# Glimpses into the past: the mystery of the distance estimator by J.G. Hofmann

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This work is aimed at studying the distance estimator by J.G. Hofmann preserved in the Deutsches Museum. Following the Winterthur model, the analysis will start by the study of the scientific device and its features. Some aspects of the life of J.G. Hofmann will be then reconstructed, and the details obtained will be used to provide a dating of the object and an explanation of its use. Finally, a possible scenario will be presented and discussed, explaining how the distance estimator likely came to Munich and, specifically, to the Deutsches Museum, as an attempt to reconstruct the life of the device.

*Keywords*: material culture, longue-vue cornet, distance estimator, Winterthur Protocol, Jean Georges Hofmann, Deutsches Museum

> We acknowledge that those […] things on which we particularly focus [here[1]] are not of such a nature that they can be completely investigated by certain research. Therefore, we cannot pretend to assert everything as true (for how could we?), but [in some cases] we can only deal with conjectures, the truth of which everyone is free to judge according to their own discretion. (Huygens 1698: 9–10)

## Introduction: studying scientific artifacts with the Winterthur model

In a world brimming with tales of human histories, endeavours and achievements, scientific instruments frequently stand as silent keepers of our past. However, if we approach in silence those apparently inanimate and frozen artifacts – often tucked away in the recesses of a museum, with their surface weathered by time – and we keep listening, we can catch soft whispers of bygone eras that reveal the mysteries and stories hidden within their very essence.

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[1] In quotations, comments added by the author are enclosed in square brackets.

Building upon these considerations, in this work we will analyse and study the distance estimator (*Distanzschätzer*) by J.G. Hoffmann (Hofmann c.1860a*)[2], trying to reconstruct its plausible biography, together with part of the life of its creator. The device, identified by the inventory number 640, is preserved in the Deutsches Museum, within the Founding Collection, and reported in the digital catalogue of the Museum (area of expertise: geodesy), complete with detailed pictures. As the name *Distanzschätzer* suggests, the instrument was (reasonably) aimed at estimating distances; however, through these pages, an accurate analysis of the device will allow us to discover numerous unexpected details.

The study conducted in this work is based on the model presented in 1974 by Edward McClung Fleming (McClung Fleming 1974) for artifact study. This model, also referred as the "Winterthur Protocol" and well-known for its interdisciplinary approach to the study of material culture, is not intended as a rigid and prepackaged structure but as a model that can "provide a framework" (McClung Fleming 1974: 154) for all the possible approaches to the study of an artifact, "relating them to each other, and thus suggest the outlines of a program of collaborative research [a characteristic that each research should have] for all who are engaged in study of the artifact" (McClung Fleming 1974: 154). The model starts from five basic properties of the artifact – history, material, construction, design, and function –, which "provide a formula for including and interrelating all the significant facts about an artifact" (McClung Fleming 1974: 156), and consists in four operations – identification, evaluation, cultural analysis and interpretation – to be performed on the properties, in order to study the artifact in detail.

Despite being originally intended for decorative arts, furniture, and everyday objects, the principles of the Winterthur model can also be profitably extended to the study of scientific artifacts. In fact, just as with research in the decorative arts, the study of scientific artifacts is enhanced by the input of experts in a variety of fields including the sciences, history, art, conservation, and museum studies. This interdisciplinary approach facilitates a comprehensive understanding of the artifacts and their significance. The Winterthur model also emphasizes the value of using the object itself as a primary source of information; this method can be applied to scientific artifacts as well, encouraging researchers to examine the materials, components, manufacturing processes, and historical background of scientific instruments, tools, and other (related or similar) artifacts. Furthermore, understanding the historical context in which scientific artifacts were created and used is crucial for their interpretation. In this sense, the Winterthur model promotes researchers' investigation into the social, cultural, and technological contexts surrounding artifacts, as well as the scientific theories and discoveries of the time. Applying the Winterthur model's principles to the examination of scientific artifacts, as we will try to do in this work, thus enables scholars to attain a more profound comprehension of science's societal role, the evolution of scientific knowledge, and the scientific material culture.

## Approaching the instrument

As the Winterthur model indicates, the primary source of information is represented by the artifact itself. In this specific case, the object comes in two parts: one part is the case of the object, and the other one is the object itself.

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[2] For the reader's convenience, references to instruments mentioned in the text will be indicated with an asterisk.

## A case study (literally)

The case (Fig. 1) is a triangular box made of dark-green leather in the external part. The box opens on the top and is sealed with a golden metal lock, which can be closed with a simple pressure mechanism. The top and the bottom of the leather box are reinforced; in particular, the opening of the box is strengthened both internally and externally (in the external part, with an additional thicker layer of leather). In the back, the leather is sewed: stitches can be clearly seen, as well as an embossing in correspondence with the back seaming.

**Fig. 1** The case of the distance estimator, as seen from two different perspectives. Source: Deutsches Museum Munich (CC BY-SA 4.0) (with respect to the original images, the background was removed).

On the left and right side of the case, as well as at the bottom of the cover, there are three belt loops perfectly aligned, that may have functioned to attach or hang the object to a belt or something similar.

Very visible are the marks on the leather that seem to show friction from usage. These marks are much more evident on the left side of the case. Moreover, there is an evident damage from the top left to the middle side of the cover, where the leather is broken.

