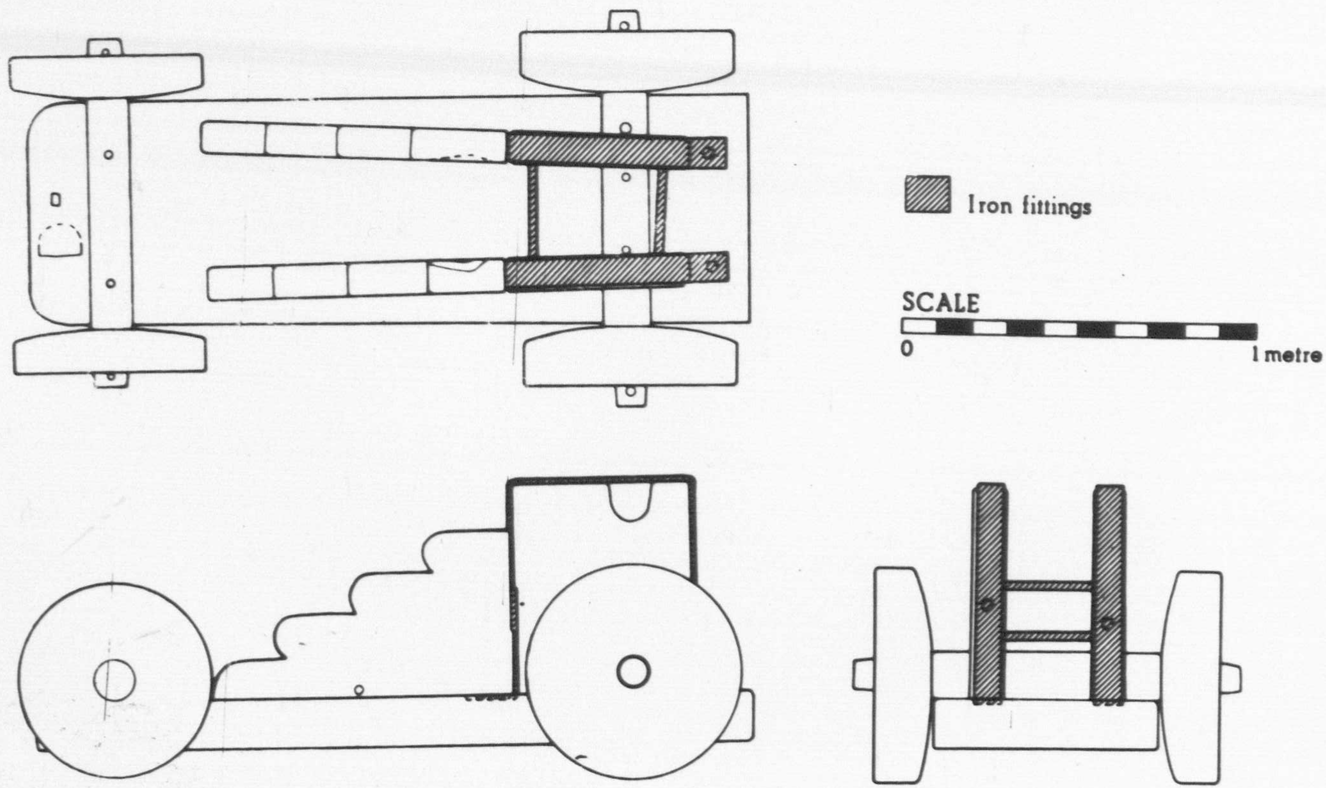


FIGURE 56

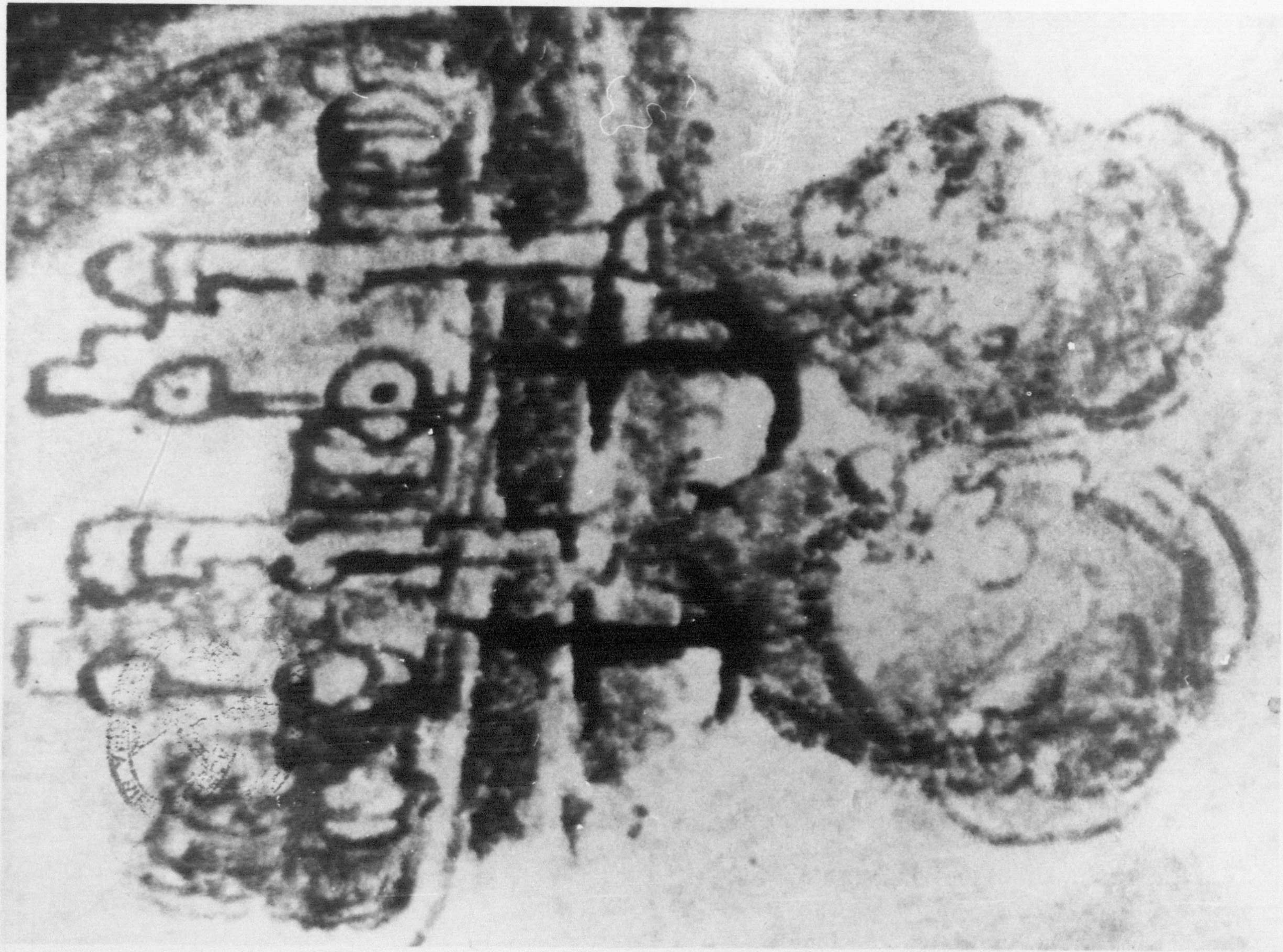


FIGURE 57

[G A 405-]

