‘Diese Flasche wurde űber Bord geworfen’: a message in a bottle from the German barque *Paula* (1886) discovered at Wedge Island, Western Australia

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Cover image: Bottle in beach find location, north of Wedge Island (Kym Illman)

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Introduction

On 21 January 2018 Kym Illman and Tonya Allan discovered an 'interesting old bottle' north of Wedge Island, 180km north of Perth, Western Australia (Figure 1).

Figure 1 Location of bottle and message slip find near Wedge Island, Western Australia (Google Earth)

The bottle was reportedly found 50 metres inland in beach foredunes, in an area indicating a storm surge/ large swell high water mark (Figure 2). It was found lying mostly exposed without any form of cork or closure, and was about a quarter full of damp sand. When the finders emptied out the sand a damp, tightly-rolled paper message tied with string around its centre, fell out. There was no evidence of any closure or cork that may have fallen inside the bottle. Upon drying out and opening the message it was realised that it had a handwritten date of 12 June 1886 and name of a ship '*Paula'*, at which point the finders contacted the Western Australian Museum to seek further information and verification of the historic value of their find.

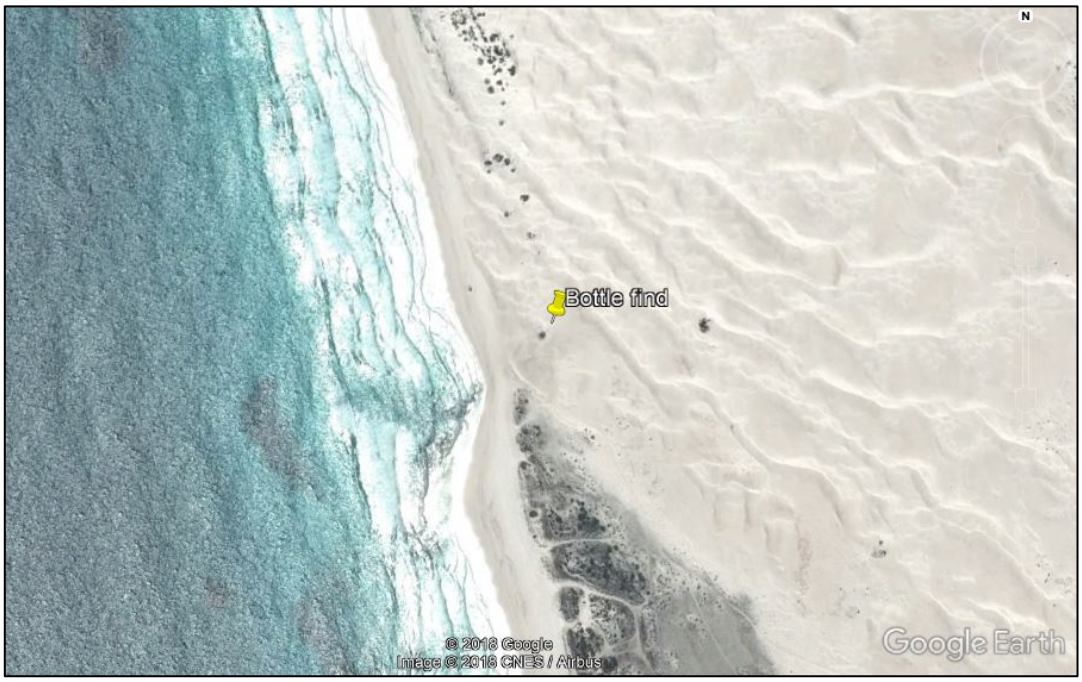


Figure 2 Location of bottle find 50 metres inland from current high tide mark (Google Earth)

Message slip

The message was rolled up tightly in a cylindrical shape, the first page with handwriting being protected on the inside, then tightly bound with a short length of twine around its centre (Figure 4). The message has impressed markings created by the pressure from the twine binding through the centre of the paper, and some eroding of the edges. A small fragment from one corner has become dislodged since being unrolled. The dimensions of the note are 200 x 153mm, while the twine has been preserved in a 12mm diameter coil, giving an indication of the original rolled up dimensions of the note. The paper and twine have been assessed by WA Museum Department of Materials Conservation staff as being in a fragile but stable condition.

Figure 3 Message note as originally found rolled up with twine binding (Kym Illman)

Figure 4 Twine used to bind rolled up message slip (Ross Anderson/ WA Museum)

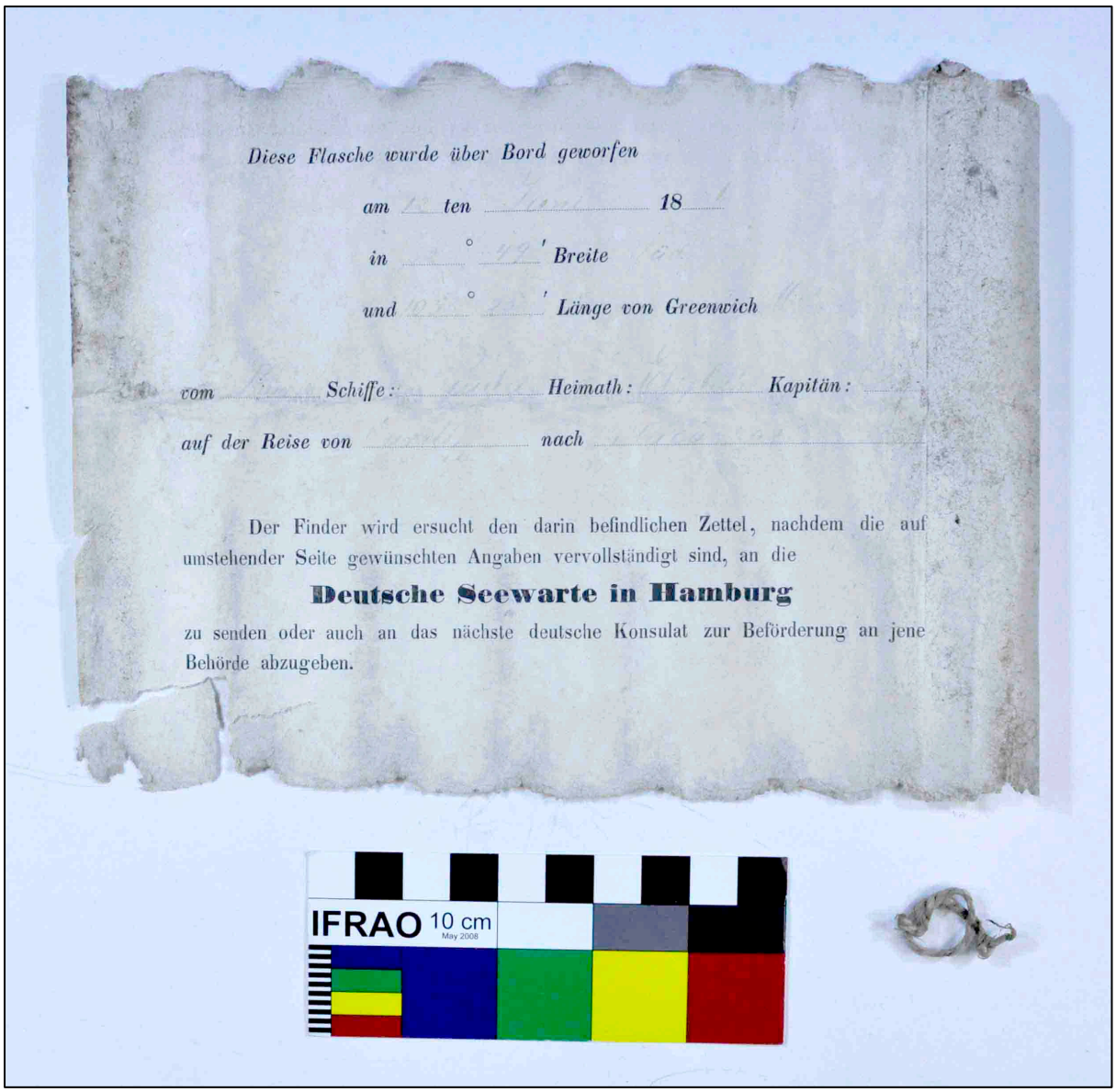


Figure 5 Page one of the message slip naming the ship *Paula*, the date, its journey and coordinates (Ross Anderson/ WA Museum)