The golden lock (Fig. 2), enriched with floral decoration, is hammered to the opening sides, and equipped with a small knob; besides the ornament, the word “BREVETÉ” (that is, “patented”, in French) appears. Also the lid and the opening are embellished, both with an internal decorative golden edge. Moreover, the leather case is adorned with several linear embossments, two on the lid, two on the opening, and one on the lower part.

Inside the case, sticked to the lid (Fig. 2), there is a paper label coming with a short text and few images, that seems to be a sort of basic instruction manual on how to use the object. The label is titled with the word “Micromètre” (that is, “micrometer”, in French). Just below, there are three circles with five central lines of different distances and placed in different ways, commented with letters (A,B,C,D,E,F) and with a short caption each:

- First circle: “Donne Mètres / Gives id. / Gibt Meters” (“Gives Meters”);
- Second circle: “Double-Mètres / id. id. / Doppel-Meters” (“Double Meters”);
- Third circle: “Demi-Décamètres / id. id. / Halbe-Decameters” (“Half Decameters”);

The abbreviation “id.” is the shortened form of the Latin word “idem”, which means “the same”.

Underneath the circles is a graph with a picture of what seems an infantryman with a long rifle and a fixed bayonet (on the left), and a cavalryman with a sword (on the right). The two soldiers could be identified through the army uniforms they wear, that, at a first glimpse, seem to be dated to the mid-nineteenth century. However, the shape and style of the uniforms are very generic and do not evoke any particular nation, and the weapon hanging from the side of the saddle; in addition, also the small flag could give a hint to a military depiction. Both men are carrying what looks like a sort of luggage or equipment.

The graph is separated into two sides: on the left, distance in meters is given, by means of six major gridlines of 50 meters each – divided in five minor gridlines of 10 meters each – ranging from 0 up to 300 meters overall, and the description “Distance”, “Entfernung” appears; on the right the description “Hauteur de l’Objet”, “Height of the object”, “Höhe des Gegenstandes” is reported, with six major gridlines of 0.5 meters each – divided in five minor gridlines of 10 centimeters each – which ranges from 0 to 3 meters.

Moving from the lid to the rest of the cover, the inside of the case is covered with a soft pink tissue that seems to be silk (Fig. 2). Moreover, on the bottom of the case there is a small textile “pod” on the left side, of different colour (more of a flesh tone) and different material, which appears to be velvet. The same material is also used at the opening of the case, for both stabilising and protecting the object.

A last detail must be pointed out: on the external part of the lid, a sort of stamp or label (very deteriorated and partly missing) is sticked (Fig. 2). The paper has a yellowish colour, with a green-blue decorative framework, consisting in a thick single line in the external part, and two thin lines in the internal part. On the stamp/label something was originally written, but unfortunately it is almost completely erased. At a closer look, watching attentively both the ink mark and the engravings left on paper, the digit “6” can be glimpsed followed by something resembling a “4” and by a third almost completely undistinguishable number (but by focusing on the marks engraved on the paper, it seems that a “0” was originally traced).

**Fig. 2** Close-ups of four different details of the case: from left to right, the locker, the stamp on the lid, the diagram sticked in the internal part and the pink inner leaning with the textile pod. Source: Deutsches Museum Munich (CC BY-SA 4.0), © Photographs on the left and on the right by Luisa Lovisetti.

Case dimensions in detail

In Tab. 1 case dimensions are reported in detail.

| | |
|---|---|
| Maximum external diameter (lower part): 62 mm<br>Maximum external diameter (upper part): 83 mm<br>Minimum external diameter (lower part): 52 mm<br>Minimum external diameter (upper part): 63 mm | Maximum internal diameter (lower part): 55 mm<br>Maximum internal diameter (upper part): 64 mm<br>Minimum internal diameter (lower part): 42 mm<br>Minimum internal diameter (upper part): 50 mm |
| Total length without the lid: 108 mm | Total length with the lid: 119 mm |

**Tab. 1** Details of case dimensions.

Looking at the object: visual analysis of the distance estimator

At first glance, the object consists of two lenses – the eyepiece and the objective lens – placed at the two ends of the central body (Fig.3).

**Fig. 3** The distance estimator, as seen from two different perspectives. Source: Deutsches Museum Munich (CC BY-SA 4.0) (with respect to the original images, the background was removed).

The device is compact and easy to hold with one hand, even though it is slightly heavy, approximately 300 grams. The upper and the lower parts of the object are made of shiny brass, as well as the eyepiece structure. Also the lever, placed on the left lateral part of the object, is made of brass. It seems (and it is reasonable to think) that even the central part of the object is entirely made of brass, but around it a woven protective/decorative coating, that leaves out only the top, the bottom, and the lever, was placed, covering the main body of the instrument and hiding it. This woven cover shows visible damages, a sort of scrapes, on the right side, mainly on the edges; they could have been caused through a soft friction, by accident or by daily use. The damages on the woven cover are located mainly next to the objective lens plate. Thanks to this friction it is possible to identify the material of the woven cover: it seems to be hemp string, woven into a basket-like structure, that was then hardened with dark paint, tar, or enamel, which gives the cover an almost metal-like appearance of a bronzed colour, not only to the sight but also to the touch (Fig.4).