M y P XVIII-

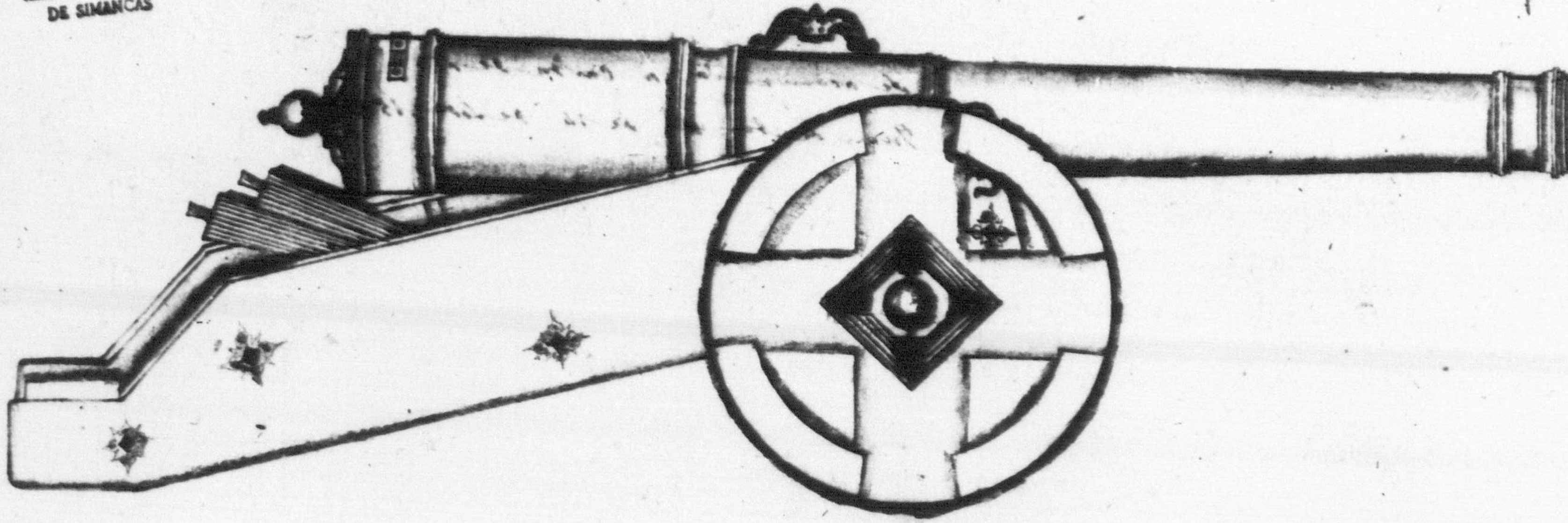


FIGURE 58

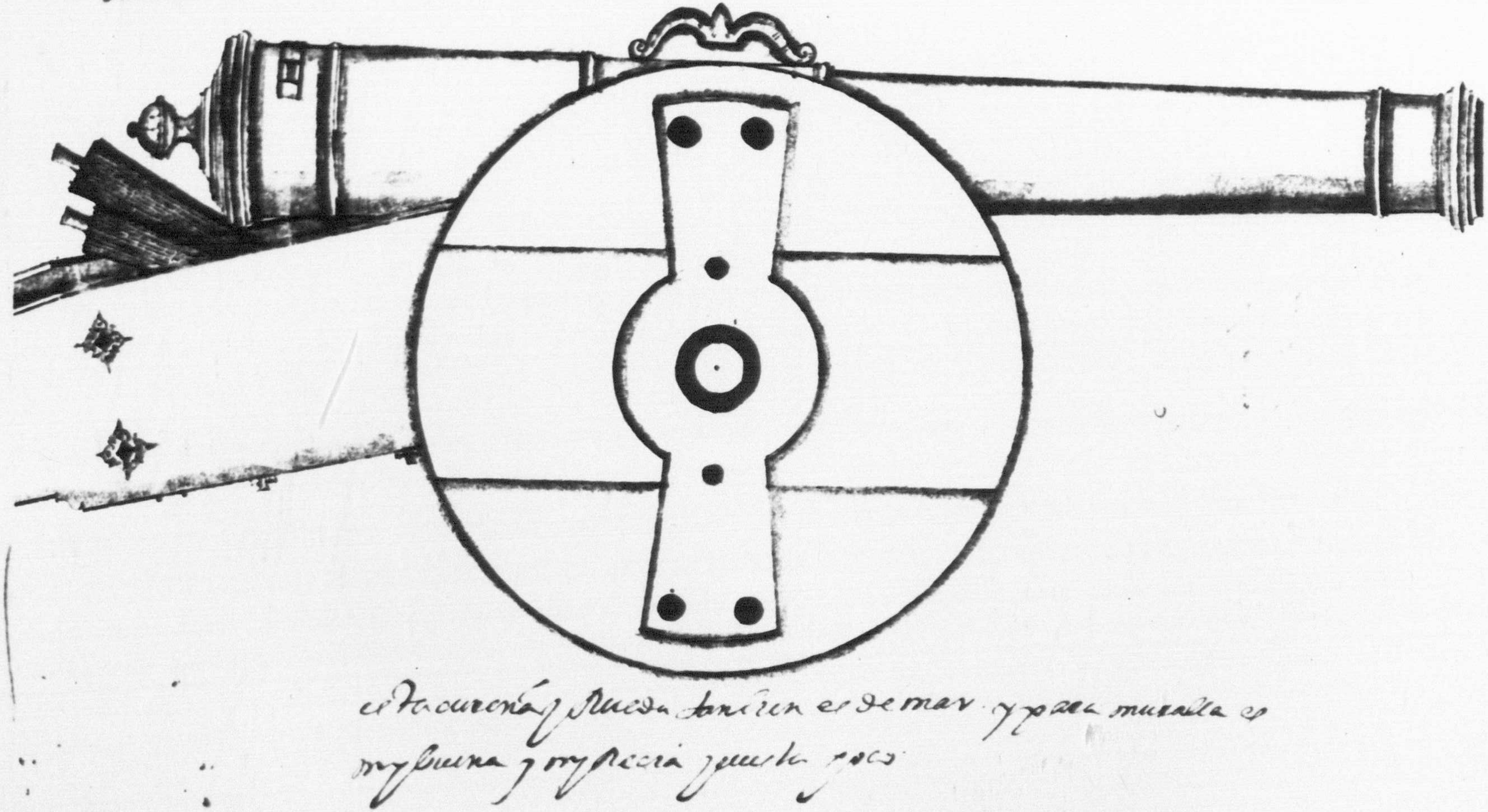

esta cureña y rueda tanbien es de mar. y para muralla es
muy buena y muy preciada que cuesta poco