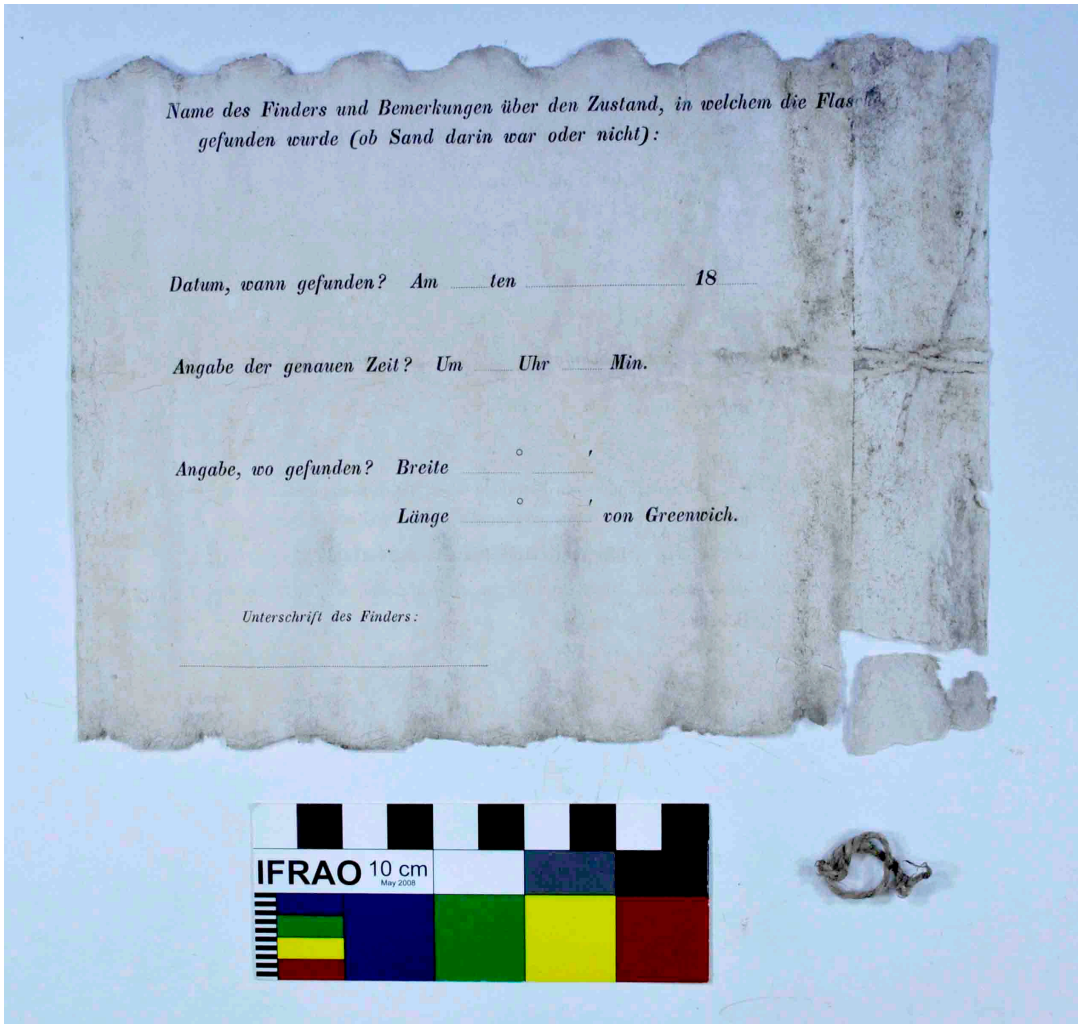


Figure 6 Reverse side of the message slip left blank for finders to complete (Ross Anderson/ WA Museum)

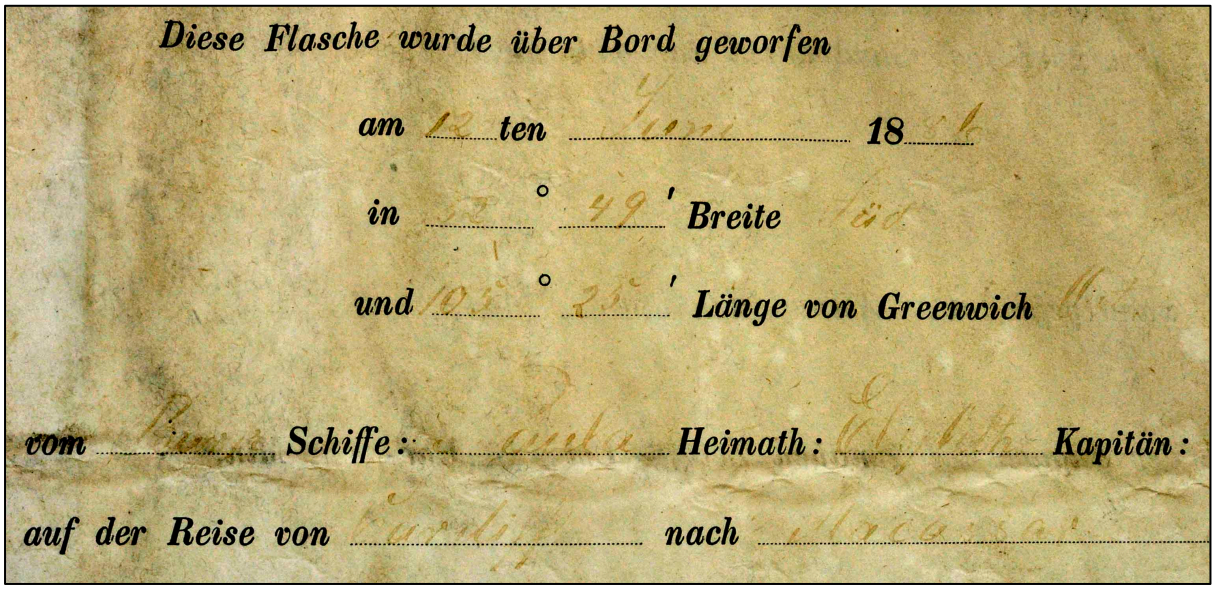


Figure 7 Image enhanced to show inked handwritten details on the message slip showing the date and coordinates at the time the bottle was jettisoned, and name, voyage and home port of the bark *Paula* (Ross Anderson/ WA Museum)

Message slip transcription in German

Diese Flasche wurde űber Bord geworfen

am *12* ten *Juni* 18 *86*
In *32° 49*' Breite *Sűd*
Und *105° 25'* Länge Greenwich *Ost*

Vom : *Bark* Schiffe: *Paula* Heimath: *Elsfleth* Kapitän: *D* [illegible]
auf der Reise von: *Cardiff* nach: *Macassar*

Der Finder wird ersucht den darin befindlichen Zettel, nachdem die auf umstehender Seite gewűnschten Angaben vervollständigt sind, an die
Deutsche Seewarte in Hamburg
zu senden oder auch an das nächste Konsulat zur Beförderung an jene Behörde abzugeben.

Name des Finders und Bemerkungen űben den Zustand, in welchem die Flasche gefunden wurde (ob Sand darin war oder nicht):

Datum, wann gefunden? Am….ten……18……

Angabe der genauen Zeit? Um…..Uhr…..Min.

Angabe, wo gefunden? Breite….° ……'
Länge ….° ……' Greenwich

Unterschrift des Finders:

Message slip translation in English

This bottle was thrown overboard
On *12* th *June* 18 *86*
In *32° 49'* Latitude *South*
And *105° 25'* Longitude from Greenwich *East*

From : *Bark* Ship: *Paula* Home (port): *Elsfleth* Captain: *D* [illegible]
On her journey from: *Cardiff* To: *Macassar*

The finder is requested to send the slip in the bottle to the
German Naval Observatory in Hamburg
or the nearest consulate for the return to the same agency after filling in the information on the back.

Name of finder and notes on the condition of the bottle when it was found (if there was sand in it or not):

Date of finding? On…. st/nd/rd/th ……18……

Exact time of finding? At…..Hours…..Min.

Exactly where found? Latitude ….° ……'
Longitude ….° ……' from Greenwich

Signature of the Finder:

'Daniel Visser & Zonen/ Schiedam' glass bottle, 19th century

The dark green glass bottle in which the message was found is a square-case gin/ genever type bottle (known as a 'cellar bottle' in the Netherlands), with 'DANIEL VISSER & ZONEN/ SCHIEDAM' embossed on one side (Figure 8). It has a tapered finish, short neck and rounded shoulders.

