

Finds from the *Hollandia*

The *Pleinschaal* from the *Hollandia*

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The discovery and first four years' work on the wreck site of the Dutch East Indiaman *Hollandia*, wrecked off the Isles of Scilly in 1743, has been reported in 1975 (Cowan *et al.*, 1975) and that interim report contains a detailed account of the history and destruction of the vessel together with a preliminary archaeological report on the initial years of survey and excavation.

The *Hollandia*, built in Amsterdam for the Amsterdam Chamber of the Dutch United East India Company (VOC), was 150 ft (45.72 m) long, had a capacity of about 750 English tons, and was one of an experimental type of *retour* ship built during that period for voyages to the Indies. The *Hollandia*, one of three vessels in the summer fleet, sailed from Texel to Batavia on 3rd July 1743, with a cargo of silver and other merchandise and stores. On 13th July, after apparently having struck the Gunners Rock to the west of the Isles of Scilly, she sank in deep water about 1 $\frac{1}{3}$ miles away from the rock, with the loss of all on board. It would be tempting to speculate that the reason for the *Hollandia* being so far north off course was the very inaccurate *pleyn-Schael* recovered from the wreck. Contemporary attempts to salvage her cargo and equipment failed due to the savage tides and poor visibility, and she remained undisturbed, except for the action of the sea, until discovered by divers in September 1971. Since then the work of survey and excavation has been carried on in a controlled way by professional divers, aided by selected amateurs, during winter and summer until 1977, and since then for an extended summer season to the present time.

In 1973, large areas of wreckage, containing cargo and stores, were sighted to the south of

the main site (Fig. 1), approximately 60 m from the perimeter of the main site, and, over a three-year period two surveys of much of the area have been carried out, using triangulation methods (with a further partial survey during 1981) and selected areas have been excavated manually, with the aid of an airlift. The scatter of material covers an area approximately 60 m square, several times the area of the main site. The enormous size of this section, together with the limitation of working time on the seabed imposed on the divers (20 min per diving day), has posed strategic problems. This resulted in the decision to excavate selected areas, rather than systematically attempt to excavate the whole of the observed south site, using traditional methods of trenching and back filling. A further area to the north of the main site (Cowan *et al.*, 1975: 279) with a further five cannons and two anchors, larger than the main site, has been surveyed and substantially excavated. A major archaeological publication of the work on the *Hollandia*, which will include all the surveys so far undertaken, is scheduled to be published by the Rijksmuseum, Amsterdam during the next year or so.

During the last 11 years' work on the main site, a comprehensive and varied collection of navigational instruments has been found. These form a special and related group. Lists of the standard establishment of navigational instruments carried by officers of VOC ships exist in the Dutch State Archives and elsewhere. One nearly contemporary *lyste* (Fig. 2; Schilder & Mörzer-Bruyns, 1977: 217) sets out the complement of instruments for vessels of different sizes. This list shows that on a ship like the *Hollandia* the Lieutenants and Masters were