Overall, the brass parts of the object are in good condition. However, some scratches can be seen also in this case. On the plate corresponding to the objective lens (Fig. 4) there is an evident scratching, which resulted in a change of colour and brightness of the metal surface: it seems like something was removed, almost as if it had been rubbed off, and three digits (6 3 9) can be glimpsed, rudely engraved in the metal.

Just above this “stain”, there is an engraved inscription, placed inside an oval, that states: “J.G. HOFMANN PARIS” (Fig. 4). It is reasonable to assume that it gives information on the manufacturer of the device and on the place of its production.

**Fig. 4** Close-ups of three different details of the objective plate. Clockwise: the brass plate with the screws and the inscription “J.G. HOFMANN PARIS”, the stain on the plate with the digits “6 3 9” clumsily engraved, and the scratches on the edge of the woven cover. Source: Deutsches Museum Munich, © Photographs by Luisa Lovisetti.

Moreover, near the objective lens, two screws can be seen (Fig. 4). Their colour differs from that of the brass plate, a hint that they are made of a different material. From the colour and the absence of rust or oxidation, it seems that they could be made of steel.

For what concerns the other brass plate (Fig. 5), the one corresponding to the eyepiece part, some minor scratches and abrasions are present as well. On the metal surface there are two visible numbers: one engraving “640” (written by hand and, apparently, in pencil; probably, the same number of that written on the label) and another one engraving “148”. The latter is written in a font similar to that used in the oval symbol; this fact makes it plausible that these two inscriptions were engraved at the same time and by the same person, probably the instrument maker: the inscription in the oval being the brand, while the number “148” maybe being a sort of serial number or production number. However, even assuming that is the case, no hints can be obtained at the moment regarding whether this number refers to the overall production of the instrument maker, or to the specific type of instrument considered here.

The eyepiece, shaped like a short tube, protrudes from the metal plate and can be disassembled via a screw mechanism. By unscrewing the detachable outer part, to which the lens is attached, the inner part of the eyepiece can be observed: a further lens can be seen, surrounded by four dark-coloured “marks” (Fig. 5). Upon careful examination of these marks, it is noticeable that they are arranged in a way that resembles the four cardinal directions. Those corresponding to the north-south direction, that is, to the upper and lower part of the instrument, when it is held in hand, appear as single lines, while those along the horizontal axis are thicker, almost forming three distinct lines. In this regard, it is useful to compare this detail with the diagrams depicted on the paper label sticked inside the lid of the case. Upon careful examination, it can be observed that the marks around the lens closely correspond to the lines of the grid diagrams. Furthermore, upon closer inspection of the internal part of the eyepiece, faint traces of glue/paint can be discerned at these marks. These elements lead to the conclusion that, most likely, threads – now no longer present – were attached to the edges of the lens, corresponding to the marks, in order to form a grid, similar to the one depicted on the paper label. In this way, the observer could make (reasonably easily) estimations of the distance of the observed objects, using the grid as a reference and following the proportional scheme outlined on the lid of the case.

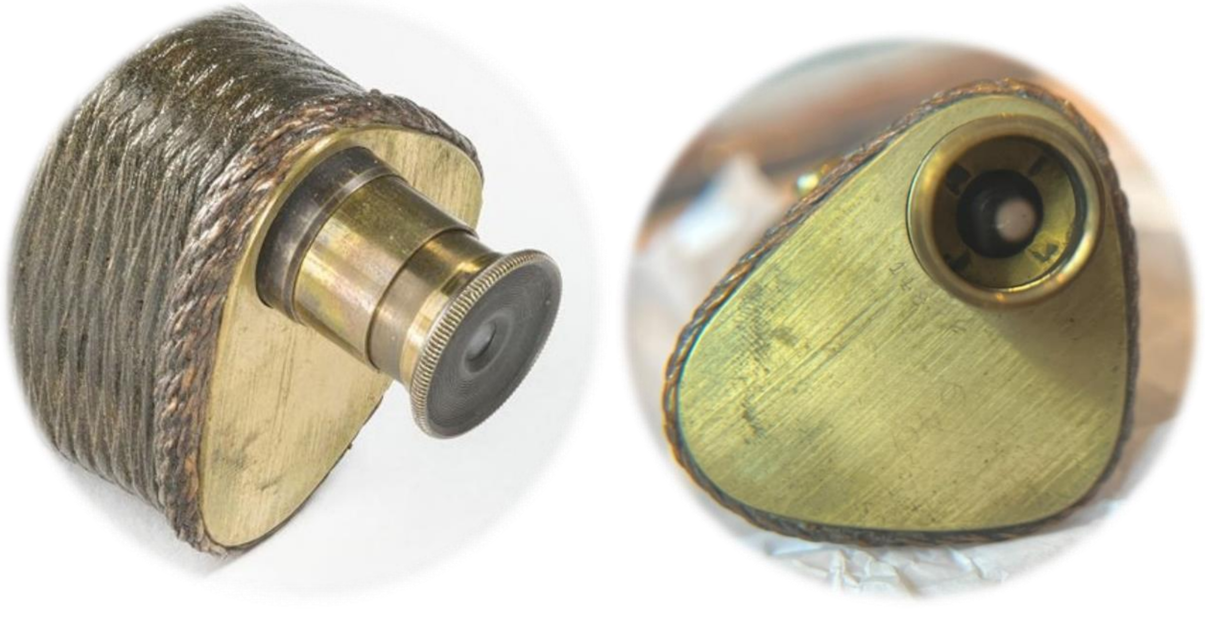

**Fig. 5** Close-ups of different details of the eyepiece plate: the eyepiece tube, the internal marks, and the two numbers engraved on the plate (“148” and “640”, the latter written in pencil). Source: Deutsches Museum Munich (CC BY-SA 4.0), © Photograph on the right by Luisa Lovisetti.