Figure 8 Square case gin type bottle embossed 'DANIEL VISSER & ZONEN/ SCHIEDAM' (Ross Anderson/ WA Museum)

There are no other manufacturers' markings, and the bottle is intact except for a small chip in the lip. The lack of obvious machine mould marks and the remnant glass pontil mark on the base show the bottle was hand-blown into a mould using a glass pontil, and it has a tapered applied lip/ finish consistent with mid to late 19th century bottle manufacturing techniques. Schiedam in Holland was a primary production centre for gin, genever (or jenever) and schnapps, and the bottle would have been a ubiquitous type found throughout Europe and its colonies at the time. Table 1 provides the dimensions of the bottle.

Measurement	mm
Total height	225
Body height (base to top of shoulder)	192
Maximum width at shoulder	76
Finish height	23
Finish diameter at base	31.5
Finish diameter at top	24
Bore diameter	17
Base (square dimensions)	61 x 61

Table 1 Bottle dimensions

Boow (1991: 97) states that the 17mm (3/4 inch) bore diameter was used to accommodate the typical ½ inch filling tube common in the nineteenth century, while the finish height deeper than 20mm (4/5 inch) is typical of that adopted after 1850-60.

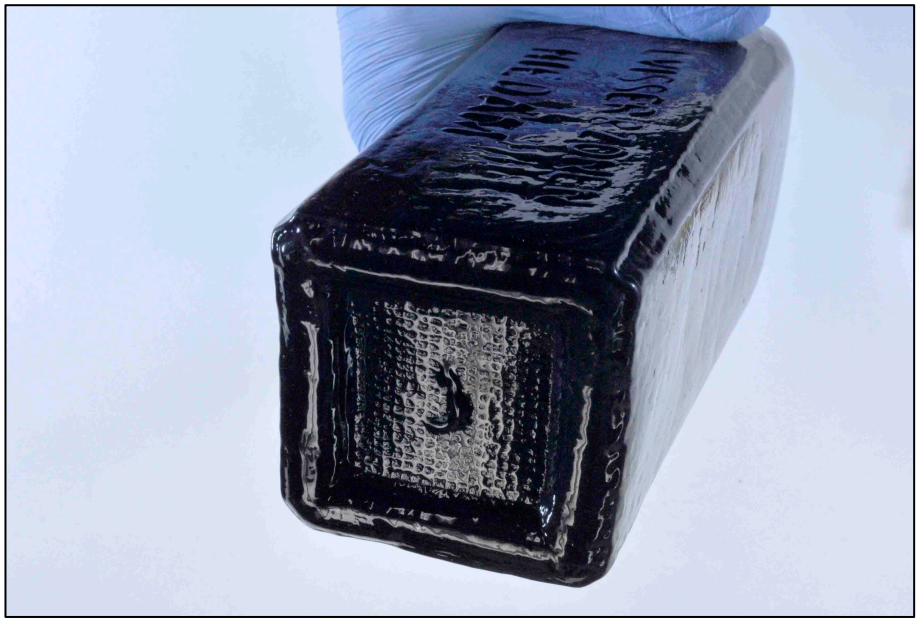


Figure 9 Detail of bottle base showing glass pontil scar (Ross Anderson/ WA Museum)

Being identified as a bottle of Dutch origin, more precise dating advice was sought from Dutch archaeologists who advised that:

> The starting point of production of this specific type of gin bottle is *c* 1880 (typical tapered shape of the rim). The oldest ones are quite angular….the later ones have a more rounded shoulder. The development from angular to round takes about 20-30 years and is gradual. From 1910 onwards the bottles were machine made and look different. Your bottle should be placed somewhere in this development; where exactly is hard to tell. So it could be dating from the late 1880s (J. van Doesburg to R. Anderson, pers. comm., 30/1/2018).

Therefore the bottle is consistent with an 1886 date.

German barque *Paula*

The information that the message emanated from the German bark (or barque) *Paula*, home port Elsfleth near Bremen, Germany correlates with a listing for the German sailing barque *Paula*, 515 gross register tons built in 1876, home port Elsfleth, Official Number 4277, in the *Handbuch für die deutsche Handelsmarine: 1877* (*German Handbook for Merchant Marine: 1877*), p.358 (Figure 10). *Paula* was built in the Lűring Yard, Hammelwarden near Bremen, Germany (Deutsche Schiffahrtsmuseum, 2018).

4274	JDNK	**Paul Teschner**	Stettin	Vollschiff	2257,6	796,95	
4275	MSGD	**Paul Thormann**	Wismar	Bark	1359,7	479,97	
4276	MSDB	**Paul & Marie**	Wismar	Brigg	592,9	209,29	
4277	NFKG	**Paula**	Elsfleth	Bark	1460,5	515,56	
		Pauli, St. *siehe* **Sanct Pauli.**					
4278	QCMV	**Pauline**	Bremen	Bark	1655,8	584,50	
4279	LBGK	**Pauline**	Heiligenhafen	Schooner	258,5	91,25	

Figure 10 Listing for *Paula* in the *Handbuch für die Deutsche Handelsmarine*: *1877* (*German Handbook for Merchant Marine: 1877*) p.358/ No.4277.

Figure 11 Image of German barque *Paula* in 1880 (Deutsches Schiffahrtsmuseum–Unterweser, Artist: Edouard Adam)

Captain O. Diekmann is recorded as having commanded the *Paula* between 1886 and 1889 (Deutsche Schiffahrtsmuseum 2018). On its 1886 voyage from Cardiff, Wales to the busy Dutch East Indies port of Makassar (Figure 12), it would most likely have been transporting a cargo of Welsh steaming coal, being the major export of Wales at this time.

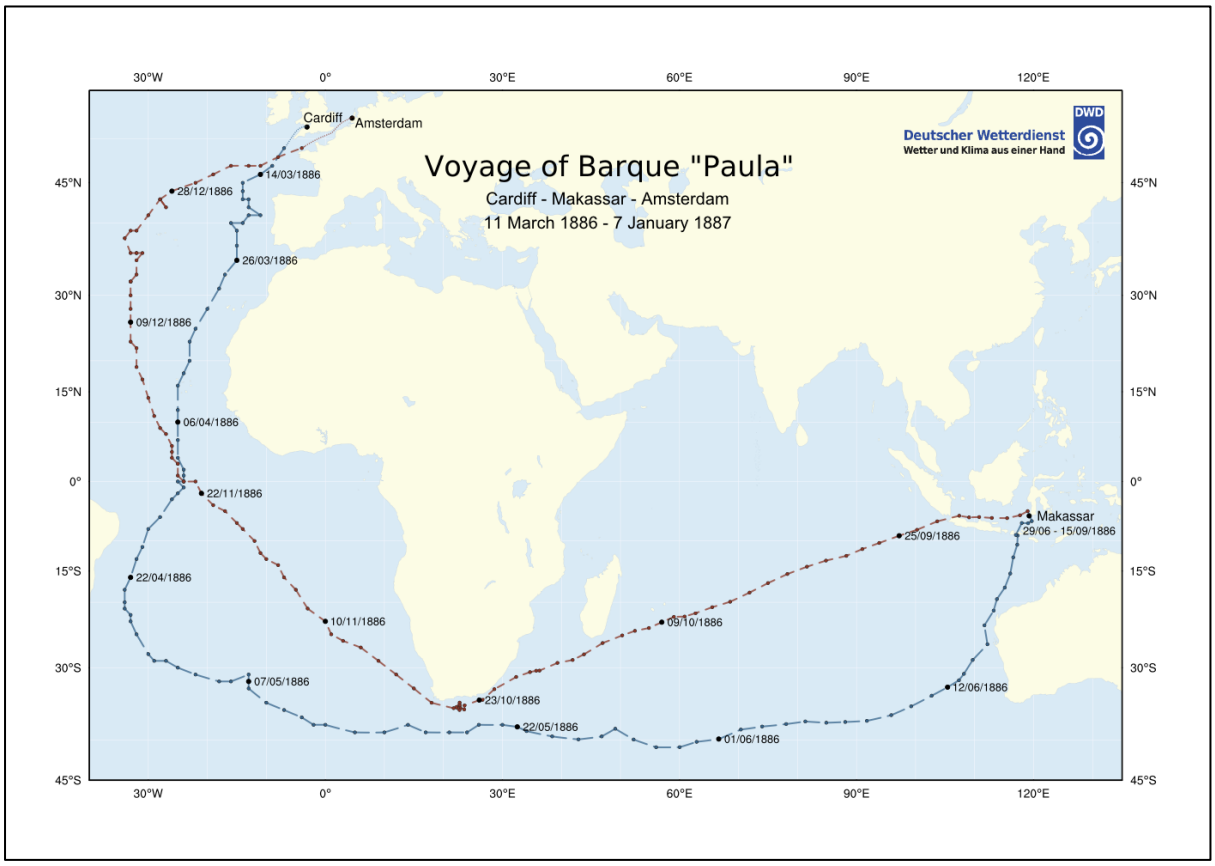


Figure 12 Map showing *Paula*'s 1886-87 outward voyage route from Cardiff to Makassar, and return to Amsterdam . Note date and location of 12 June 1886 where bottle was jettisoned off the Western Australian coast (Deutscher Wetterdienst)