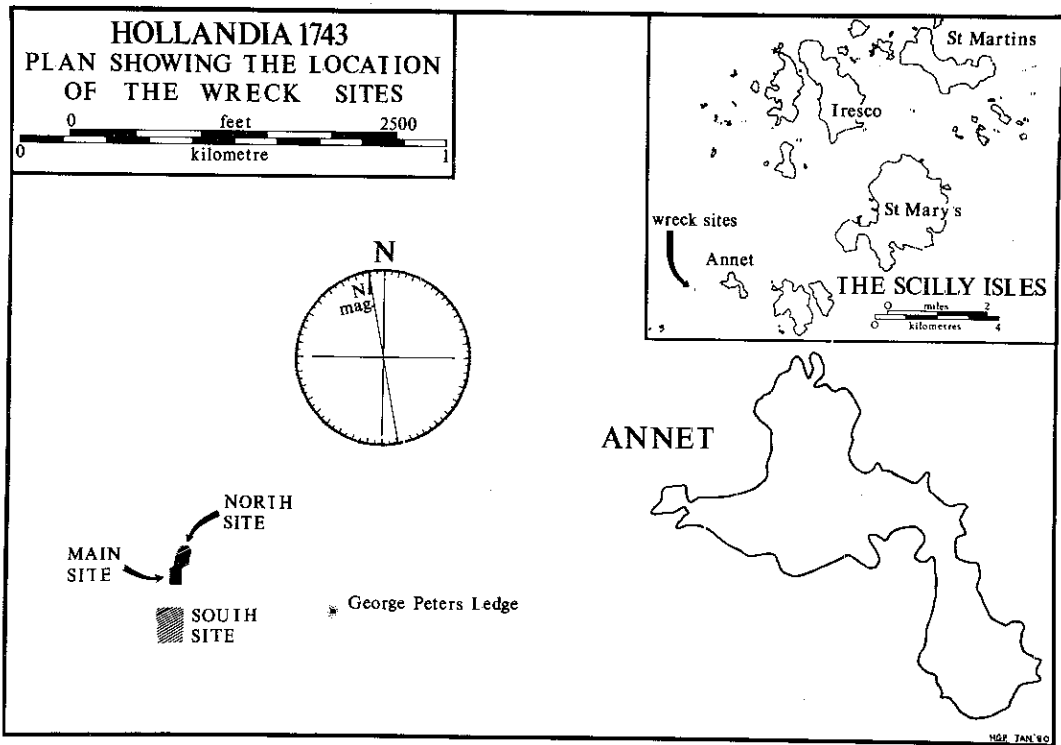


Figure 1. Plan showing the immense scatter of the *Hollandia's* remains over almost 1/3 km.

likely to have had three or four *plynfhalen* for their use.

The wide range of instruments prescribed is confirmed by the recoveries from the *Hollandia* site, as is the blend of conservative and modern preferences demonstrated by the officials responsible for compiling the instrument establishment. Obviously influenced by the preference of navigators for tried and traditional methods, fragments of cross staves have been recovered from the *Hollandia*, but also large sections of one of the then most modern instruments, Hadley's Octant, invented by James Hadley in 1731 and designed to establish latitude accurately.

The pieces of the octant from the *Hollandia* have been rebuilt with modern additions by the Scheepvaart Museum in Amsterdam and as a completed instrument is on permanent exhibition in that museum. It is the earliest *dated* specimen in existence.

Identified navigational instruments recovered from the *Hollandia* are:

Cross staff	Fragments of two staves
Brass dividers	12 complete pairs
	16 fragments of other pairs
Drawing compass	1 brass
Drawing instrument set	1 including case, pencil, brass ruler and dividers
Globes	2 brass mounts graduated for night and day
Octant	10 fragments and lens holder of the same instrument
Pencil	1 consisting of graphite in wood encased in a bone tube
Rulers	7 fragments of hinged folding rulers
Navigational slates	4 fragments
Sounding leads	14 complete large leads (with following incised figures indicating weights: xxxii, xxii, x, xx, xxii, xii0
	2 fragments of large leads
	3 small leads (1-3 lb) no incised weight figures
Telescope	1 brass eye-piece

On 3rd June 1978 a wooden ruler was found in grid area E.15 (Cowan *et al.*, 1975: 282), this area is postulated to contain part of the

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GENERALE LYST

Van de Stuurmans gereedschappen, Kaarten en Boeken met derzelver vastgestelde Prijzen, zoo als die by de Kamer Amsterdams worden geleverd, en mede gegeven aan de Eerste Gezagvoerders op de Schepen van de Ed. Oost-Indische Compagnie, volgens Resolutie van de Vergadering der Zeventienen, genomen den 13. Maart 1747.