Object dimensions in detail

In Tab. 2 object dimensions are reported in detail.

| | |
|---|---|
| Length of the central body (without the eyepiece tube): 101 mm<br>Total length with the eyepiece tube fully extended: 118 mm<br>Total length with the eyepiece tube not extended: 107 mm | Maximum diameter of the objective lens plate: 62 mm<br>Maximum diameter of the eyepiece lens plate: 54 mm<br>Minimum diameter of the objective lens plate: 46 mm<br>Minimum diameter of the eyepiece lens plate: 39 mm |
| Diameter of the eyepiece lens: 8 mm<br>Diameter of the objective lens: 30 mm | |

**Tab. 2** Details of object dimensions.

## Looking through the object: how does the distance estimator work?

Not being able to open the device and look at the internal structure during the direct study of the object, the only possible thing at this point was looking through it. This fact provided several information about the instrument.

As mentioned before, the object can be hold with a single hand; in particular, the device is intended for right-handed observers, and the lever could be moved with the left hand. If the lever is turned towards the observer, the eyepiece extends; if the lever is turned away from the observer, the eyepiece gets shorter.

Looking through the monocular, by turning the lever, the observer can focus on different objects, depending on their distance: therefore, the object can be used as a sort of spyglass, but it has a much smaller size and also a smaller weight with respect to a common spyglass of similar magnifying power, since it has no draws. This fact renders the object very portable and handy.

The observer has to manage to focus on the desired object: this operation, also due to the screw mechanism of the lever, actually takes some time to be completed, because the visual field is not very large (about 5 degrees, in a quick estimate, at a glance), human hand is not always stable in holding the device, and it is thus not so easy to immediately focus on a specific point. At the same time, however, the lever mechanism for focusing the image makes the movement of the eyepiece much more precise and stable compared to the manual adjustment of the draw tubes in traditional spyglasses. This feature is a further undeniable advantage of the instrument in question.

Distant objects in the outside and in bad weather conditions or in condition of weak light appear, as it is natural, in pale colours, almost in greyish tones.

Moreover, by looking through the monocular it is easy to realise that the optimal visual field is comprised between few meters and approximately 300-500 meters. These distances correspond with those reported on the diagram sticked on the internal side of the case lid. Nevertheless, even more distant objects can be seen in a sufficiently clear way, as we could ascertain by looking from the window of the Kerschensteiner Kolleg of the Deutsche Museum to and beyond the two bell towers of St. Luke’s Church, located at a distance of about 650-700 meters.

The two external lenses are not aligned; hence, this fact suggests the presence of something located internally, such as a prism or a mirror, changing the direction of light. It is more reasonable to assume it is a prism, due to considerations of greater stability and robustness of the entire device. Moreover, given the position of the two lenses, it is reasonable to assume that there are at least two internal prisms; otherwise, from a geometric perspective, it would not be possible to direct the light entering from the objective to the eyepiece.

No coloured fringes can be seen at the edges of the visual field: this fact gives an important hint on the internal part of the instrument, since it indicates that, most likely, an achromatic lens was used to avoid chromatic aberration. However, no clues could be obtained about the kind of achromatic lens used: the most common type of achromat is the achromatic doublet, composed of two individual lenses made from glasses with different amounts of dispersion – typically, a concave lens made out of flint glass and a convex lens made of crown glass –, but no further information could be obtained from an external observation.

In addition, the image is not turned upside-down, but it appears upright, making observations much easier and simpler to be conducted. In this sense, since three different lenses could be seen while analysing the instrument, it is quite reasonable to assume that most likely at least a fourth lens is hidden inside the device, to avoid upside-down images. This fact is in accordance with the supposition made before concerning the possible usage of an achromatic doublet: in this case, two lenses would form the objective and another two the eyepiece, for a total of four lenses.

Last but not least, by looking through the monocular, no grating or wires cross can be seen, which could aid us to precisely establish the distance of the object we are looking at. As already said, this could be a hint that one crucial part of the original instrument is most likely missing: the wires, which, due to their delicate nature, probably went quickly lost or got broken and were not replaced.

## J.G. Hofmann: the man of the mystery

Now that we have analysed in detail the visible characteristics of our instrument, it is rather logic to wonder what clues can be obtained from the brand “J.G. HOFMANN PARIS” impressed on the device and enclosed within the oval shape.

“Hofmann! Who was he?” it is now natural to inquire, paraphrasing the famous phrase of Don Abbondio in Alessandro Manzoni’s book *The Betrothed* (Manzoni 1834: 87). Actually, very little is known about the life of J.G. Hofmann and no known biography about him is available: a somewhat inexplicable mystery, considering that, at the time, he was considered “one of our [French] most eminent opticians” (Moigno 1867: 717).