FIGURE 59

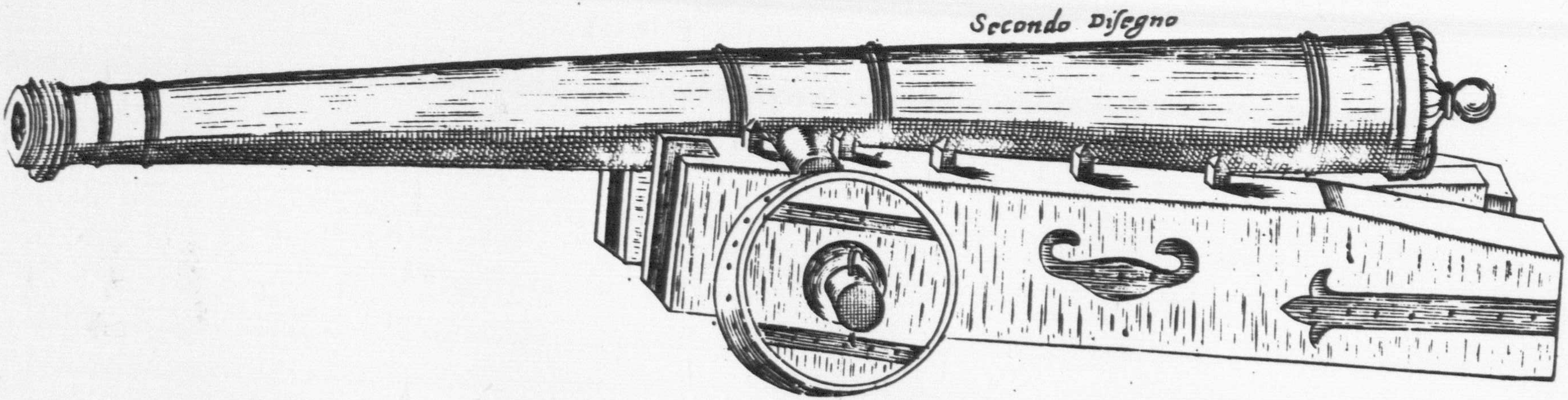


FIGURE 60

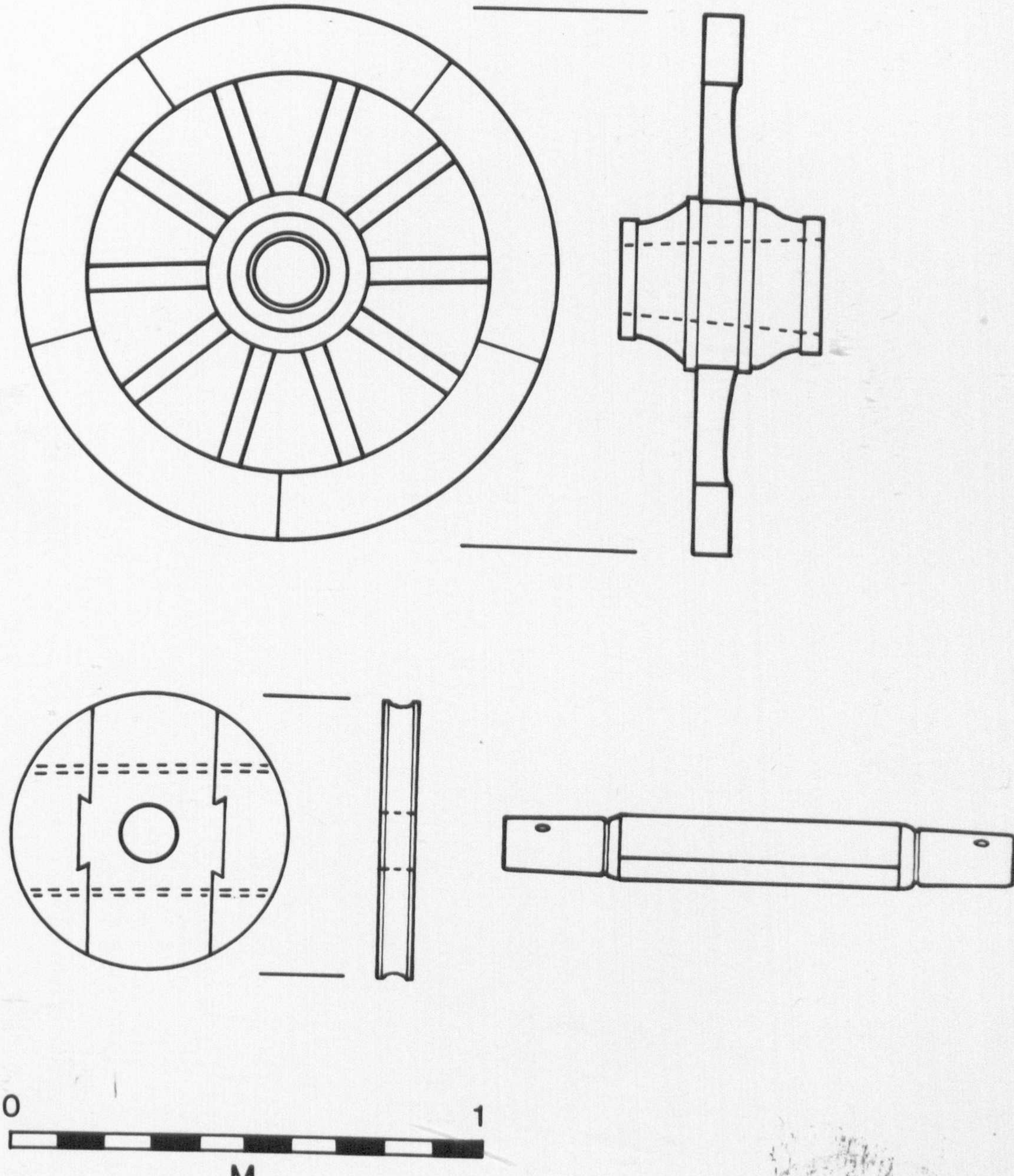


FIGURE 61

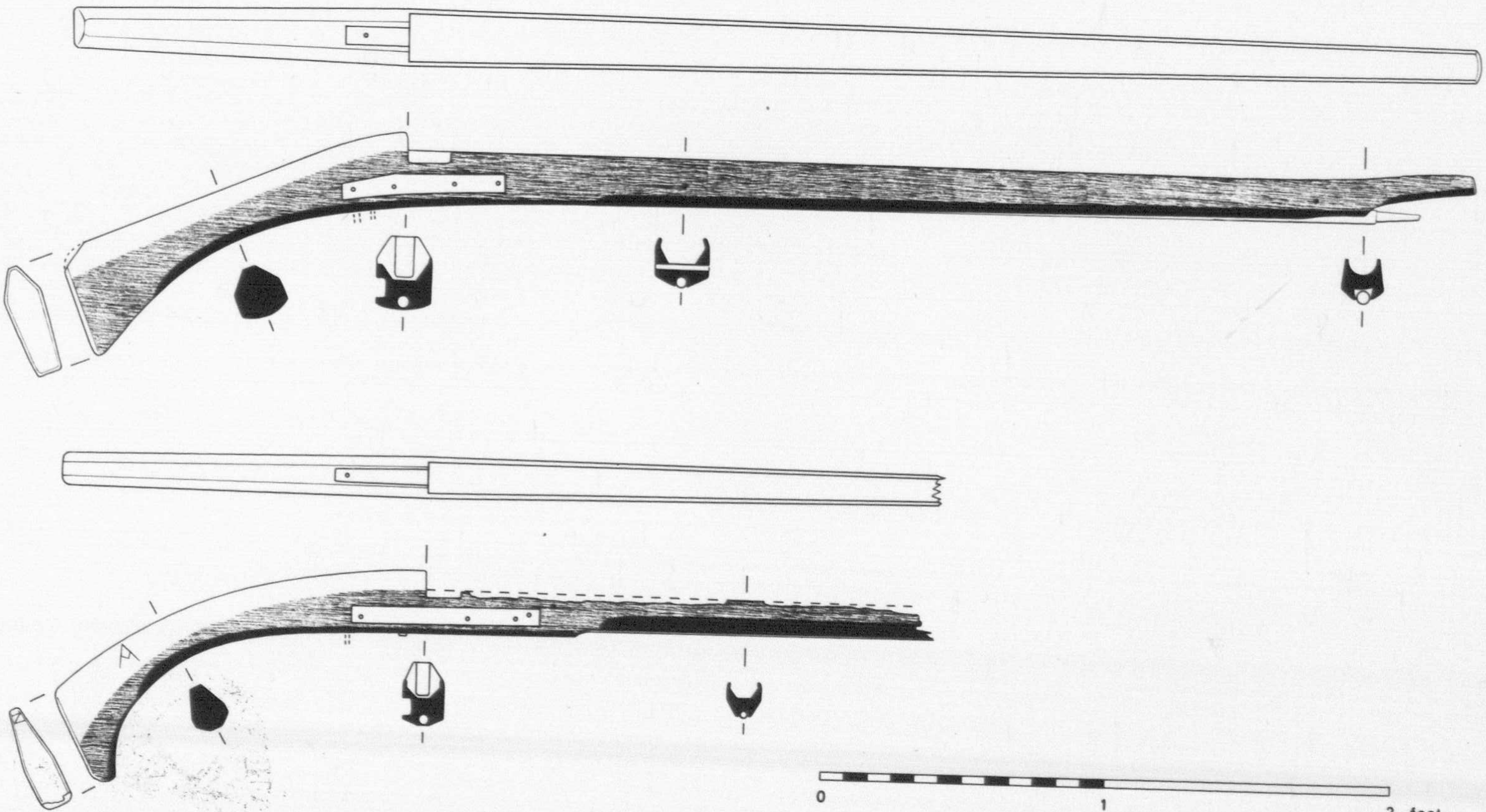


FIGURE 62

FIGURE 63

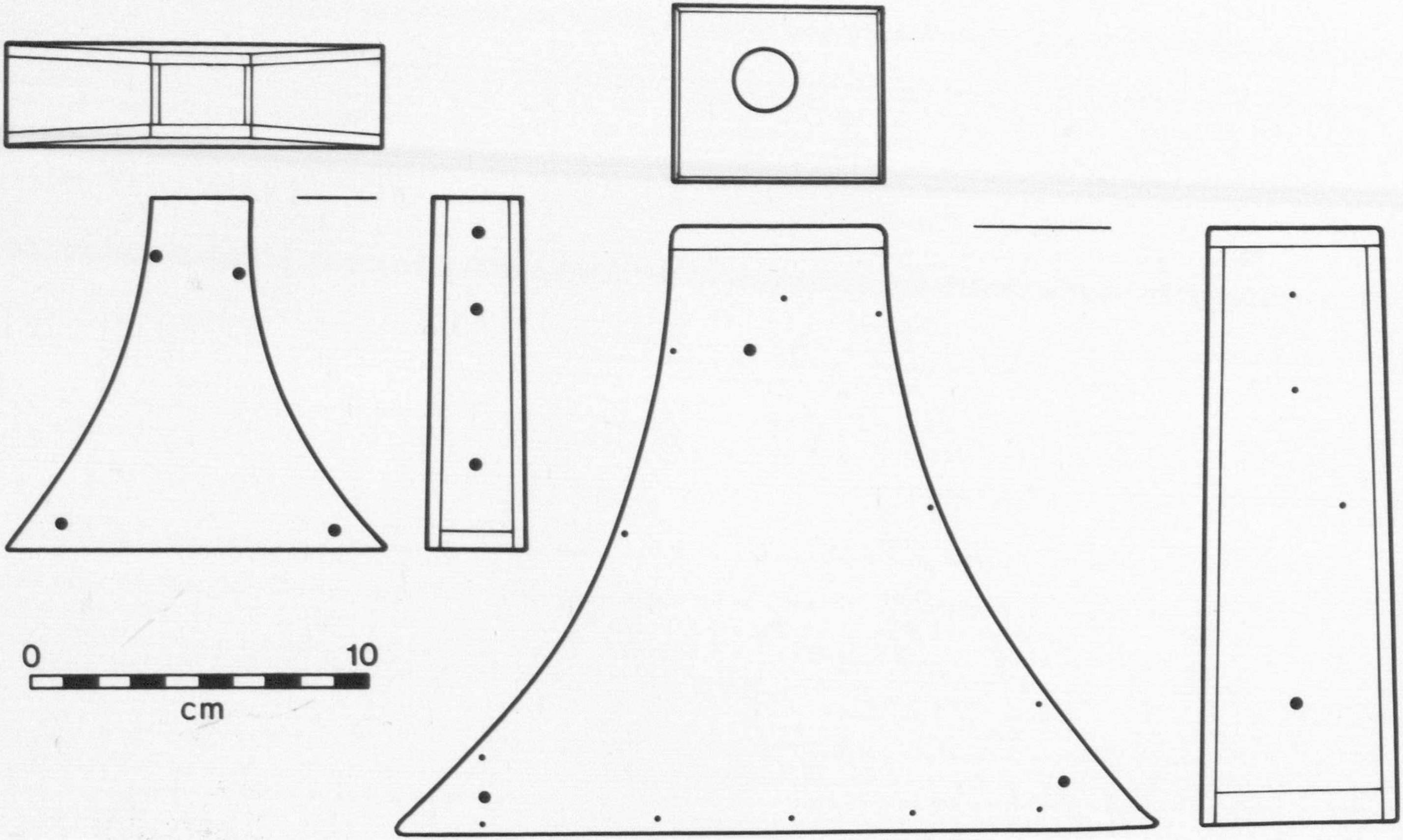


FIGURE 64

FIGURE 65

FIGURE 66

FIGURE 67

FIGURE 68

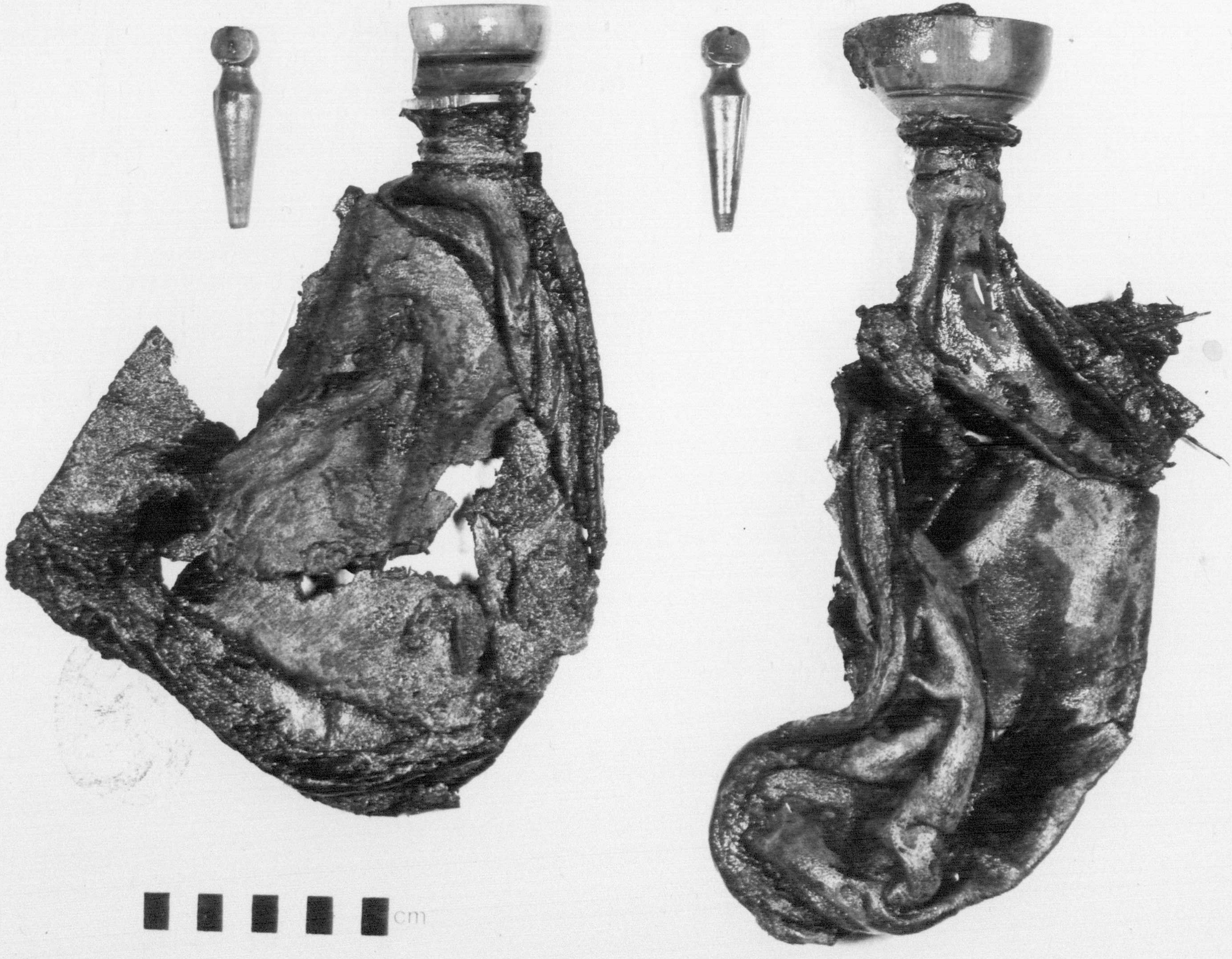


FIGURE 69

FIGURE 70

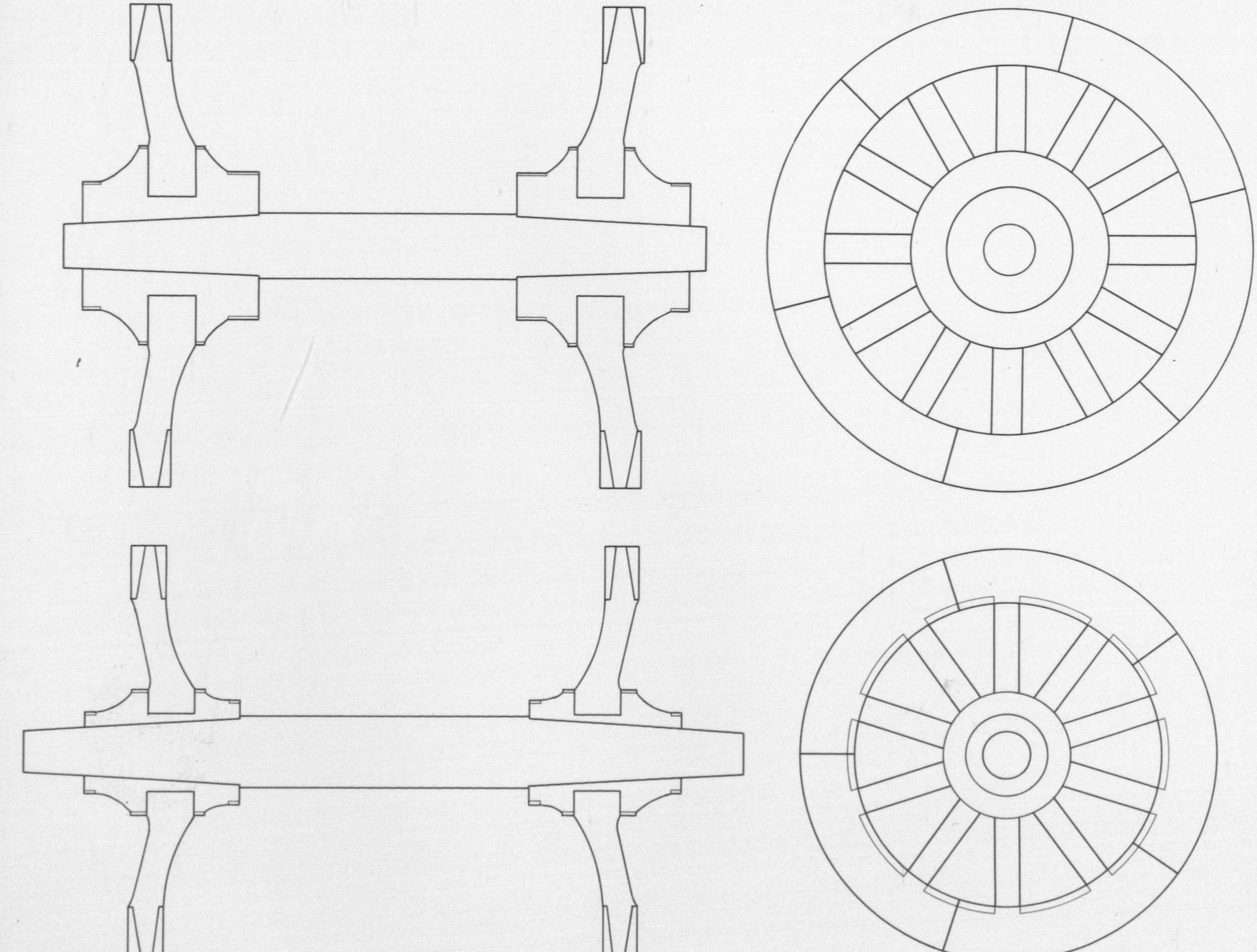


FIGURE 71

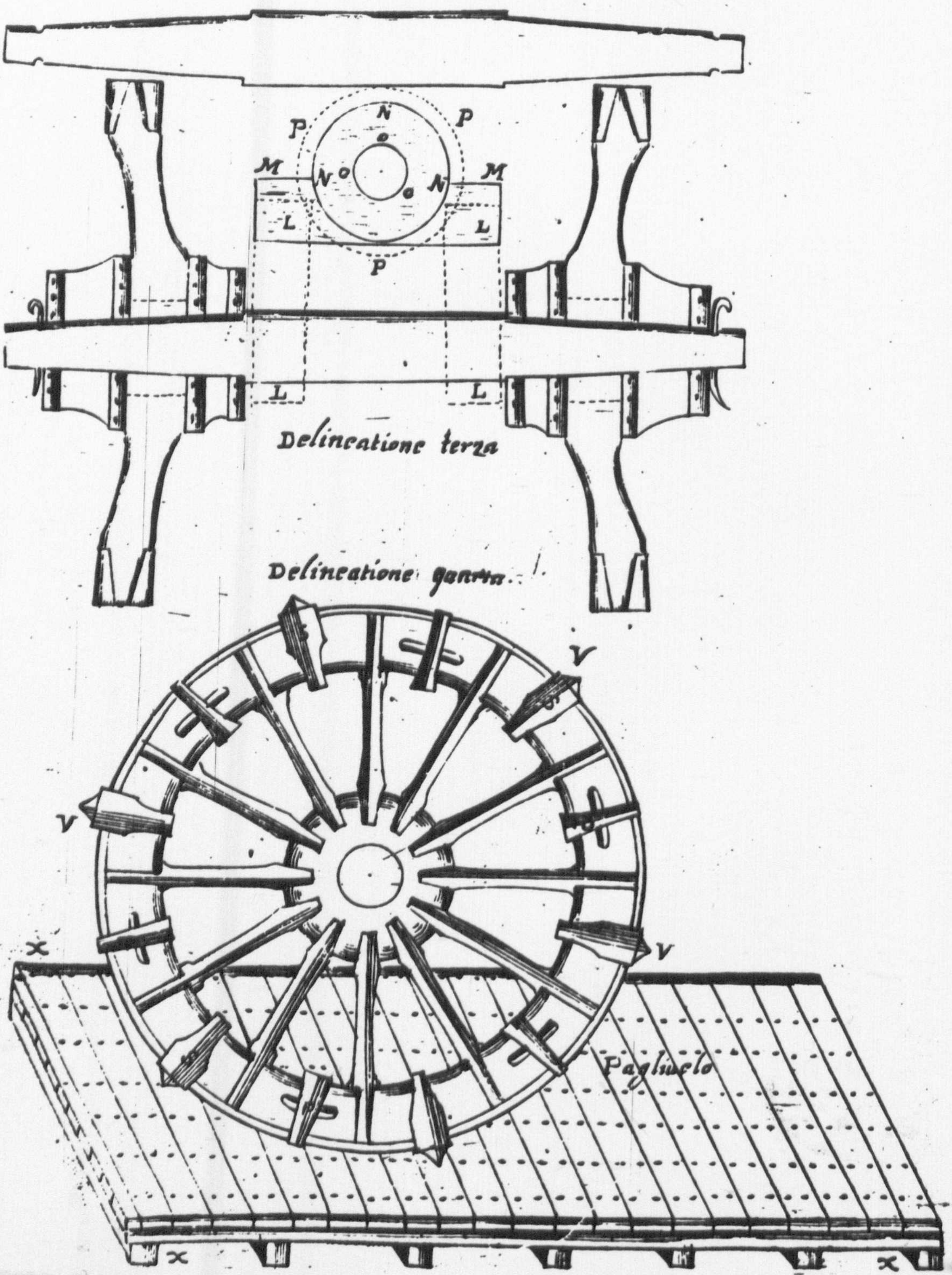

P
N
P
M
N
N
M
L
L
P
L
L
Delineatione terza
Delineatione quarta