	guld.	fl.	p.
1. Kopere Azimuth-Compassen	36		
1. Roos met een Agate dop, voor hetzelfde ter Waarlo.	6		
2. Staale en 2. Kopere Pennen voor dezelve ieder	10		
6. Kopere Nagthuis- of Zyl-Compassen	9		
6. Roozen met Agate doppen voor dezelve ter Waarlo.	4		
6. Kopere en Staale Pennen van ieder de helft.	10		
6. Glazen, best glas voor dezelve	8		
2. Kopere Pyl-Compassen	36		
2. Roozen met Agate doppen ter Waarlo voor dezelve	6		
1. Grote schuivende Roos, om Havens en Landen te peilen.	6		
6. Kopere en Staale Pennen van ieder de helft.	10		
6. Glazen waar onder drie voor 1. Azimuth-Compassen	18		
2. Ofsanten met kopere Indexe ieder	75		
1. Kopere Lijstaal voor de eerste Gezagvoerders	1		
1. Kopere Winkelhaak	1		
1. Kopere Verrekijker van 3. voer, met twee Leeden	10		
1. Potloot Pennen, met kopere doppen hier dozyn	1		
3. Graadhoozen met Vizeren ter Waarlo	5		
1. Kaartpassers met Staale Punten	1		
1. Schryfpasera	11		
1. Pleinschalen voor de Lieutenants en Smuulieden	12		
1. Blikke Geschilderde groote Roepers	3		
2. dito kleine Roepers	2		
2. dito Kaartkokers waarvan 2. voor den Gezagvoerder	12		
3. Doozen voor de Roozen, glazen en pennen ter Waarlo voor de Zyl-Compassen	18		
1. Doos voor de Roozen Ext. der Pyl-Compassen, ieder	1		
1. Half Minuts Zandloper voor de Loglyn	10		
1. Quart Minuts dito	10		

Ge-

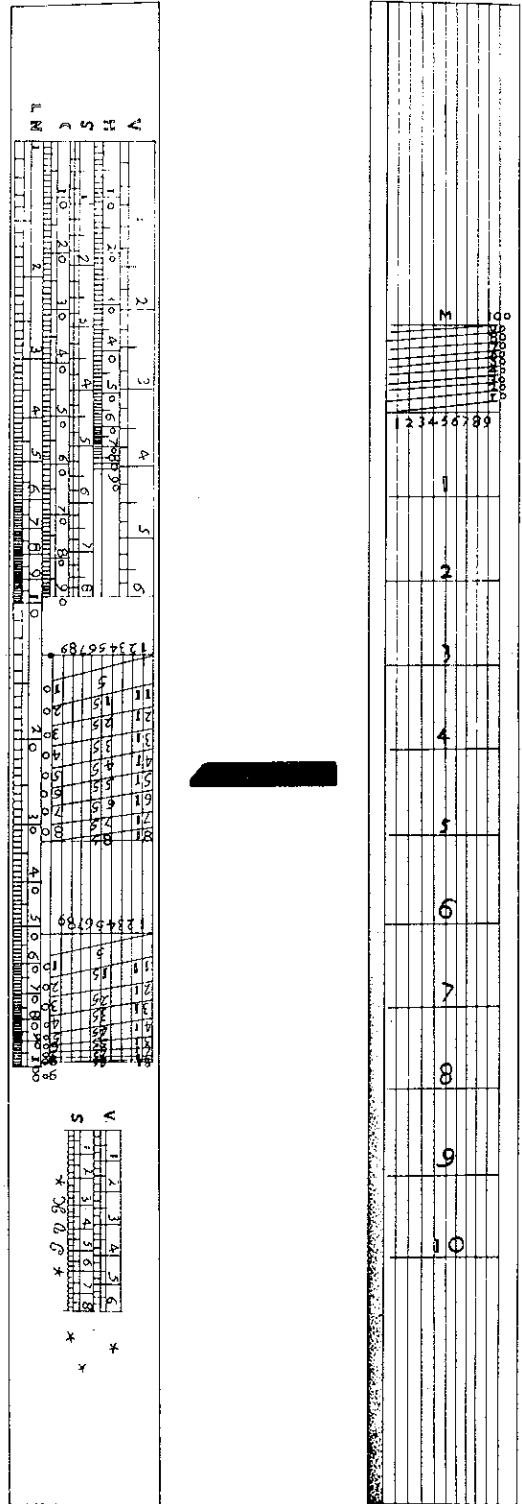
Figure 2. The later *Lyste* of 1747 for the Amsterdam Chamber, prescribing three *pleinschalen*; this is probably the number carried on the *Hollandia*.