Jean Georges Hofmann (Bockenheim, 1823 – Paris, 1892) (Office of the civil states 1892) was an important maker of scientific instruments. He was born in Germany and later moved to Paris, where he devoted himself to the creation of optical instruments: initially, from 1855 to 1858, at 5 Rue de Fleurus; then, from 1859 to 1877, at 3 Rue de Buci; and finally, from 1878 to 1887, at 29 Rue de Bertrand. These details were obtained by consulting the issues from 1850 to 1890 of the *Annuaire-almanach* of commerce (Didot-Bottin 1850-1890), an official and institutional document and, therefore, a reasonably reliable source, where the name of Hofmann appears in the section “Manufacturers of optical and scientific instruments”. However, for accuracy, it is necessary to specify that the volumes corresponding to the years 1867, 1868, 1869, and 1872 are not available and, in the volume for the year 1873, the name of Hofmann does not appear. Moreover, we must keep in mind that an uncertainty of few months must be considered regarding these dates. In fact, the almanac was based on the information received before October of the previous year, as specified in the cover of each volume: in case the relocation of the activity occurred between October and December (without being communicated before October), this fact cannot be obtained by reading the almanac; and, in the worst case, the almanac could even report the outdated and wrong address for the whole following year. In the specific situation of Hofmann, luck is on our side, since it can be discovered that he actually moved from 5 Rue de Fleurus to 3 Rue de Buci before the beginning of the year 1859: in fact, a letter dated December 1858 (Hofmann 1858) discusses the relocation of his business from 5 Rue de Fleurus to 3 Rue de Buci. The letter, written on letterhead (Fig. 6), is clearly addressed to a customer of his shop, although it appears blank, likely because the recipient's address was written on an envelope or another sheet, or simply because it was a sort of "pre-printed form" to be filled in later with the recipient's details. In the letter, Hofmann informs that he has just moved his shop, and that the new location will allow him to produce a greater quantity of instruments – particularly the so-called *lunette bi-prismatique sans-tirage*, literally bi-prismatic telescopes without draw (Hofmann c.1860b*) – thus reducing the price of such instruments and promoting their usage. According to Hofmann, this price reduction was already feasible at the time of the letter, and he was already able to fulfil any orders that would be commissioned to him.

At some point, the firm was called *Institut d'Optique* (Institute of Optics). Probably, this denomination was adopted in the mid-1870s: on a spectroscope of the National Museum of American History, purchased in 1869 (Hofmann 1869*), this wording does not appear; moreover, neither a spectroscope exhibited at the Astronomical Observatory of Padua and purchased in 1870 (Hofmann 1870*), on the occasion of the Solar eclipse, bears this inscription; an inscription that appears, instead, on some other instruments made by Hofmann and dated around 1870-1880: for example, a monocular preserved in the Science Museum Group Collection (Hofmann c.1870a*) and a spectroscope belonging to a private collection (Hofmann c.1870b*). Furthermore, some letter sent by Hofmann in 1870 (Hofmann 1870) do not contain such inscription (nor in the text nor in the letterhead), while a letter dated February 1875, bears the inscription *Institut d'Optique* on the letterhead (Hofmann 1875). It is thus reasonable to think that such a denomination appeared around the mid-1870s.

FABRIQUE D'INSTRUMENTS
d'Optique, de Mathématique & de Physique.

J.G. HOFMANN
OPTICIEN-CONSTRUCTEUR
3 rue de Buci, ci-devant rue de Fleurus, 5

Spécialité de Longues-Vues militaires dites Lunettes-Cavalier avec Micromètres pour mesurer les distances et de Lunettes-Hofmann bi-prismatiques sans tirage, brevetées s.g.d.g. à l'usage de la Marine et de la Campagne.
Seul constructeur de l'Optomètre perfectionné par J. G. HOFMANN servant à mesurer le foyer de toutes les vues.
Polariscope-Hofmann (Appareil de Polarisation) et Goniomètres d'application d'une construction nouvelle.
Pinces à Tourmalines parfaitement achromatiques.
Tourmalines en plaques, etc. (Il y en a plus que 2000 à choisir.
Prismes en tous genres, Objectifs et Lentilles,
Rhombes, Rhomboïdes, Cubes, Prismes de Nicol etc. de toutes dimensions en Spath d'Islande et spécialement tous les Verres et Cristaux concernant les expériences d'optique.

**Fig. 6** Detail of the letterhead on which the letter dated December 1858 was written (Hofmann 1858). It is worth noting that, beneath the business logo, there is a detailed list of all the instruments produced and sold by Hofmann in his shop, partially depicted in the beautiful figure above Hofmann's name. In the upper left corner, a picture of the distance estimator can be seen, which is reported as the first instrument in the list. The device just to its left, instead, is the *lunette bi-prismatique sans-tirage*, reported as the second instrument in the list. This fact should not be surprising, given that the distance estimator was of Hofmann's highlights. In fact, according to the *Annuaire-almanach*, Hofmann was "specialised in *lunettes cavalier* [another name of the distance estimator] and *lunette marine bi-prismatique sans tirage*" (Didot-Bottin 1855: 749). In the letterhead, it is also specified that our "mystery" instrument was equipped with a micrometer, thus confirming the previously made hypothesis, and that it was indeed designed for measuring distances.