V
V
V
x
Pagliuolo
x
x

FIGURE 72

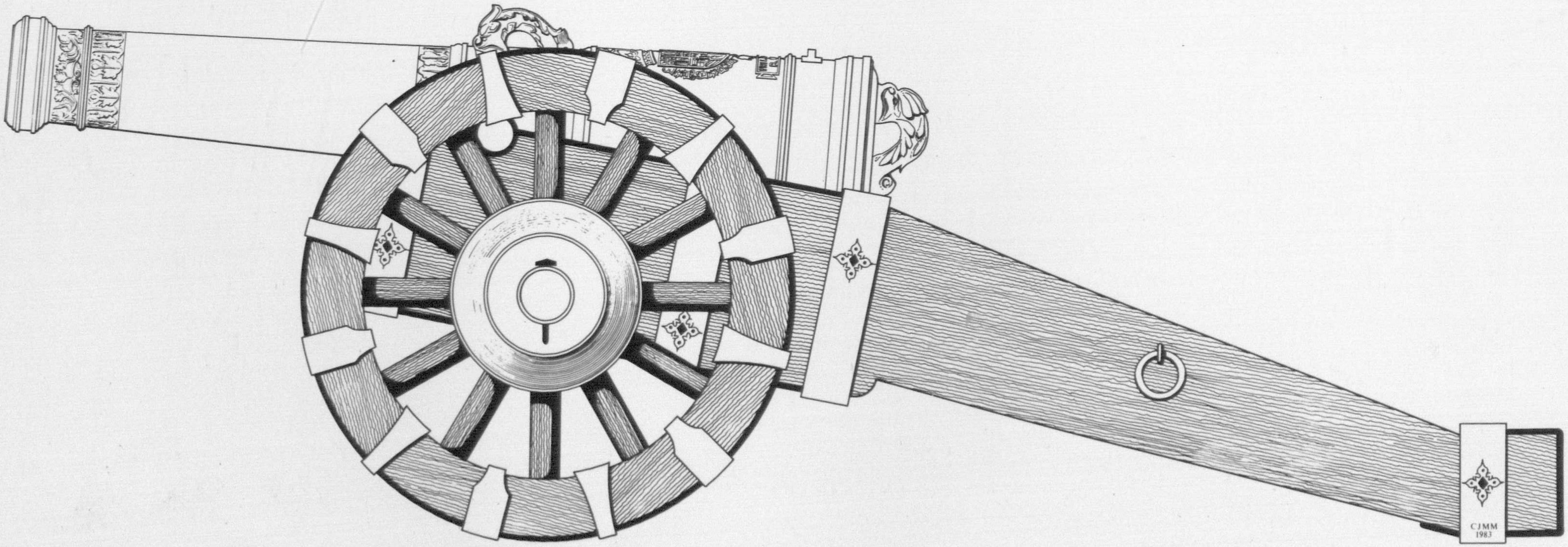


FIGURE 73

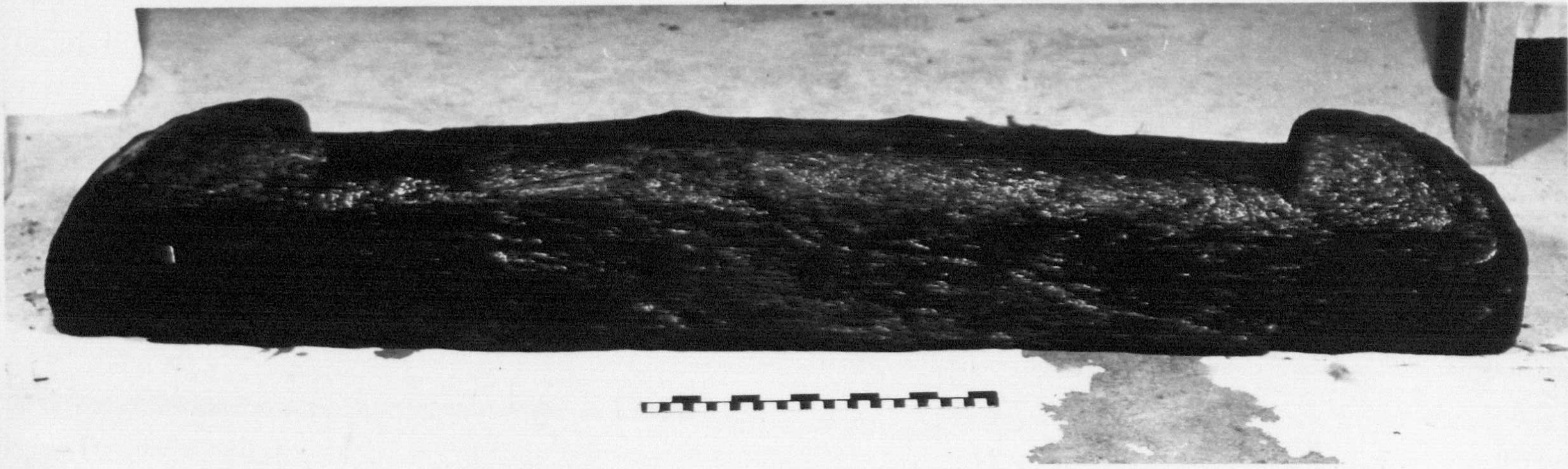


FIGURE 74


Ankummen vnd Einreyten Kaiserlicher Maiestat/ vnsers al
ler gnedigsten herrn/ zu München/ vnd irer Kais. Maiest. da
selbst erzeigter Triumph vnd Herrligkeiten/ mit raisings vnd
füß volcks kriegßordnung vnd vbung/ auch geschütz vñ fewr
werck/ vnd andere kürtzweyle/ gar eygentlich auff gegenwer
tigen zetel verzeichnet vnd auffgedruckt.
S. Ni
clas.
NM