forward remains of the ship. After cleaning, some inscribed and complex graduations with a small group of stars clustered near the initials JvK could be seen (Figs 3 and 4). The ruler responded well to careful treatment in the conservation laboratories of the National Maritime Museum at Greenwich: PEG was the agent used. The ruler has now been studied by experts and identified as a version of a Gunther scale, or as called by the Dutch a *pleyn-Schael* or *pleinschaal*. It is the only known version made by Johannes van Keulen, a world famous cartographer of the 18th century, and instrument maker for the VOC. Only two similar instruments are known in Holland; one is of uncertain date, made by Jacobus Kley; and at present in the collection of the Scheepvaart Museum, the other, unsigned and undated, but less sophisticated than the *Hollandia* scale, and hence probably older, is in the Museum Boerhaave in Leiden. One can only speculate why or how the ruler came to be in the forward part of the wreck. It was buried deep in the concretion of the wreck and covered with a film of conglomerate. The scatter of navigational finds from the *Hollandia* is considerable and bewildering. Brass dividers, for instance, have been found all over the main site, as far apart as 24 m. It is another example of the caution necessary before drawing any conclusions from the analysis of the distribution of finds emanating from a smashed and scattered wreck site.

Acknowledgements

Roy Graham, the diving leader of the *Hollandia* team at the time of the recovery of the *pleinschaal* ensured that both the excavation and emergency conservation was undertaken diligently. Howard Pell, archaeological draughtsman prepared the accurate drawing depicted. I am grateful to Cdr. W. E. May, who first alerted me to the identity of the rule, which has been acquired by the Rijksmuseum, Amsterdam, where it has already been displayed to the public. Professor G. Schilder discovered the printed *Lyste* of 1731 and supplied me with a copy.

Figure 3. Drawing of the *pleinschaal*, showing the mark of Johannes van Keulen and the six stars, probably his trade mark.



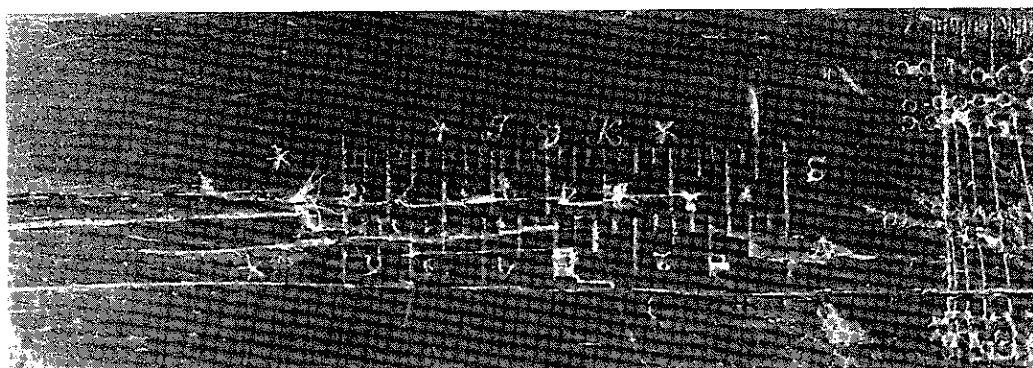


Figure 4. Photograph of the ruler with detail of van Keulen's initials and mark. Scale in centimetres.