As for the studies and youth of Hofmann, also in this case very little is known, but it is stated that:

> The power of vocation, intuition, and genius is such that Mr. Hofmann has never attended optics classes, yet crystallographic optics, the most challenging branch of the science of light, holds no mysteries for him. (Moigno 1872: 186)

It is known that Hofmann took part in the International Exhibition of 1862, held in London, in the section "Class 13, Precision instruments" (Commission Impériale 1862: 111), in which he distinguished himself for the excellent quality of his devices and lenses (Society of Arts 1863: 25,27,30,31,99), and again in 1867, in Paris, in the section "Class 12, Optical instruments" (Moigno 1867: 717).

> His exhibition was marvellous from all points of view: knowledge, art, mechanical or manual work. His display overflowed with feats of modern optics; nowhere and never we had seen a more admirable collection of crystals and cut glasses conforming to the laws discovered by Brewster, Fresnel, Biot, Savart, Cauchy, Jamin, etc., to highlight the mysterious phenomena resulting from the molecular action exerted on light by refracting media […]. No, never had the curious and striking phenomena of refraction, dispersion, rectilinear, circular, elliptical, and chromatic polarization been so well represented. […] But this is only half of his exhibition, and the list of rewards truly does not do justice to him when it reduces him to the status of a crystal cutter. Mr. Hofmann is above all a constructor and an eminently skilled constructor, universally known, greatly sought after, of all kinds of optical instruments, often invented by him. (Moigno 1867: 717–718)

Often… but non always. In the case of our investigation, another eminent figure here enters the scene: Ignazio Porro (Pinerolo, 1801– Milan, 1875), an Italian inventor, optician, and topographer. Porro became a major in the Military Engineering Corps of the Kingdom of Sardinia in 1836 and specialized in topographic surveys. He moved to Paris in 1847; there, with the financial help of Count Eugène Panon Desbassayns de Richemont (Paris, 1800 – Paris, 1859), he established the *Institut Technomatique et Optique* (Technomatic and Optical Institute), at 10 Boulevard d'Enfer (today, Boulevard Raspail). The firm remained active[3] from 1854 (Didot-Bottin 1854: 401) until 1862 (Didot-Bottin 1862: 862) and manufactured several optical instruments for surveying work and military usage (Gariboldi 2014: 1751–1753).

No later than 1850 (Anonymous 1850), Porro started producing distance estimators called *longue-vue cornet*, substantially identical to the distance estimator of the Deutsches Museum, a specimen of which, with an ivory shell, is exhibited in the Deutsches Museum (Porro c.1854*). In some devices made by Porro, the diagram with the distance scale was larger in size with respect to those of Hofmann and applied over the right side of the instrument body (Habegger 2019: 24). Porro's *longue-vue cornet* (Bonnardot 1855: 223–236) was a terrestrial telescope, or, better, a rangefinder, weighing approximately 300 grams, with a compact size of only 10 centimetres and offering a magnifications power of about 10-12 times. Due to the presence of a reticular micrometer, it allowed for the determination of the distance of an infantryman or a cavalry soldier. This telescope – called *cornet* because its shape and handling resembled the acoustic horn of the time, while l*ongue-vue* stood for terrestrial telescope – featured an indirect-vision prism system.

In 1854, Porro patented its prism image erecting system both in France (Porro 1854) and in England (Porro 1855a), for a duration of 15 years. The system was "Breveté SGDG", an abbreviation of "Sans Garantie Du Gouvernement", that is "without government guarantee". This mention was established by the law of July 5th, 1844, article 331, which stipulated that patents were issued "without prior examination, at the risks and perils of the applicants, and without guarantee of the reality, novelty, or merit of the invention, or of the fidelity or accuracy of the description".

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[3] Porro's firm appears in the *Annuaire-almanach* from 1854 until 1862 (included). However, to this regard, it is interesting to note that, instead, according to Giovanni Schiaparelli (Savigliano, 1835 – Milan, 1910), "In 1861, he [Porro] left Paris and his Technomatic Institut" (Schiaparelli 1910: 303) and that "The Technomatic Institute lasted for fourteen years [from 1847] until 1861" (Schiaparelli 1910: 298). Moreover, it is worth noting that in the *Annuaire-almanach* of 1853, Porro does not appear in the section "Manufacturers of optical and scientific instruments" (as usual), but his name only appears in the section "Catalogue of patents for inventions (related to optical instruments)", where he is listed as active at 80 Rue de l'Ouest (Didot-Bottin 1853: 2219).

In 1855, Porro created an improved version of the *longue-vue cornet*, which was presented on February 22nd (Anonymous 1855) to Emperor Napoleon III (Paris, 1808 – Chislehurst, 1873); the emperor greatly appreciated the device, which was later named *longue-vue Napoleon III* in his honour (Porro 1855b). In the same year, Porro was awarded the second-class medal on the occasion of the International Exhibition, held in Paris (Bonaparte 1856: 403).