Documentary evidence

Official references corroborating the information found on the message slip describe the *Paula* having being in Macassar between July and September 1886, and a drift bottle jettisoned on *Paula*'s return voyage from Makassar to Amsterdam in December 1886 being retrieved in Barbados, West Indies:

> 6. (D.S.) Flaschenposten a) Durch den Herrn C.C. Knollys in Barbados (Westindien) ist der Seewarte ein Flaschenpostzettel zugegangen, welcher von der Deutschen Bark “Paula”, Kapt. O. Diekmann, auf der Reise von Macassar nach Amsterdam am 2. Dezember 1886 auf 9° 58’N…..
>
> (Translation) 6. (D.S.) Bottle Items a) By Herrn C.C. Knollys in Barbados (West Indies) received a bottle-paper slip from the German bark "Paula", Captain O.

Diekmann, on the journey from Macassar to Amsterdam on 2 December 1886 at 9 ° 58' N…..
(*Annalen der Hydrographie und Maritimen Meteorologie*, Volume 15, p.375)

17. (D.S.) Makassar. Kapt. O. Diekmann von der Deutschen Bark “Paula” berichtet: Obgleich wir gegenwärtig — 1 Juli bis 13. September 1886 — in Makassar die trockene Jahreszeit haben, regnet es doch ziemlich häufig; gewöhnlich setzt ein Tag um den andern gegen 4 Uhr Nachmittags ein Gewitter mit Regen ein. Der Wechsel von See- und Landbriese findet an ganz verschiedenen Stunden statt. In der Regel weht erstere von des Morgens 8 Uhr bis am Nachmittage um 4 Uhr aus der Richtung S bis SSW. Fluth und Ebbe treten je nur ein Mal innerhalb 24 Stunden auf…..

(Translation) 17. (D.S.) Makassar. Capt. O. Diekmann of the German Bark "Paula" reports: Although we currently have the dry season in Makassar on 1 July to 13 September 1886, it rains quite frequently; Usually one day at a time around 4 o'clock in the afternoon a rainstorm sets in with rain. The change of sea and land breeze takes place at very different levels. As a rule, the former blows from 8 o'clock in the morning until 4 o'clock in the afternoon from the direction S to SSW. Flood and low tide occur every now and then within 24 levels….
(*Annalen der Hydrographie und Maritimen Meteorologie*, Volume 15, p.521)

Further archival research conducted by the Deutscher Wetterdienst (National Meteorological Service of the Federal Republic of Germany) has resulted in the location of *Paula*’s original Meteorological Journal. The relevant page including the entry for 12 June 1886 records ‘Stromflasche über Bord’ (drift bottle overboard). The date and coordinates correspond exactly with the date and coordinates on the *Paula* bottle message (Figure 13).

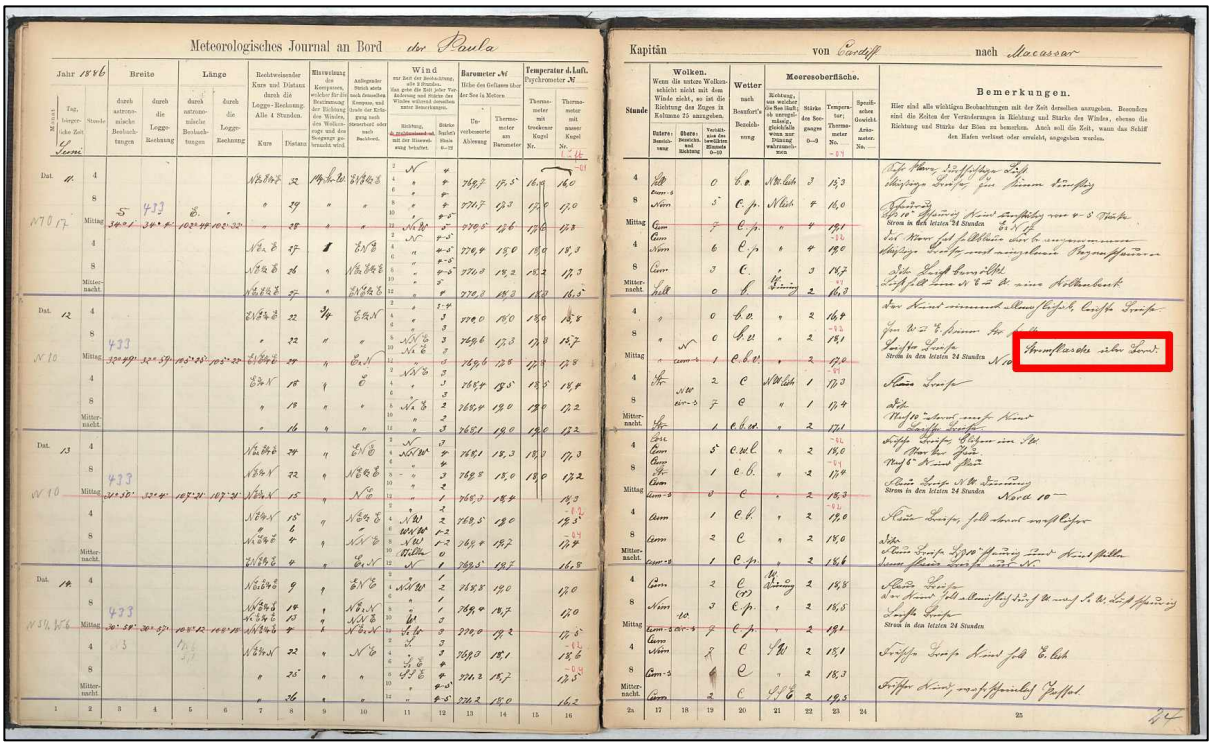
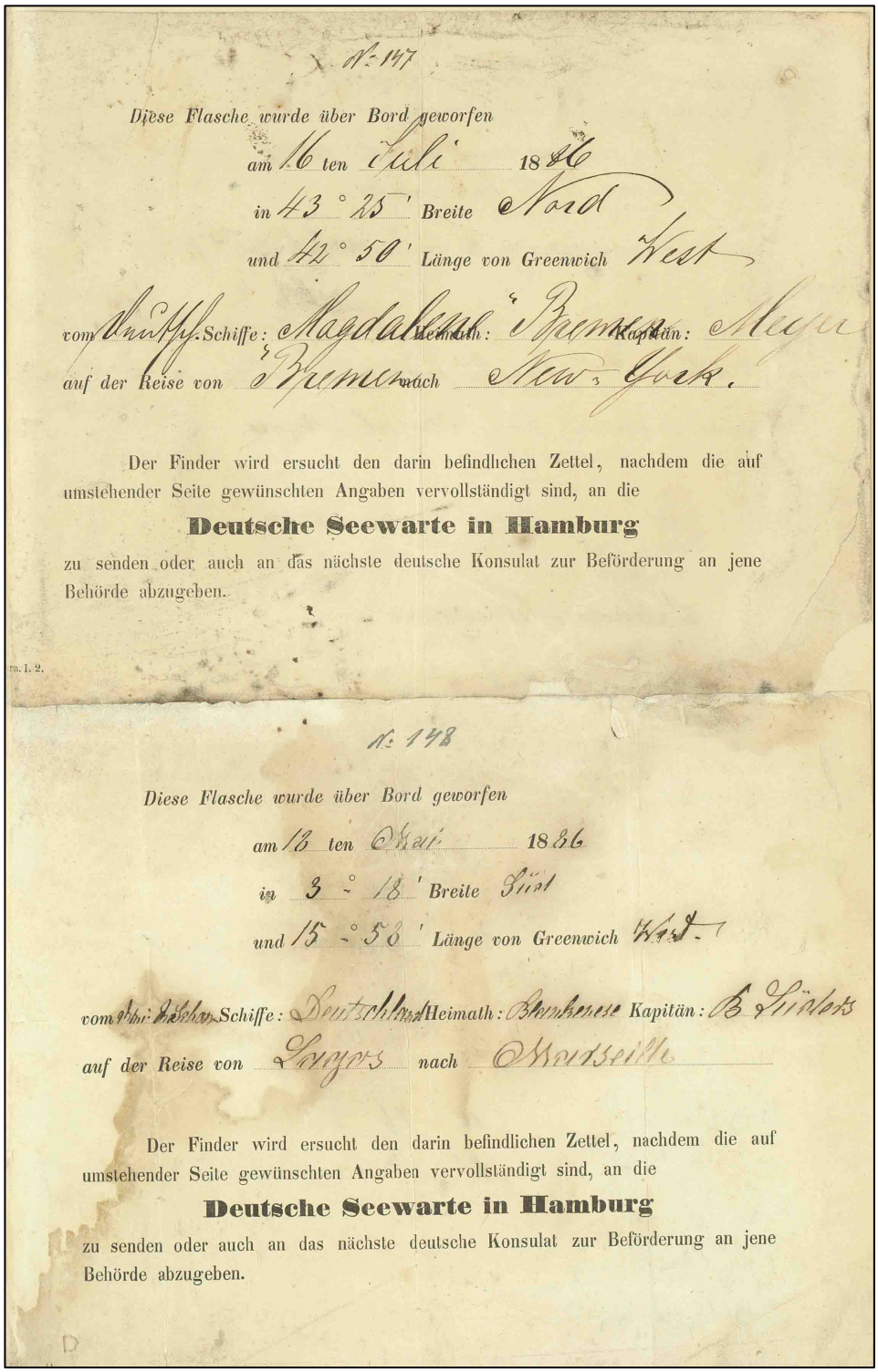