The navigational ruler from the *Hollandia* (1743)

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Museum Boerhaave, Leiden

The plebeian fact that the earth has the shape of a sphere rather than a disc has caused difficulties to seamen since the earliest days of their long-distance voyages over the world's oceans. The plane maps with which these seamen were provided always gave a distorted image of the world, since they were necessarily projections of a spherical configuration on a plane sheet of paper. Therefore, courses to be sailed between distant points on the earth, and the distances between these points could not be read off charts directly, but had to be found through a fair amount of calculation. Analogously, the position arrived at after a journey on a well-known course and of a well-known distance had also to be calculated and could not immediately be read off a chart. So besides maps, other means were needed to assist the navigator in his duties. Such means rapidly became available in the 17th century. All sorts of rulers, scales and maps were produced by instrument- and mapmakers, designed to reduce complicated mathematical calculations and geometrical constructions to a set of standard manipulations. The navigational ruler made by J. van Keulen which was discovered in the 1743-wreck of the Dutch East-Indiaman *Hollandia* off the Scilly Isles is such a computational means (Figs 3 and 4). It is one of the

few extant examples of what appears to have been a fairly popular type of navigational instrument. These instruments were called *pleinschaal*, and according to the inventories of the Dutch East-India Company VOC, they were standard-issue to the navigational officers of this company (cf. Mörzer-Bruyns, 1980). Apart from the *pleinschaal* recovered from the *Hollandia*, a few more examples exist in Dutch museums. The Scheepvaartmuseum Amsterdam possesses an almost identical scale made by Jacobus Kley [no. S3392 (2) P15] (Fig. 5). Furthermore, the Museum Boerhaave in Leiden owns an unsigned, much less sophisticated and hence presumably older plain scale (no. A290).

The history of the *pleinschaal* goes back to 1624, when John Aspley first described such a scale in his *Speculum Nauticum* (Aspley, 1624). Aspley's plainscale consisted of five straight lines, which were divided as follows: a line of equal parts, a line representing the chords in a circle between 0 and 90°, a line of chords of the rhumbs (i.e. the eight winds in one quadrant of a compass), a line indicating the number of leagues that had to be sailed on a given latitude to produce a difference of one degree in longitude, and finally a logarithmic line. Aspley's scale was especially helpful for carrying out dead-reckoning procedures (cf. Waters,

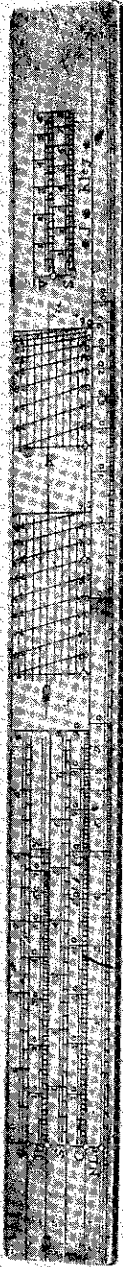


Figure 5. Similar rule in the Rijksmuseum Nederlandsche Scheepvaart Museum, Amsterdam by a different maker, undated.

1958). It was made popular in the Low Countries by Dierick Ruyter's book of 1631, *De platte ofte pleynschaal verclaert* . . . (Fig. 6) which in fact does not make any reference to Aspley (cf. Crone, 1927). The plain scale remained popular among Dutch seamen throughout the 17th and 18th centuries. But innovation in navigational theory and competition among instrument makers and navigation-instructors produced changes in the design of the plain scale. Hence the rulers of Van Keulen and Jacobus Kley are more complicated than the original ones described by Aspley and Ruyter.