Regarding Hofmann, on the other hand, his skill and fortune were no less than those of Porro. In fact,

> As the foreman of Mr. Porro's workshops, and delighted with the advantages of the curious telescope known as the *Cornet-Porro* or *lunette cavalier*, whose length is halved by the brilliant idea of cutting the visual ray in two, and bringing it back on its path by a clever combination of two prisms with total reflection, Mr. Hofmann set out to manufacture it, and he did so with such perfection that he gave great popularity to an instrument that its poor construction would have stifled in its cradle.
> The *Cornet-Porro*, a charming feat, did not have enough power; it was not a telescope, but only a telescopic opera glass; Mr. Hofmann supplemented it with the biprismatic telescope without draw, which bears his name, and which the Italian campaign made famous. His Majesty the Emperor, after serious examination, made it the inseparable companion of his glorious expedition. (Moigno 1867: 718)

In addition, Hofmann also constructed instruments designed by other famous astronomers, on behalf of the latter. For example, some very powerful spectroscopes designed in 1862 by Pierre Jules César Janssen (Paris, 1824 – Meudon, 1907), which were notable for being compact and pocket-sized, consisting in a series of prisms (Janssen 1862; Janssen 1863). In this regard, a disagreement emerged between Janssen and Hofmann as the latter sought to assert authorship for both the construction and the design of the instruments (Moigno 1863a; Moigno 1863b; Aubin 2002: 627–629; Launay 2012: 22–24).

During the 1860s and early 1870s, numerous were the relationships that Hofmann established "with the most illustrious scholars and the most eminent professors who became his clients" (Moigno 1867: 726). In fact, it is known that some of the most authoritative astronomers of the time commissioned and bought instruments from Hofmann's shop. Among them, we recall Angelo Secchi (Reggio Emilia, 1818 – Rome, 1878) (Braun 1868a; Braun 1868b), John Thomas Romney Robinson (Dublin, 1792 – Armagh, 1882) (Mollan 1995: 36) and William Huggins (London, 1824 – London, 1910) (Huggins 1909: 206).

However, he did not take part for unspecified reasons in the International Exhibition of 1878, held in Paris, in the section "Class 13 – Precision Instruments, Physics, and Navigation" (Rédacteurs des Annales du Génie Civil 1879: 476).

Despite the limited information available, it is evident that, in the 1860s and 1870s, Hofmann was one of the leading instrument makers in the French and not only French scene. Undoubtedly, thanks to his instruments, he must have gained not only a good reputation but also a substantial fortune.

Indeed,

> Mr. Hofmann, who, in the quiet of a modest but famous workshop, had acquired so much skill and accumulated such wealth, exhibited for the first time in London in 1862, with unparalleled success. Barely a month had passed before he had already sold the multitude of objects that filled his elegant display case. (Moigno 1867: 726)

In this sense, it is interesting to make a comparison between Porro and Hofmann. Regarding Porro, concerning the price of his instruments, it is noted that the *longue-vue cornet* had "very high price (150 francs and above)" (Anonymous 1850: 288). At that time (1855-1875), 150 francs was a rather significant amount. In fact, in 1871 "In Paris, shop clerks and employees earn an average of 1,400 francs per year, while in the provinces, their salaries are only 719 francs" (Société de statistique de Paris 1875: 42), with salaries increased on average by 40% from 1853 to 1871; therefore, in 1855, the yearly average salary was about of 1,000 francs in Paris and 514 francs in the provinces.

For what concerns Hofmann, we find eight advertisements in 1859 and three in 1860 in the magazine *Le moniteur de l'armée* (Hofmann 1859; Hofmann 1860), stating that the distance estimator was sold for only 65 francs, and 70 francs in the case of object shipment (Fig. 7).

**LONGUE VUE MILITAIRE dite LUNETTE-CAVALIER**

**Par J.-G. HOFMANN, opticien, rue de Buci, 3, à Paris.**

La seule convenable pour les *opérations militaires*, grande puissance, petit volume. pas de tirage, longue de 10 cent.; elle s'ajuste d'une seule main; pourvue d'un micromètre, elle indique la distance ou la hauteur d'un objet.

L'extension donnée à la fabrication de ces précieux instruments, permet de les vendre au prix de 65 fr. à Paris, ou contre un bon de poste, expédition *franco*, 70 fr.—*N. B.* Tout instrument doit être pourvu du cachet de fabrique : J.-G. HOFMANN, à Paris, et d'un *numéro d'ordre*.

**Fig. 7** Advertisements of Hofmann's shop, with the price of his *longue-vue cornet* (Hofmann 1860: August 10th).

Perhaps also due to the affordable prices, as well as owing to the quality of his instruments, Hofmann sold numerous units of his distance estimator:

> Seeger (Seeger 2010:15) […] estimates that Hofmann made approximately 1,000 of these monocular telescopes. It was the first prism telescope made in series. (Louwman & Zuidervaart 2013: 215)

This fact strengthens the idea that the number reported on the eyepiece brass plate is likely a sort of serial number of the instrument, engraved by Hofmann himself.

## Object dating

No date is indicated either on the case or on the device; therefore, it is extremely difficult to precisely identify the year in which the object in question was produced. However, one element may be useful in this regard. Indeed, a brother specimen is housed at the National Museum of American History (Hofmann 1862*). This device bears the number 443. Furthermore, as stated on the museum's website, both prisms are marked in pencil "J.G.H.", while the objective lens is marked in pencil "J.G. Hofmann à Paris 1862". Actually, this is not an isolated case, as other instruments by Hofmann also display a date, presumably the year of production, inscribed on the lenses and prisms[4] (Colombo 2020). Considering this fact, and since the device at the Deutsches Museum bears the number 148, it is reasonable to assume that it was crafted before 1862.