FIGURE 75

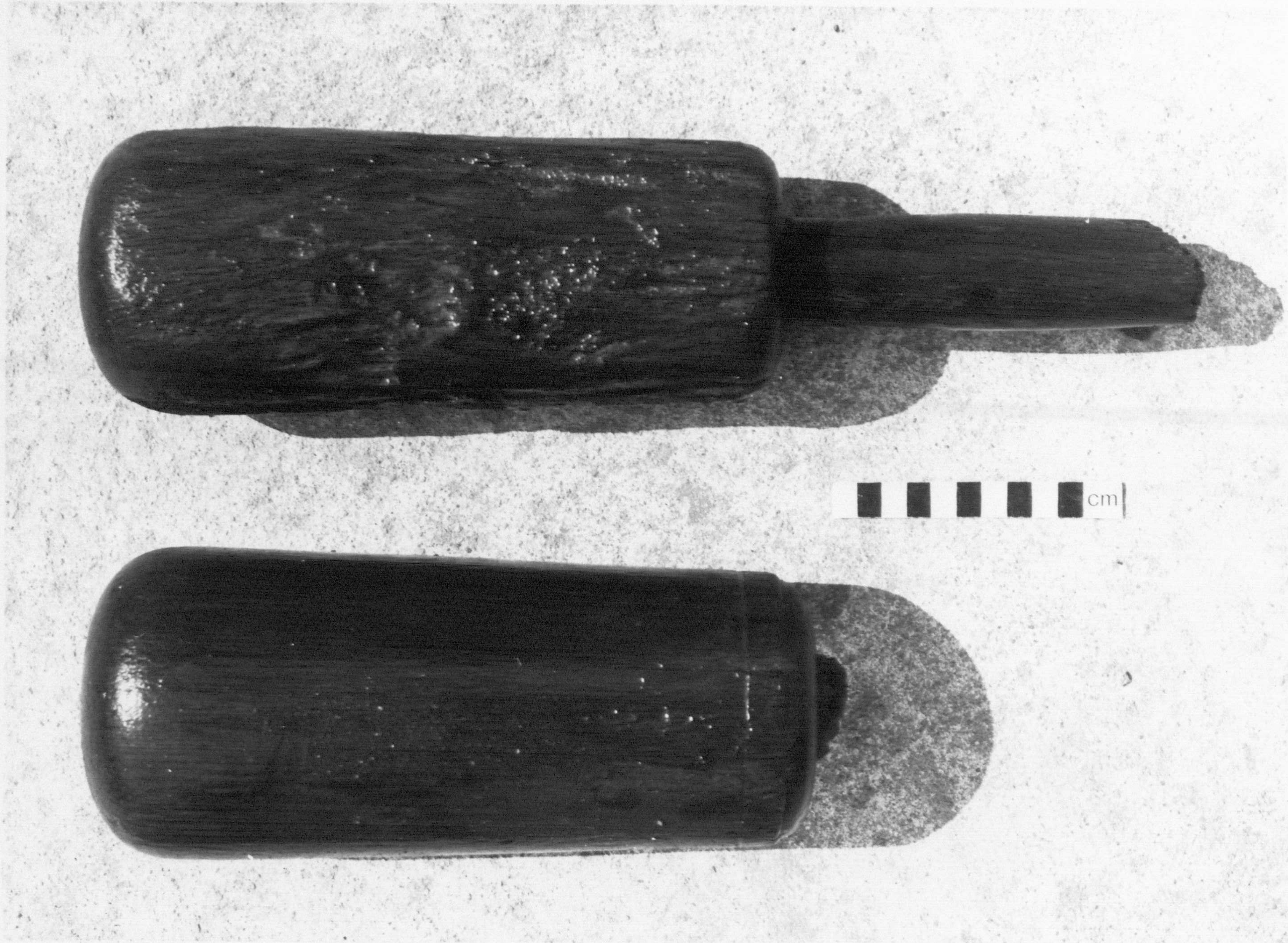


FIGURE 76

FIGURE 71

FIGURE 78

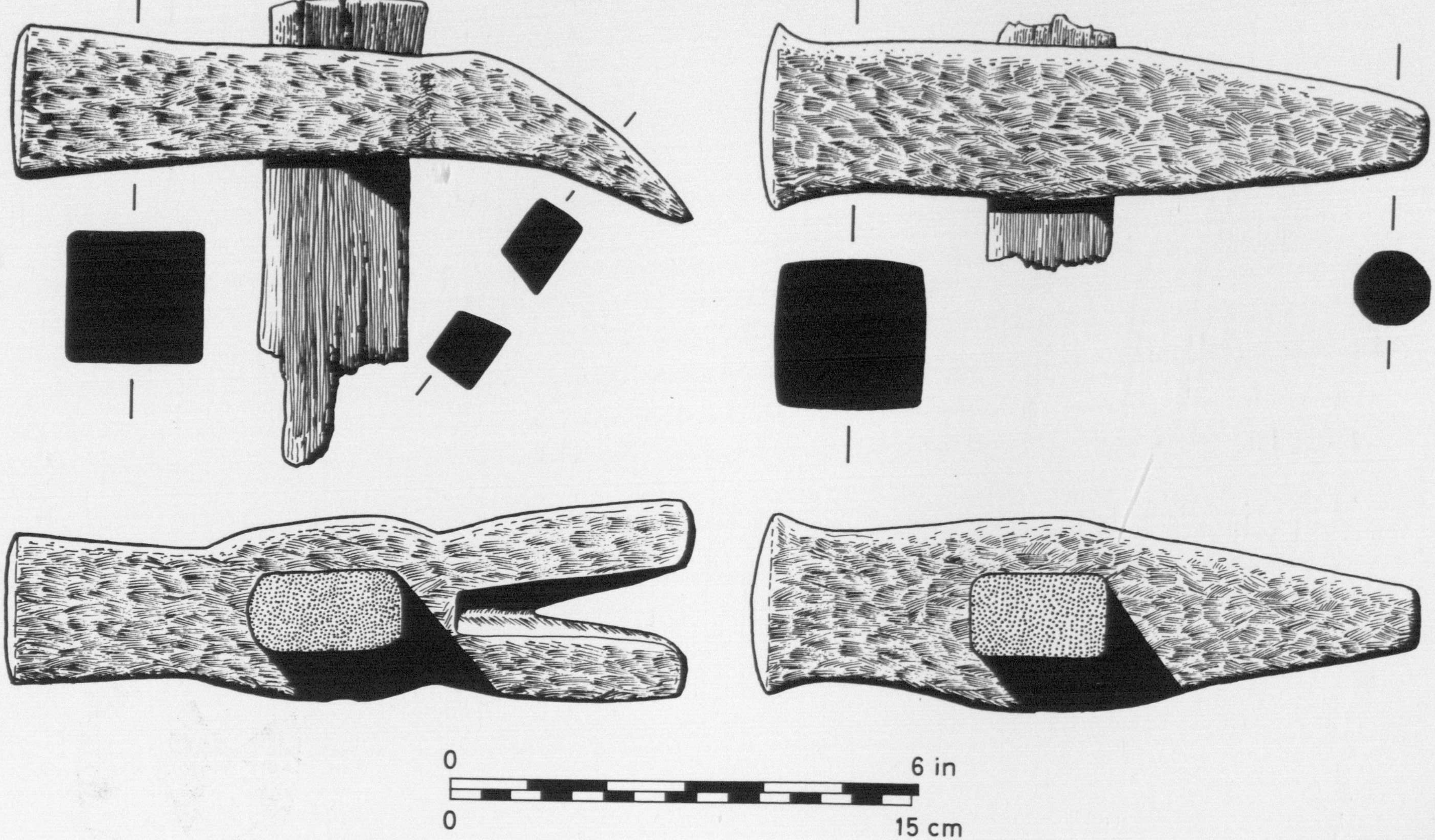


FIGURE 79

FIGURE 80

FIGURE 81

FIGURE 82

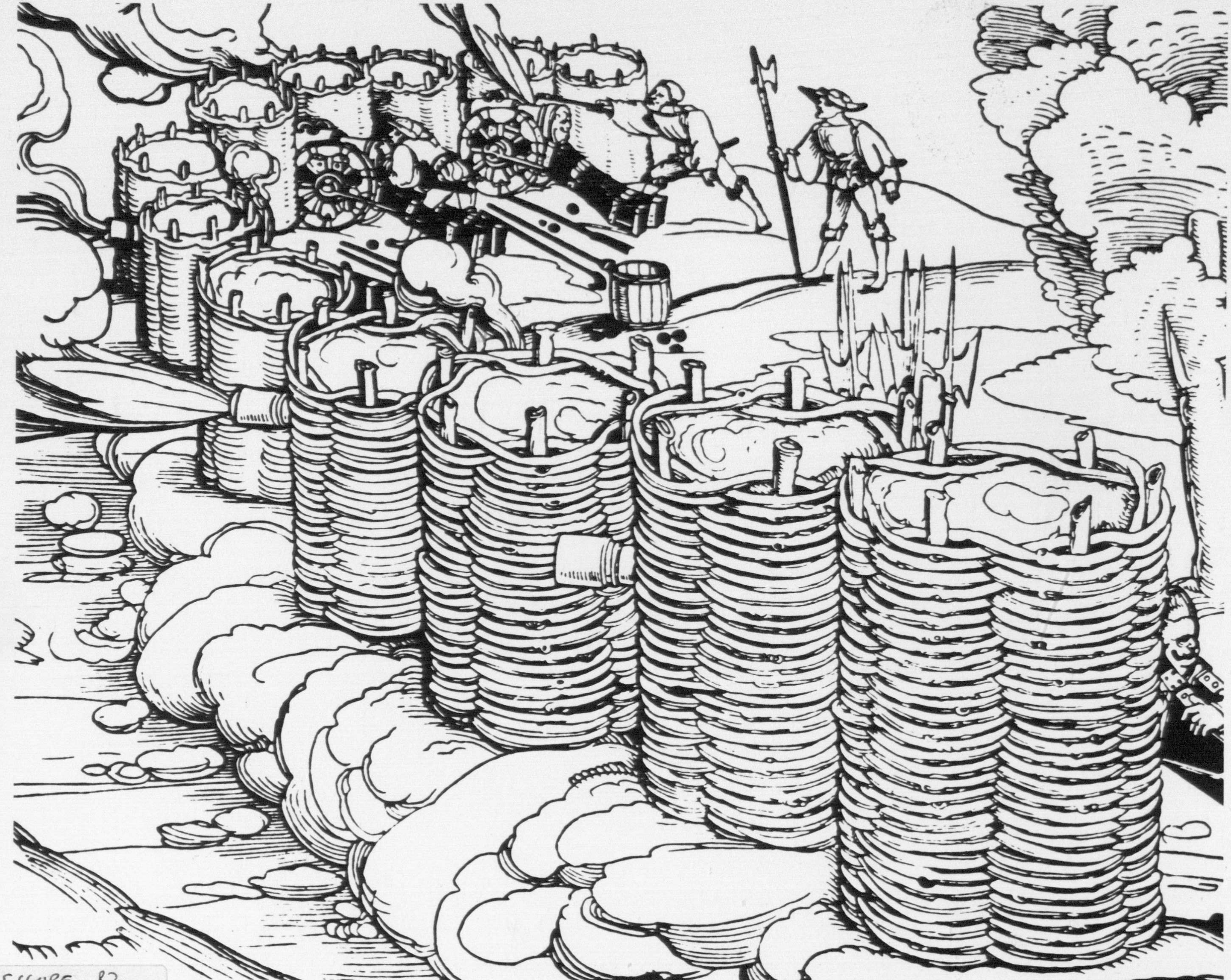


FIGURE 83

FIGURE 84 (a)

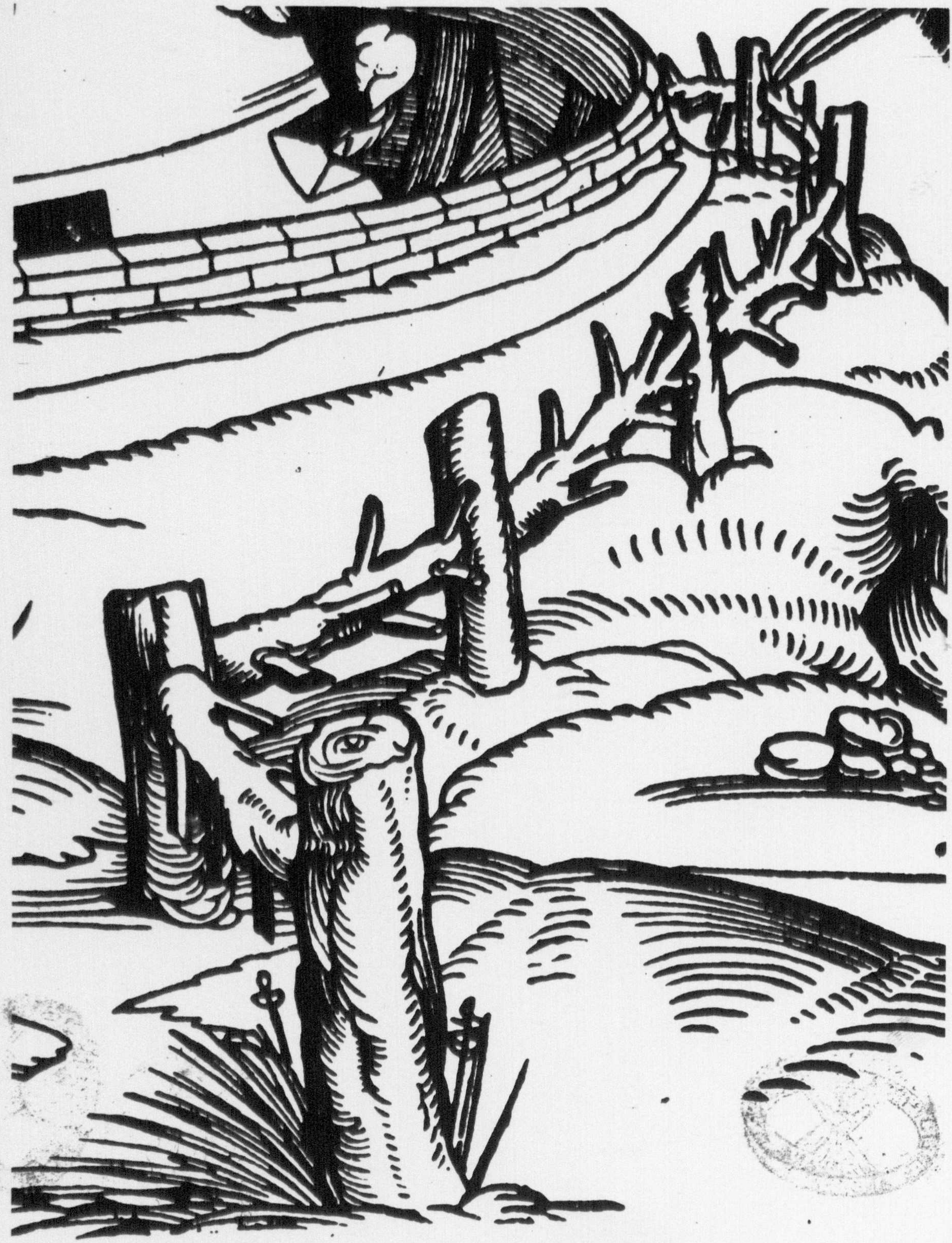


FIGURE 84 (b)