Both sides of Van Keulen's plain scale are engraved. One of the sides bears only a scale of equal parts, marked M in which a block of transversals makes it possible to read off the opening of a pair of compasses in three digits. The unity of this scale does not relate to the scales on the other side, but was presumably related to the scales of the nautical maps employed. The other side is more interesting, as it contains five different types of division. At the bottom a logarithmic scale (marked LN)—a so-called Gunther or Wingate line—is engraved, which together with a pair of compasses can perform exactly the same function as a modern slide-rule. However, the scale is quite inaccurate, as is Kley's scale in the Scheepvaartmuseum Amsterdams, since, e.g. $\ln(4) - \ln(2) \neq \ln(2)$; the other scales also suffer from such inaccuracies. The four other scales are marked V, H, S, C and they pertain to circular quantities.

Three of them (V, S, C) represent the chords of angles between 0 and 90° , but in different types of units: C chords by degree, S chords of the rhumbs by a quarter rhumb, V the chords of a 6-division of the quarter circle. The fourth scale H represents the sinus of angles between 0 and 90° . These four scales appear twice, related to two different circles, the radii of which are in ratio 5:2. The radii of these circles could be found from the scale C, being equal to the chord of 60° . Since all applications of the plain scale required that this circle was drawn first, the marks of 0 and 60° in the C scales were protected against wearing off by small brass inlays, both in Van Keulen's and in Kley's scale.

A history of the use and supply of the *Pleynschael* by instrument makers to the VOC

W. F. J. Mörzer-Bruyns

Rijksmuseum 'Nederlands Scheepvaart Museum', Amsterdam

In 1624 a pamphlet entitled *Speculum Nauticum, a Looking Glasse for Sea-men, wherein they may behold a small Instrument called the Plain Scale ... etc.*, appeared in London. It had been written by John Aspley and went through several reprints during the 17th century. It is the first book in which mention is made of a ruler called the 'plain scale' or the *pleynschaal* as it is called by the Dutch. This is not to say that the Dutch name has been derived from the English name; both 'plain' and 'plein' mean 'plane', in this case on a plane surface (Crone, 1927).

Nauticum, Dirk Ruyter, who came from Zealand, obtained a copy of such a ruler. Ruyter, a seaman, cartographer and writer, recognized the value of this instrument for use at sea and wrote *De Platte ofte Pleyn-Schaal verclaert* (Middleburg, 1631, The plain scale explained; Fig. 6). He based his booklet for a considerable part on Aspley's work. It is almost certainly due to Ruyter that the plain-scale became a very popular ruler among Dutch seamen, in contrast with the English, among whom it was soon ousted by the Gunther scale (Crone, 1927). About the extent of the use of this instrument more is known from the 18th

Some years after the publication of *Speculum*

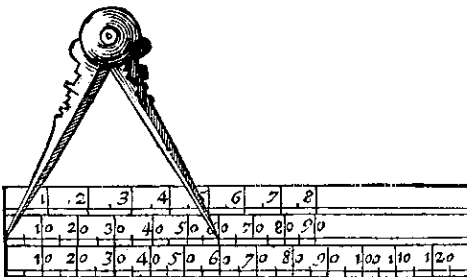
DE PLATTE,
OFTE
PLEYNSCHAE L,
VERCLAERI.

Vaer in aengewesen wert/
hoemen alle Sphaerische Rekeninghen ende
questien (soo veel tot het gebuyck der Zee-vaert noodich
is) seer licht / dooz den Passer / op den Circkel / sal conuen
upt-wercken.

Tot dienst ende nut van alle Zee-vaende lieden / ende Lief-
hebbers der seiver const / upt-geheben.

Door DIERICK RVYTER

Lief-hebber der *Matematica*, woonende tot Middelburgh in Zeelandt;
v



TO I MIDDELBURGH,

Gedrukt booz Dierick Ruyter, woonende inde Bellinck-strate.

Met Privilegie voor 10. Iaren.

Figure 6. Frontispiece of Dierick Ruyter's book, published in 1631 showing a pair of dividers in use on a *pleynschael*.