Figure 13 Extract from *Paula*'s Meteorological Journal for 12 June 1886 with the entry 'Stromflasche über Bord' (Stream/ drift bottle overboard) (Deutscher Wetterdienst)

The German Government's Bundesamt für Seeschifffahrt und Hydrographie (BSH - Federal Maritime and Hydrographic Agency) has provided the following assessment that supports the message as being genuine:

> As far as we can judge the photos and information from a distance, it is an authentic bottle post, which was thrown overboard from the PAULA in 1886 as part of the experiment on flow research. The information from the PAULA Meteorological Journal confirms the ejection of a stream bottle on the appropriate route. The information on the found form can therefore also be regarded as authentic.
>
> Reasons that speak against it being a forgery: There are no lists of the then ejected bottle items. The knowledge about the ejection of a bottle post with exactly this data about ship, route and exact date would be available only through access to various official historical sources. However, these sources are not easily accessible to the public. This makes a fake in terms of content extremely unlikely.
>
> The appearance of the form from the found bottle is exactly the same as that of the other forms from the year 1886, which were sent back in the following years to the Deutsche Seewarte and are available to us in the original. The forms have changed a lot over the years, but in the 1886 period the form is exactly what you have (M. Plettendorff to C. Porr, WA Museum, pers. comm. 13/2/2018) (Figure 14, Figure 15).



№ 147

Diese Flasche wurde über Bord geworfen

am 16 ten Juli 1886

in 43 ° 25 ' Breite Nord

und 42 ° 50 ' Länge von Greenwich West

vom Dmpfr. Schiffe: Magdalena Heimath: Bremen Kapitän: Meyer

auf der Reise von Bremen nach New York.

Der Finder wird ersucht den darin befindlichen Zettel, nachdem die auf umstehender Seite gewünschten Angaben vervollständigt sind, an die

Deutsche Seewarte in Hamburg

zu senden oder auch an das nächste deutsche Konsulat zur Beförderung an jene Behörde abzugeben.

m. I. 2.

№ 148

Diese Flasche wurde über Bord geworfen

am 13 ten Mai 1886

in 3 ° 18 ' Breite Süd

und 15 ° 56 ' Länge von Greenwich West

vom Dmpfr. Schiffe: Deutschland Heimath: Bremerhaven Kapitän: B. Lüders

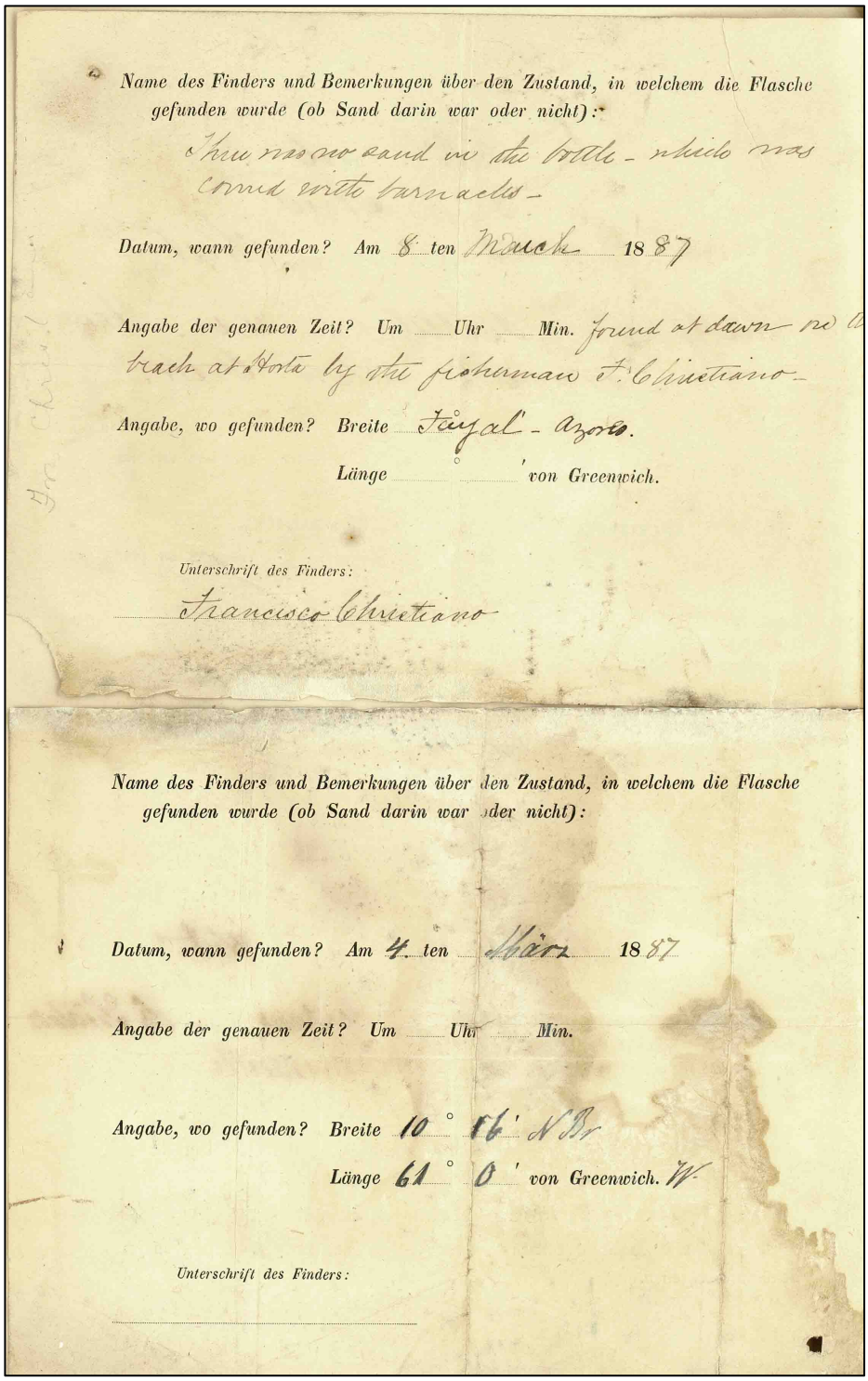
auf der Reise von Lagos nach Marseille

Der Finder wird ersucht den darin befindlichen Zettel, nachdem die auf umstehender Seite gewünschten Angaben vervollständigt sind, an die

Deutsche Seewarte in Hamburg

zu senden oder auch an das nächste deutsche Konsulat zur Beförderung an jene Behörde abzugeben.