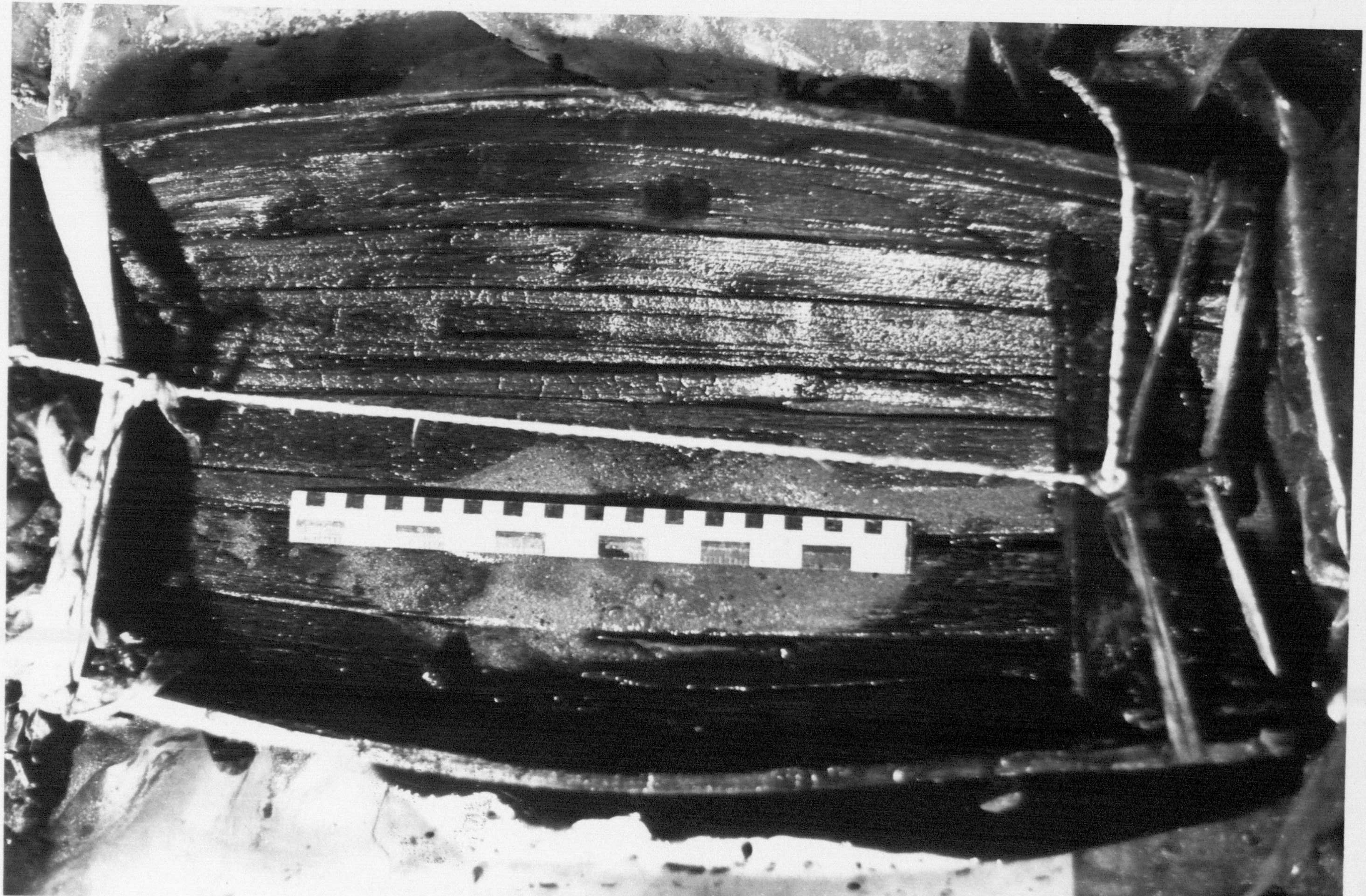


FIGURE 85

FIGURE 86

FIGURE 88

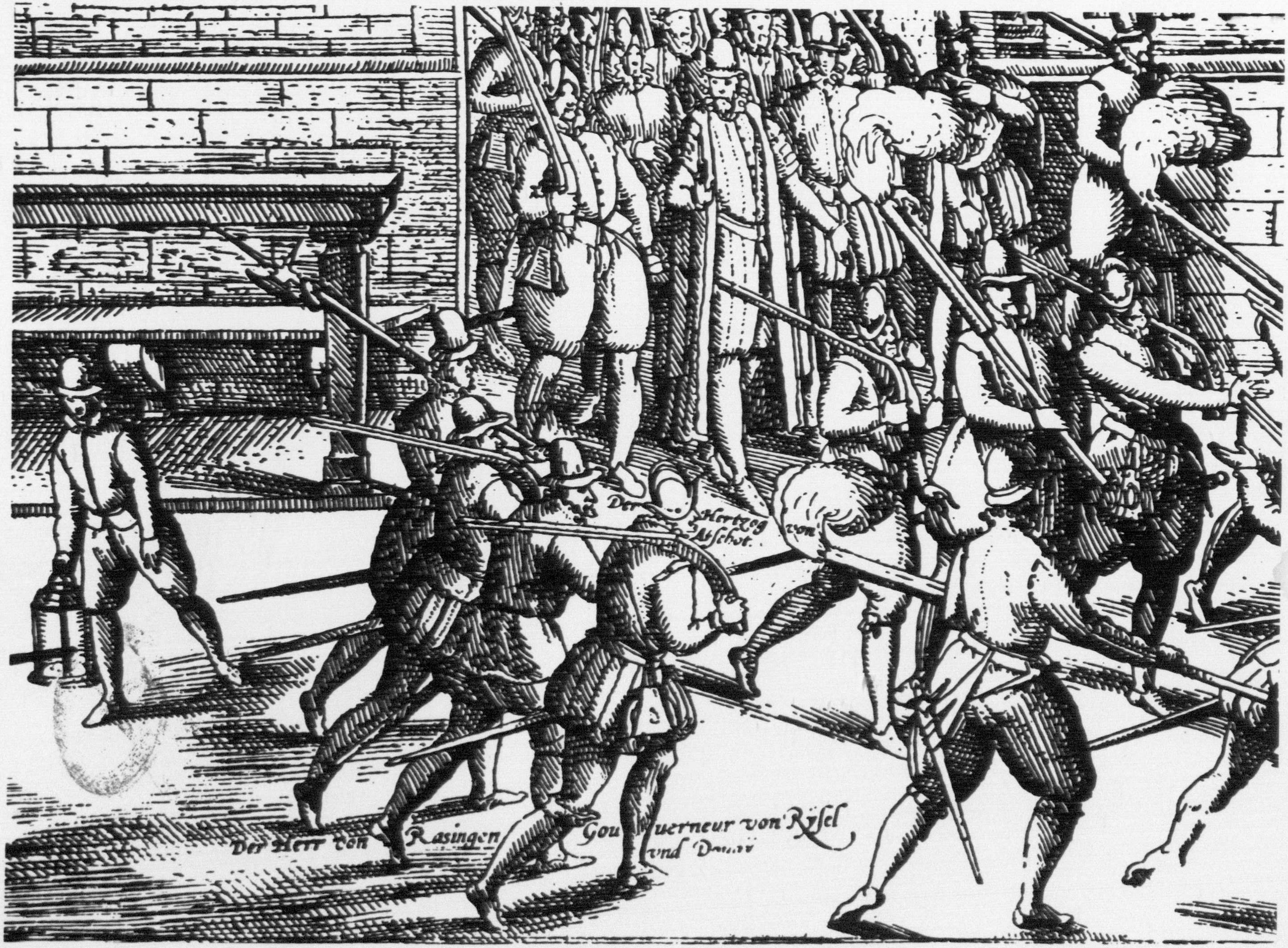

Der Hertzog von Arschot.
Der Herr von Rasingen Gouuerneur von Rÿsel vnd Douaÿ

FIGURE 89

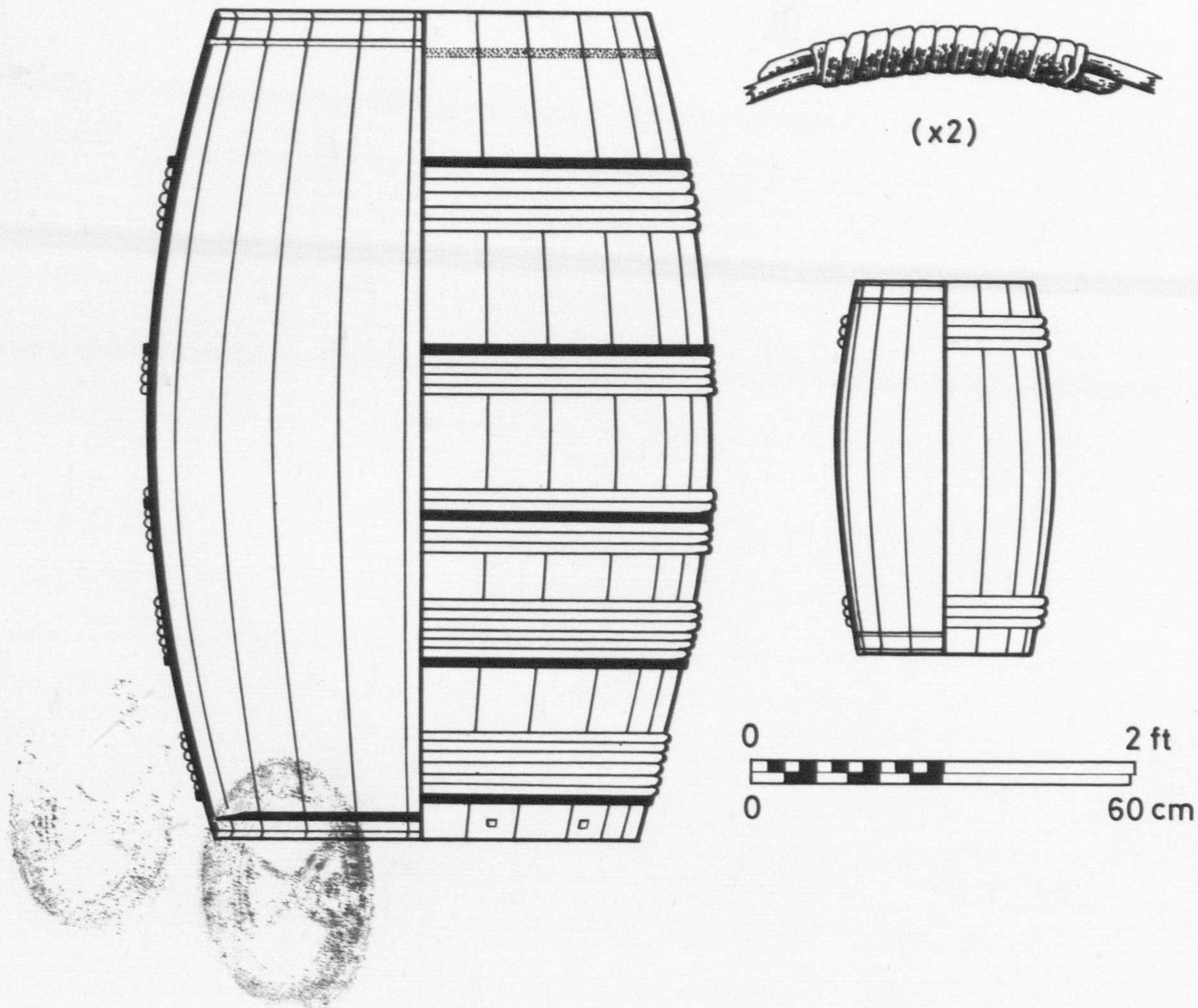


FIGURE 90

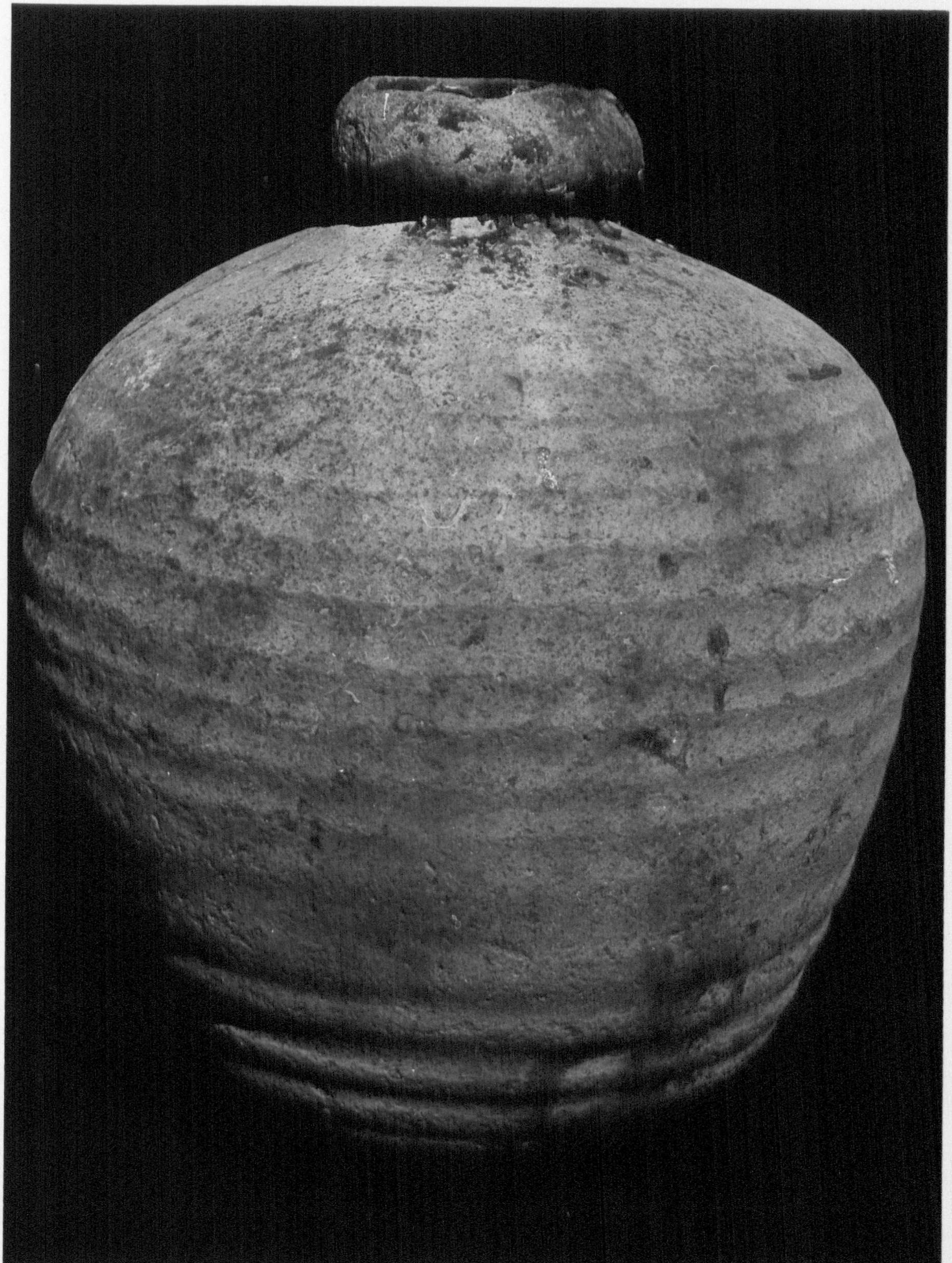


FIGURE 91