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L Y S T E

Van de Boeken, Kaarten en Stuurmans-gereedschappen, die voorsaan de Scoepen, na Indiën gaande, zullen worden mede gegeven, voor en ten behoeve van den Schipper, en dat volgens Resolutie den 28 Maart 1731, ter Vergadering van de Sevensiene genomen, met byvoeginge van de pryfen, zoo die ter Kamer Zeeland worden geleverd.

	gald.	ft.	p.
1 Groot Vierkant Peyl-Compas	22	0	0
1 Ordinair Vierkant Peyl-Compas	6	15	0
2 Groote Peylroozen	3	0	0
4 Ordinaire Peylroozen	0	16	0
1 Schuyvende Roos	0	16	0
2 Groote Koopere Pennen	1	10	0
2 Ordinaire Koopere Pennen	0	1	0
4 Groote Glaazen	0	12	0
12 Ordinaire dito	0	6	0
2 Kaartpasser met staalePunten en platteKoppen	1	4	0
1 Schryfpasser met een rende Kop	0	11	0
1 Plynschaal	0	12	0
1 Graadboog met kopere Visier en dubbelde kopere Schroeven	5	0	0
1 Goede groote Verrekijker met 4 Glaazen	7	0	0
1 Dito kleine met kopere Buffen	3	0	0
2 Groote Roepers	3	0	0
2 Kleine dito	2	4	0
1 Doos tot 't Stuurmans Gereetschap	0	6	0
1 Blikke koker tot de Kaarten	1	4	0
1 Verguld Ligt der Zeevaart of Konst der Stuurlieden, door Gietermaker, met de Tafels van Lengte en Breette	2	16	0
1 Graadboekje	0	6	0
1 Agtjarige Almanach	0	3	0
1 Gelynd Journaalboek van 3 Boeken	2	5	0
1 Ongelynd Journaalboek van 2 Boeken	0	12	0

K A A R-

Figure 7 The 1721 *Lyste* of navigational instruments, prescribing only one *plynschaal* but this was the equipment of a smaller vessel than the *Hollandia*, and for a different Chamber—Zeeland.

than from the 17th century. Two well-known Dutch plain scales also date from this period.

At a meeting of the Heren XVII (the executive of the Dutch East India Company in which five chambers were represented) held in Amsterdam on March 28, 1731, a new *Lyste van Kaarten en Stuurmansgereedschappen* (list of Charts and Mates' Instruments) became obligatory for the ships of the VOC (Dutch

East India Company; Fig. 7; (Schilder & Mörzer Bruyns, 1977). This was the third general revision since the preparation of the list in 1655. These revisions always resulted from an increased knowledge of the art of navigation and the development of nautical instruments and cartography.

The plain scale first appeared in the 1731 list (A.R.A. K.A.: 268). In future the masters

of all VOC ships had one on board, the instrument costing 12 pence. As was the case with all mates' instruments handed by the VOC to their masters, the equipment of 1731 was issued under a Bill of Lading. This meant that the responsible officer signed a receipt and was responsible for its undamaged return on arrival in the home port. The value of lost or damaged charts and instruments was deducted from the wages of the officer responsible (Mörzer-Bruyns & Schilder, 1974).

The lists were drawn up by the official cartographer of the Company and by the examiner of the Amsterdam Chamber of the Company (the largest Chamber). In 1731 they were Isaac de Graaf (d. 1743) and Mattheus Soetens (d. 1733). The latter was also reader in mathematics, astronomy and navigation in the *Athenaeum Illustre* in Amsterdam. When De Graaf died in 1743 his task was taken over by the famous firm of Van Keulen, cartographers and instrument-makers, who continued to perform this task until the Company was wound up in 1795 (Schilder & Mörzer-Bruyns, 1977: 200). During that period Messrs Van Keulen supplied the Amsterdam Chamber of the Company with instruments as well as charts. The Rotterdam Chamber was probably supplied with instruments made by Jacobus Kley (1715/16–1791) (Schilder & Mörzer-Bruyns, 1977: 218).