Figure 14 Two examples of facing pages of printed bottle message slips from 1886 (Bundesamt für Seeschifffahrt und Hydrographie)



Name des Finders und Bemerkungen über den Zustand, in welchem die Flasche gefunden wurde (ob Sand darin war oder nicht):

There was no sand in the bottle - which was covered with barnacles -

Datum, wann gefunden? Am 8 ten March 1887

Angabe der genauen Zeit? Um ... Uhr ... Min. found at dawn on the beach at Horta by the fisherman F. Christiano -

Angabe, wo gefunden? Breite Fayal - Azores.

Länge ... ° ... ' von Greenwich.

Unterschrift des Finders:

Francisco Christiano

Name des Finders und Bemerkungen über den Zustand, in welchem die Flasche gefunden wurde (ob Sand darin war oder nicht):

Datum, wann gefunden? Am 4 ten März 1887

Angabe der genauen Zeit? Um ... Uhr ... Min.

Angabe, wo gefunden? Breite 10 ° 56 ' N Br

Länge 61 ° 0 ' von Greenwich. W.

Unterschrift des Finders:

Figure 15 Two examples of reverse sides of printed bottle message slips from 1886, completed by finders and returned to the German Naval Observatory in Hamburg (Bundesamt für Seeschifffahrt und Hydrographie)

Handwriting comparison

A comparison of the handwriting of both the bottle message and *Paula*'s Meteorological Journal shows the handwriting is identical in terms of cursive style, slant, font, spacing, stroke emphasis and capitalisation. The numbering style is also identical (Figure 16). This is direct evidence supporting a link between the writer of the bottle message slip, and of *Paula*'s Meteorological Journal, which is undoubtedly *Paula*'s Captain O. Diekmann.

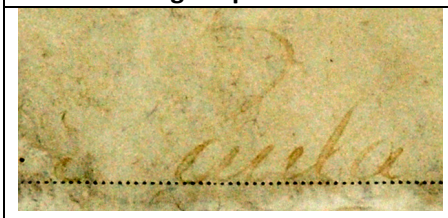
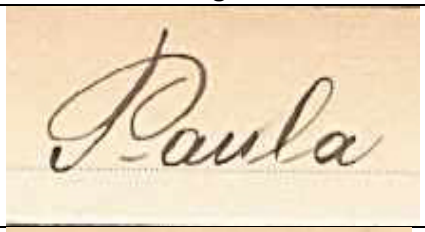
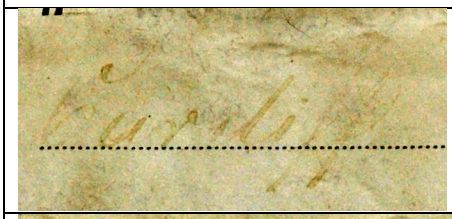
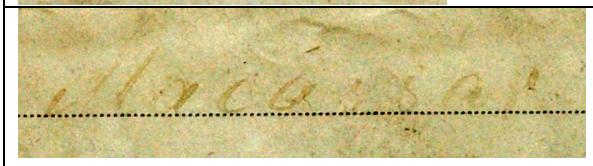
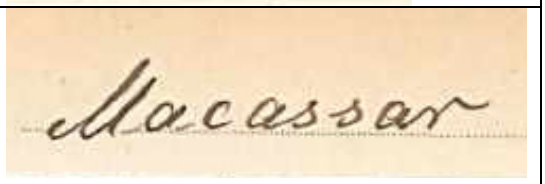
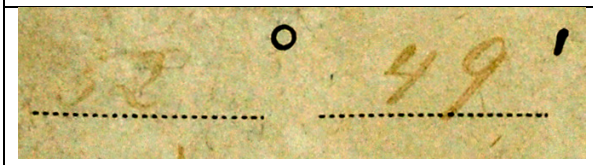
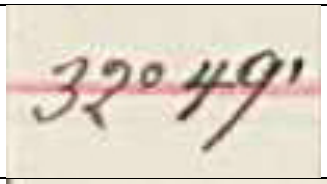
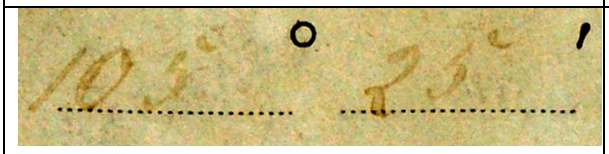
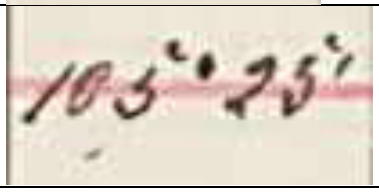
***Paula* message slip**	***Paula* Meteorological Journal**
	
	
	
	
	

Figure 16 Comparison of handwriting styles between *Paula*'s message slip (left) and *Paula*'s Meteorological Journal (right)

Likely time of drift and state of preservation

The location of the find 950km east-northeast from the *Paula* bottle's recorded jettisoning location in the Indian Ocean in June 1886 (Figure 17) is generally consistent with prevailing ocean current and drift patterns during wintertime in the southeastern Indian Ocean. A bottle jettisoned in this location would be likely to have reached the Western Australian coast within a period of about six to twelve months.

The lack of any marine growth on the bottle is a further indication it was not a recently washed up object.

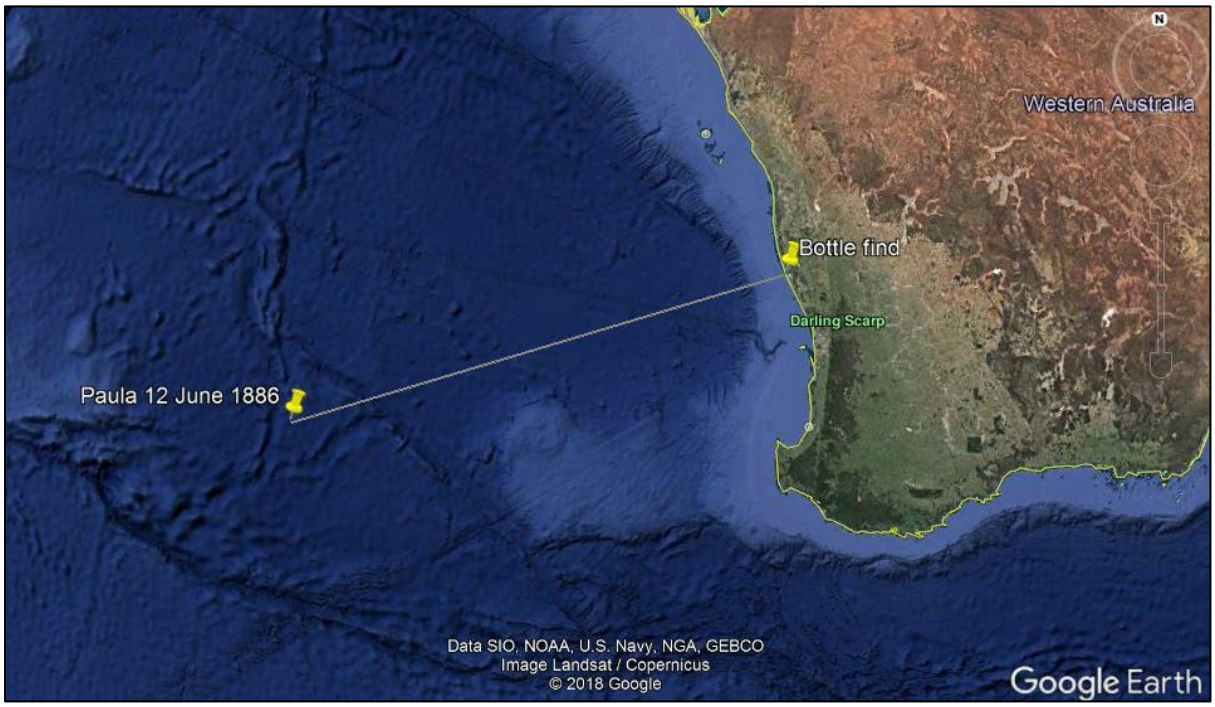


Figure 17 Map showing trajectory of bottle drift from *Paula* in 1886 950km to location of discovery in 2018

In considering a possible explanation for the excellent state of preservation of both the bottle and paper, the bottle must have, for the most part of its life, lain in a buried or mostly buried state, filled, or partially filled with damp sand. It may also have been subject to cyclical periods of exposure, being alternately exposed, or partially exposed and buried.