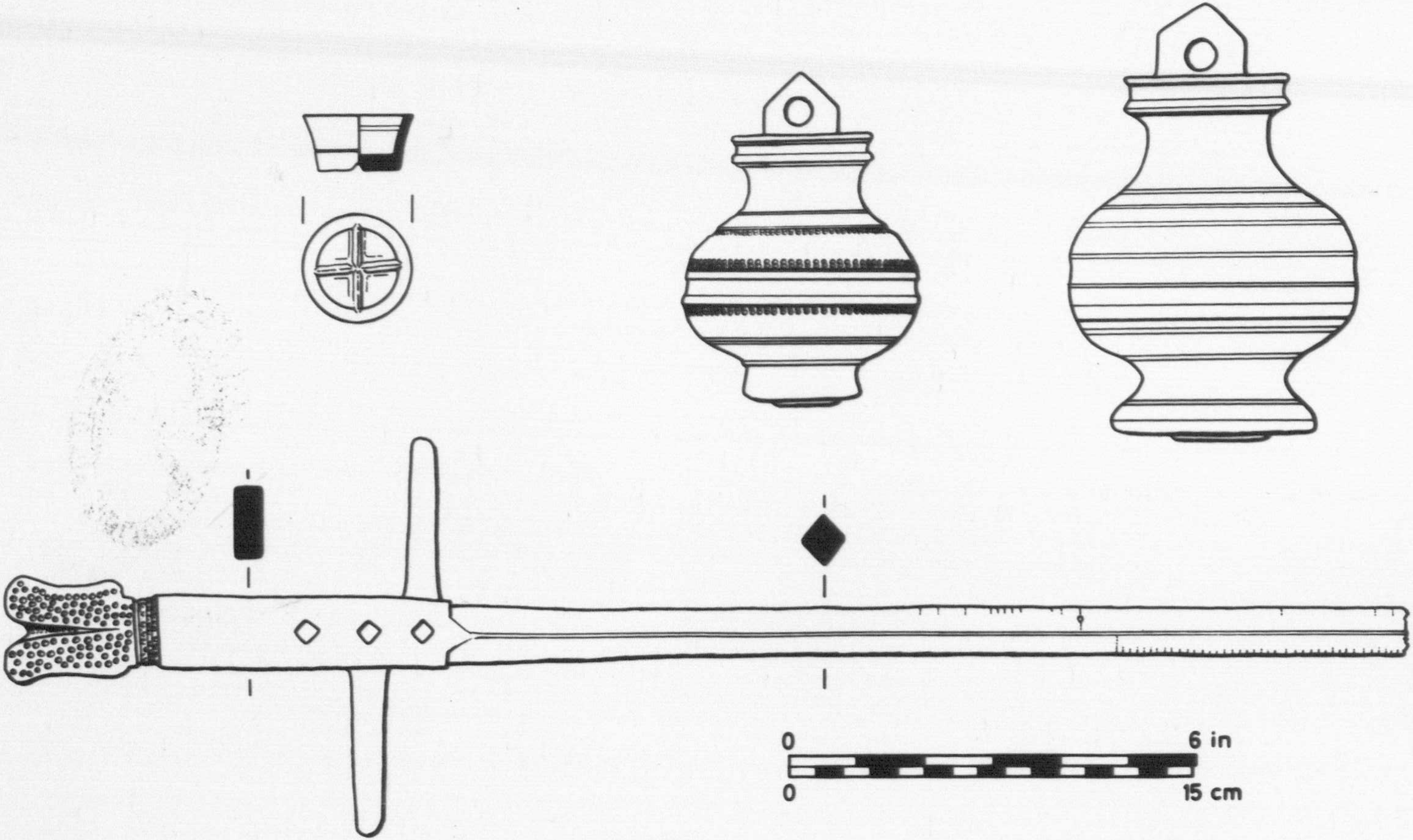


FIGURE 92

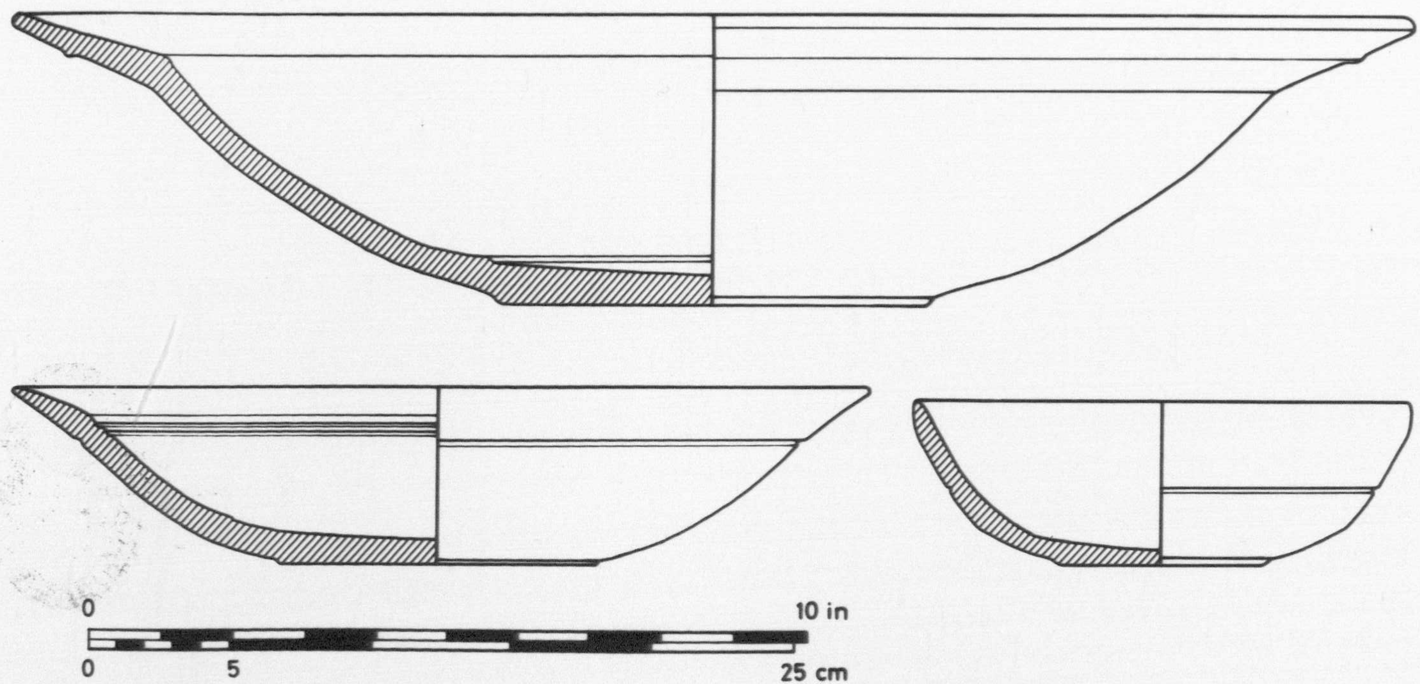


FIGURE 93

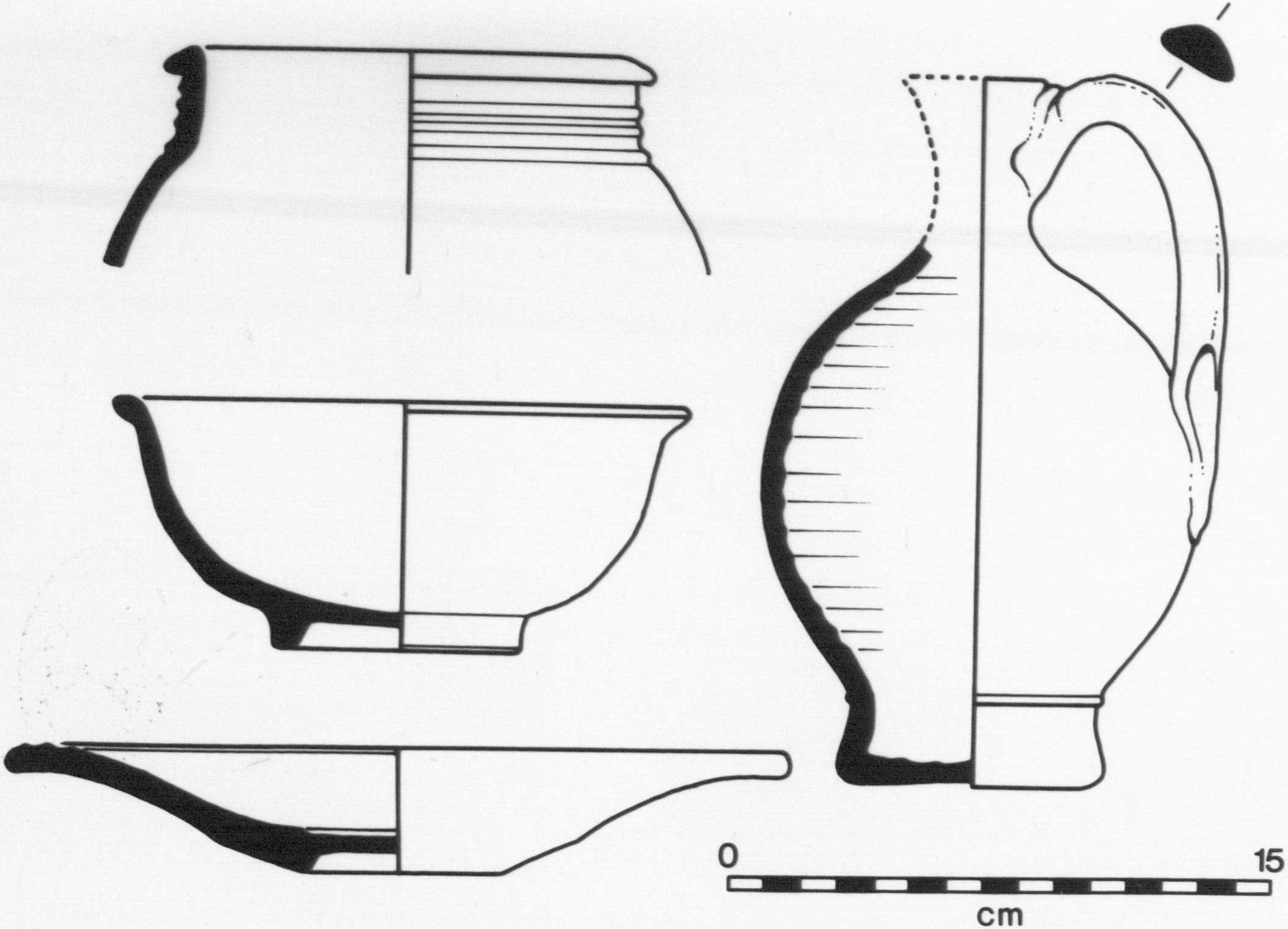


FIGURE 94

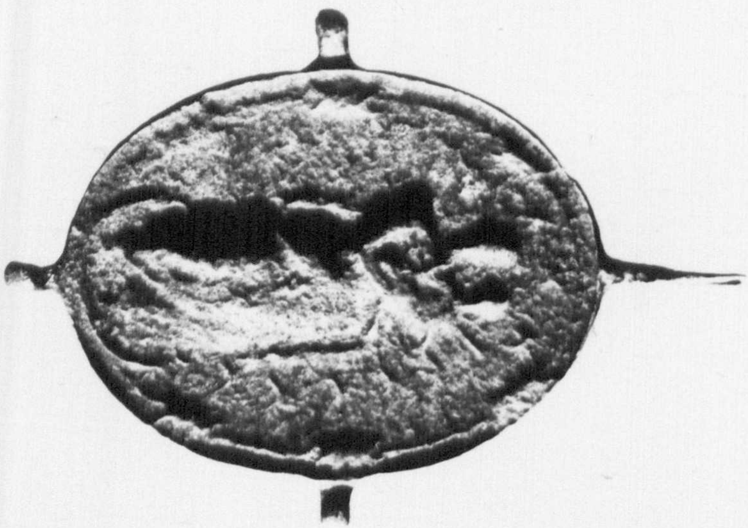
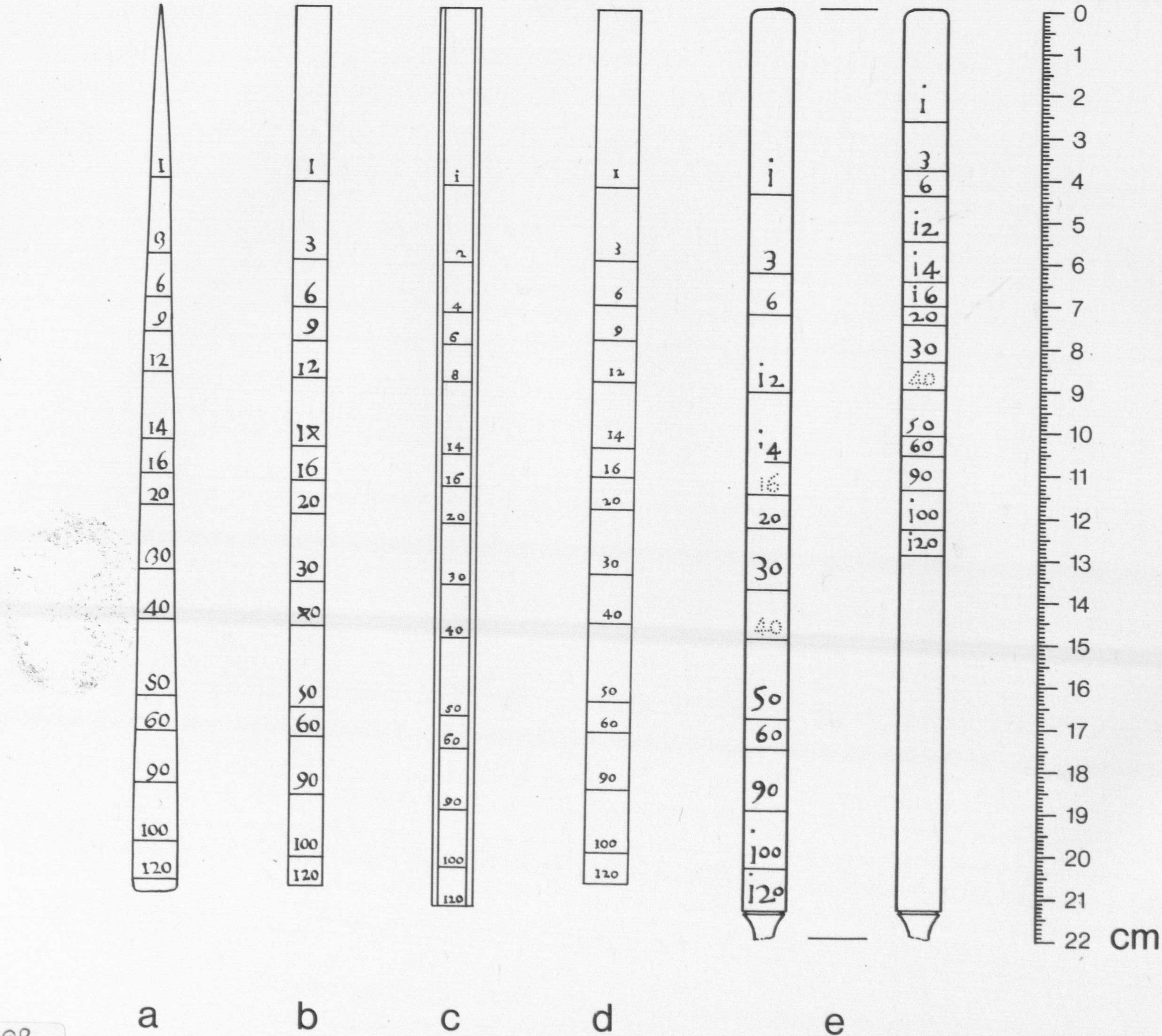


FIGURE 9D



1 3 6 9 12 14 16 20 30 40 50 60 90 100 120
1 3 6 9 12 1X 16 20 30 X0 50 60 90 100 120