A price list of Messrs Van Keulen from 1777 mentions plain-scales at 12 pence, the same price as occurring in the VOC lists, while a Gunther scale costs one guilder and 10 pence (there were 20 pence in a guilder) (Schilder & Mörzer-Bruyns, 1977: 217).

In 1745 Jan de Marre was appointed practical examiner of the mates of the Amsterdam Chamber. As from 1743 there were two examiners in Amsterdam, one for theoretical and one for practical subjects. In 1731 De Marre (1696–1763) was appointed manager of the theatre in Amsterdam after having spent some years at sea. He wrote several plays (Molhuysen, 1911: 1312). For navigation he was important as compiler of the sixth volume of the *Nieuwe Groote Lichtende Zeefakkell* (A great, new shining torch for the sea). This volume which was published by Messrs Van Keulen in 1753, for the first time contained printed charts and sailing directions for sailing routes east of the

Cape of Good Hope, the monopoly area of the Company (Schilder & Mörzer-Bruyns, 1977: 202). Shortly after De Marre had been appointed examiner he wrote a memorandum on improvements of mates' instruments. Besides recommending the procuring of the octant invented in 1731 for the ships of the company, he suggests that plain-scales should not be given to the master in future but instead the three mates should be provided with such an instrument. He does not state a reason for this, but obviously the mates wanted a plain-scale more than the master. In 1747 the list was completely revised for the fourth time and the two recommendations mentioned above appear to have been adopted by the Heren XVII (Fig. 2). We find one octant in it (at f 75,) and three plain-scales (still at 12 pence) (Schilder & Mörzer-Bruyns, 1977: 217). In the course of the 18th century the list was adapted several times to the developments of cartography and navigation. The number of plain-scales to be given to the mates, however, remained unchanged.

After the winding up of the Company in 1795 we find the plain-scale again in the list of mates' instruments of the *Raad der Aziatische bezittingen* (Council for the Colonies in Asia), 1800–1804 and also in the list of mates' instruments from 1802 of the *Raad der Marine of the Bataafse Republiek* (Council for the Navy of the Batavian Republic). Before that time this ruler had been in use by the navy, although naval officers until 1788 had to provide their own instruments. Such an instrument has come to us from the possessions of Vice-Admiral Jacob Pieter van Braam (1737–1803). From 1748 Van Braam sailed for the Admiralty of Amsterdam. Between 1764 and 1776 he served the Amsterdam Chamber of the VOC, *inter alia*, in the capacity of a master, after which he returned to the Amsterdam Admiralty. Jacobus Kley, the maker of van Braam's plain-scale was a well-known and skilled instrument-maker from Rotterdam. Several beautiful nautical instruments made by him have been preserved, such as a back staff in the *Scheepvaartmuseum* in Amsterdam and an octant in the *Boerhave Museum* in Leiden (Rooseboom, 1950: 87). From approximately 1760 Kley supplied octants to the Rotterdam, Delft and Zeeland Chambers of the VOC (Mörzer-Bruyns, 1980:

34). It is not unlikely that he also supplied other instruments which these Chambers needed for their ships.

Plainscales were also sold outside VOC circles. In 1750 the inventory was made of a business in charts and mates' instruments *In de Jonge Lootsman* (At the young pilot's) in Amsterdam. The last partner, Isaac Swigters, had died in that year and the property was sold by auction. Besides 14 cross staffs there were also 10 plainscales. A second cousin of

Swigters', the cross staffmaker Hendrik Mooy, continued the business under the old style. Of the inventory that had been sold by auction the navigation books with their privileges had been bought by Johannes Van Keulen and the copper plates for the charts by the cross staffmaker Joachim Hasebroek. Partners of *De Jonge Lootsman*, both before and after the sale of the property in 1750, were not among the regular suppliers of the VOC but obtained their income from the sale to private persons (Gernez, 1954).

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