Being found 50 metres inland from the current high water mark, the bottle must have been deposited in that location by a storm surge and/ or large swell event. The finders who are local to the area report that the sand dunes in the area where the bottle was found are mobile and subject to movement during storm events or erosion by heavy rain, and such an event of heavy rainfall in January 2018 may have led to the bottle's most recent exposure (K. Illman to R. Anderson, pers. comm., 7/2/18). Over the intervening years during periods of exposure to strong sunlight the cork (presumed to have been originally fitted when thrown into the sea in 1886) could have dried out and shrunk to become dislodged and missing, while the tightly rolled paper along with a quantity of sand remained inside preserved. There was no evidence of any other method of closure such as wire or wax sealing. The narrow 17mm bore of the bottle opening and thick glass would have assisted to buffer and preserve the paper from the effects of full exposure to the elements, providing a protective microenvironment favourable to the paper's long-term preservation.

Georg von Neumayer (1826-1909), the Deutsche Seewarte and historical background to 19th century German bottle drift experiments

As early as 310 BC the Greek philosopher Theophrastos (c.371–c.287 BC) had conducted drift experiments with sealed jugs to prove the Atlantic's influence on the Mediterranean Sea. Subsequent scientific experiments by Benjamin Franklin and others indicated the existence of the North Atlantic Gulf Stream, while the British rear admiral Alexander Becher is believed to have conducted the first study of drift bottles travelling around an ocean gyre, between 1808 and 1852 ('Message in a bottle', Wikipedia, 14/2/18). In the 19th century, scientific researchers continued to experiment with drift bottles to enable greater understanding of global ocean currents. The primary objectives were to understand the fastest and safest routes for shipping, with their attendant social and economic benefits.

One of the leading figures in this area was the German scientist Georg von Neumayer (1826-1909), who became the first Director of the Deutsche Seewarte (German Naval Observatory) in Hamburg in 1876 (Figure 18).

Figure 18 Georg von Neumayer in 1879, when Director of the Deutsche Seewarte (Bundesamt für Seeschifffahrt und Hydrographie)

Prior to holding the Director's position in Hamburg, Neumayer had lived and worked in Australia, having worked as the Director of the first magnetic survey of the Colony of Victoria from 1859 to 1864, based in Melbourne's Flagstaff Hill Observatory.

Neumayer is considered the founder of German drift bottle research. Returning from Melbourne to Germany aboard the *Garawalt* in 1864, von Neumayer threw 45 drift bottles overboard (Die Flaschenpost, 1867: 683). On 14th July 1864 von Neumayer's

servant E. Brinkmann threw a bottle overboard the *Norfolk* near Cape Horn. The bottle contained a pre-printed slip prepared by von Neumayer on which Brinkmann noted the date, the coordinates, the ship's and captain's name as well as the travel route (Melbourne to London). The slip asked the finder to fill in information such as date of finding, exact time and locality where found, and under what circumstances the bottle was found. This message was found by a farm labourer near Portland, Victoria, Australia in 1867 (http://www.bsh.de/de/Das_BSH/Flaschenpost-Sammlung/index.jsp) (Figure 19).

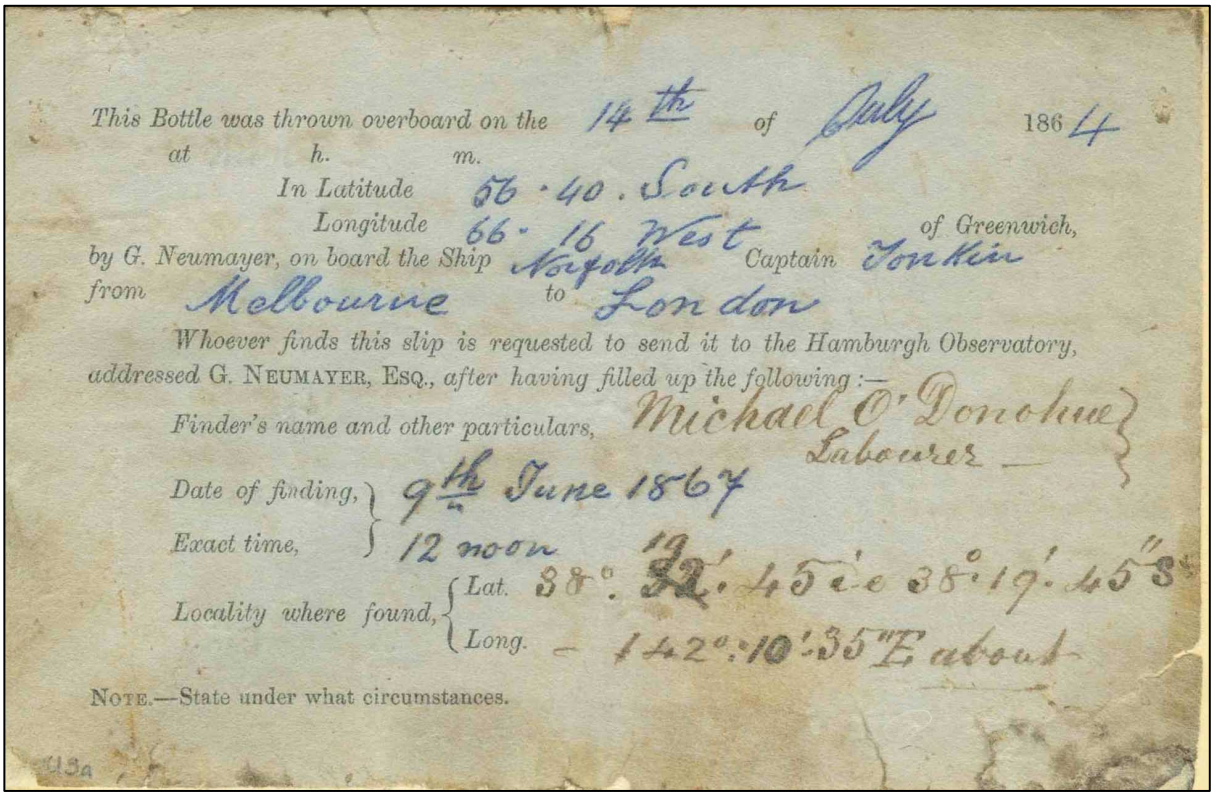

This Bottle was thrown overboard on the 14th of July 1864
at h. m.
In Latitude 56 · 40 . South
Longitude 66 · 16 West of Greenwich,
by G. Neumayer, on board the Ship Norfolk Captain Tonkin
from Melbourne to London
Whoever finds this slip is requested to send it to the Hamburgh Observatory,
addressed G. NEUMAYER, ESQ., after having filled up the following :—
Finder's name and other particulars, Michael O'Donohue Labourer
Date of finding, 9th June 1867
Exact time, 12 noon
Locality where found, Lat. 38°. 22'. 45"e 38°19'45"S
Long. — 142°:10':35"E about
NOTE.—State under what circumstances.

Figure 19 Printed message slip jettisoned by Georg von Neumayer's servant E. Brinkmann in 1864 from the ship *Norfolk*, during his voyage from Melbourne to Germany (Bundesamt für Seeschifffahrt und Hydrographie)

Upon his return to Germany and having been appointed as Director of the Deutsche Seewarte, Neumayer conceived and implemented the drift bottle experiment that would last from 1864 to 1933, and include thousands of bottles. Of all these jettisoned bottles only an estimated 8-10% (662 message slips) found their way back to Hamburg, where they now reside in the archival collection of the Bundesamt für Schifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency) (Schott 1898; M. Plettendorff to C. Porr, pers. comm., 31/1/2018 and 7/2/2018).