i 2 4 6 8 14 16 20 30 40 50 60 90 100 120
1 3 6 9 12 14 16 20 30 40 50 60 90 100 120
1 3 6 12 4 16 20 30 40 50 60 90 100 120
1 3 6 12 14 16 20 30 40 50 60 90 100 120
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 cm
a
b
c
d
e

FIGURE 98

FIGURE 99

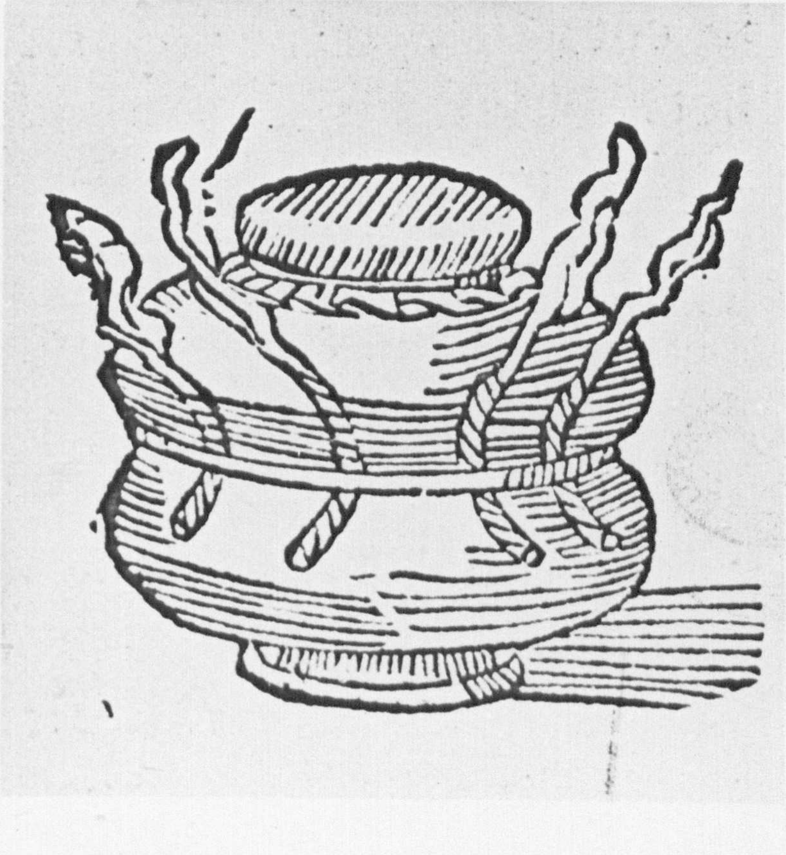


FIGURE 87