In the drift bottle experiment conducted by the Deutsche Seewarte pre-printed message slips were given to ships' captains, who would fill in all the necessary information and throw the corked and sealed bottle at a predetermined point over board. Finders of any washed up bottles were asked to complete the reverse side of the message and return it to the Deutsche Seewarte. Up to 1890 the pre-printed text was only in German. One of the concerns raised during the project was the weight of

the bottles, which only contained the paper. Some researchers argued that the bottles were too light, and that wind would too strongly influence the drift. However, later studies showed that ballasting the bottles with sand didn't have any effect on the outcome. This was mainly to due the fact that the bottles themselves only offered a small contact surface. The paper used for the experiments was not of any special type or treated to make it more waterproof or durable. In some cases so called Chinese ink (waterproofed ink) was used. A distinctive feature of the Deutsche Seewarte experiment was its global scope, with the inclusion of oceans worldwide, providing valuable data on the great ocean currents (Figure 20). In later years bottles were only thrown into the Nordic and Baltic Sea (http://www.bsh.de/de/Das_BSH/Flaschenpost-Sammlung/index.jsp; M. Plettendorff to C. Porr, pers. comm., 7/2/2018).

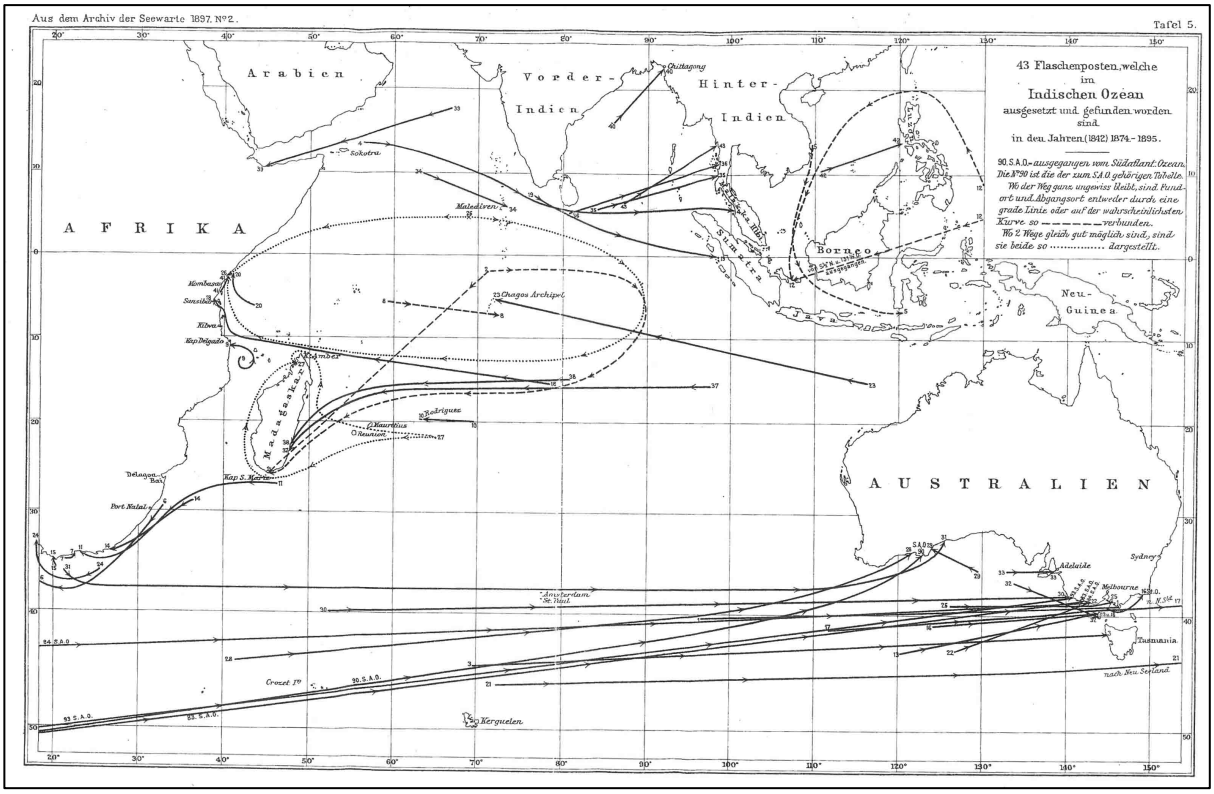


Figure 20 Trajectories of German drift messages found in the Indian Ocean region between 1874-1895 (Bundesamt für Schifffahrt und Hydrographie)

Summary of the evidence

This following evidence confirms the message slip and bottle find to be genuine artefacts relating to a long-term, official German Naval Observatory program investigating global ocean currents conducted between 1864 and 1933.

- The message contains handwritten information that the bottle was thrown from the German barque *Paula* in 32° 49' latitude south and 105° 25' longitude east on 12 June 1886, while on a voyage from Cardiff to Macassar. This information is corroborated by the *Paula*'s original Meteorological Journal

held by the Deutscher Wetterdienst (German Meteorogical Service), which contains an entry recording the throwing of a drift bottle overboard on 12 June 1886, at exactly the same coordinates during *Paula*'s voyage from Cardiff to Macassar;

- The German Maritime and Hydrographic Agency have confirmed the type of message, wording and print layout on the paper message are identical to comparable examples of pre-printed drift bottle message slips held in their archives for the year 1886;
- The German Maritime and Hydrographic Agency advise on the basis of the above they believe the message slip to be authentic;
- The handwriting in *Paula*'s Meteorological Journal is identical to the handwriting on the message slip, further corroborating the link;
- The Daniel Visser & Zonen square case/ cellar bottle was of a type manufactured in Europe between 1880 and 1910, with the bottle morphology consistent with an 1886 date;
- Expert assessment of the paper by WA Museum conservators is that while exact dating of paper is not possible, the paper fabric and coloration appears consistent with cheaply-made 19th century paper. The yellowing of the paper and fading of the ink are likely to be due to a combination of age, ink type, dampness and natural paper acidity.

The period of nearly 132 years between the bottle's jettisoning from the German barque *Paula* on 12 June 1886, and its discovery on 21 January 2018 make it the oldest known message in a bottle to have yet been discovered, although it probably only drifted for a period of six to twelve months before washing up on the Western Australian coast. Upon reaching the coast the message and bottle is likely to have spent the majority of its life buried within a layer of damp sand to have remained so well preserved, with a period of recent exposure allowing its fortuitous discovery by the finders.

Statement of Significance

Rarity

The *Paula* (1886) bottle and message slip is an exceedingly rare find to make in the 21st century, and is unprecedented in the Australian context. The last message slip returned to the Deutsche Seewarte was in 1934. It is also extremely rare to find historic paper preserved in a littoral environment. When combined with the fact it is believed to be the world's oldest message in a bottle yet found, the *Paula* bottle and message slip has a high level of uniqueness and rarity.

Representativeness

The *Paula* bottle and message slip is representative of the materials and methods utilised in official, late 19th century German hydrographic experiments investigating ocean currents.

It is also an iconic example representing the many different types of flotsam and jetsam materials, both historic and modern, to have drifted, and that continue to drift onto Western Australia's coast as a result of global wind and current patterns.

Scientific

The *Paula* bottle and message slip are scientifically significant for their association with official German Naval Observatory data gathering experiments undertaken during the late 19th century, to better understand global ocean drift patterns. Ocean current and drift patterns are still not completely understood, and modern scientific work continues to investigate ocean currents, gyres and drift patterns using drifters with GPS beacons and other drift targets. In modern times super-computers are also used to conduct modelling for climate and search and rescue purposes by factoring in wind, current, swell, sea-level and temperature data derived from bottle and drift targets, ocean weather buoys and satellite observations. The need to understand long-term climate change patterns has also seen historic data, such as that recorded in *Paula*'s meteorological journal and other 19th century ships' logbooks, added as datasets into global climate models.

Archaeological

The *Paula* message slip, twine and bottle are archaeologically significant as they provide information on human behaviour in terms of the common type of bottle used in the experiments, and method of preparing the message slips for placement into the bottle. As only the message slips were returned to the German Naval Observatory in Hamburg, the bottle is additionally significant as the only known example of the type of bottle used in the experiment.

Historical

The *Paula* bottle and message slip is historically significant for its association with Georg von Neumayer, the first Director of the Deutsche Seewarte, who conceived and implemented Germany's first official drift bottle experimental program. It also

demonstrates the historical and commercial significance of sail trading routes that linked Europe with Australia, India, Southeast Asia, Japan and China, including the 'Roaring Forties' sailing route following 40 degrees latitude south across the southern Indian Ocean, during the 19th century.

Social

The 'message in a bottle' is a widely-recognised symbol found in numerous cultural references, usually associated with individual human attempts at communication while in emotional or physical distress, and less so with organised scientific endeavour. As such, the *Paula* message and bottle has social significance being a highly symbolic, and iconic example of long-distance, 'deep time' communication.

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