In addition, given the substantial difference between the numbers 443 and 148, it can be (likely) inferred that this instrument dates back to no later than 1860, since, despite the rapid and extensive annual production of Hofmann's instruments, it is quite reasonable to assume that he did not produce more than a hundred instruments of this kind per year. However, a (maybe) definitive answer to this question might be obtained by opening the instrument and inspecting whether there are any pencil inscriptions on the prisms and lenses.

## How is the distance estimator made and how does it work?

But how is the distance estimator constructed internally? The answer to this question is contained in an article published in 1850 the French journal *L'illustration*, in which the device designed by Porro is presented (Fig. 8 and Fig. 9).

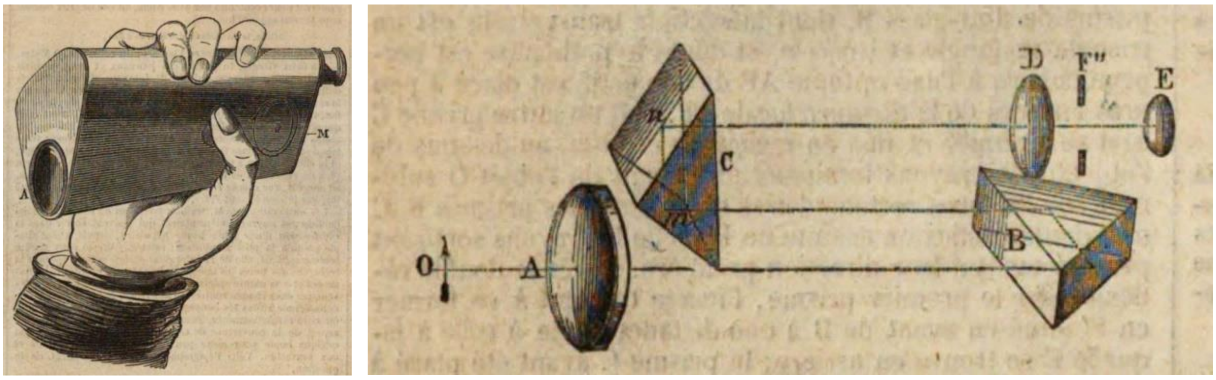

**Fig. 8** On the left, the *longue-vue cornet* held by the observer. On the right, the path of light rays inside the *longue-vue cornet* (Anonymous 1850: 288).

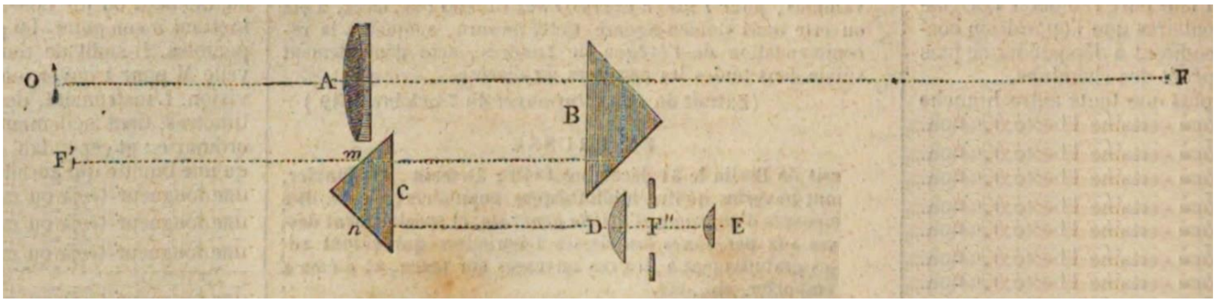

**Fig. 9** Diagram of the internal structure of the *longue-vue cornet* with the total reflections that allow to reduce the length of the device (Anonymous 1850: 288).

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[4] To this regard, a heartfelt thanks goes to Ulrich Zeun, who has purposely checked and confirmed the same thing for another device.

> [In Fig. 9] Let $A$ be the objective lens of the telescope, and $F$ be the focal point of this lens. The ordinary terrestrial telescope is composed, in addition to the objective lens $A$, of an eyepiece with four glasses [lenses and prisms] placed to correct the inverted image of the object, which has formed at $F$. In Mr. Porro’s telescope, a prism made of flint-glass $B$, whose cross-section is a right-angled and isosceles triangle, and whose hypotenuse is perpendicular to the optical axis $AF$ of the objective lens, is placed at approximately one-third of the focal distance $AF$. Let another prism $C$, identical to the first one, be placed facing it below the objective lens; the light rays coming from the object $O$ will undergo a double reflection on the rectangular faces of each of the prisms $B$, $C$, after which the rays will emerge parallel to their original direction. After the double reflection on the first prism, the image would tend to form at $F'$, located in front of $B$ at a distance equal to that at which $F$ is located behind; since prism $C$ has been placed at approximately half of this distance, the final focal point $F''$ where the image is formed, is adjacent to the prism. It is with respect to this focal point $F''$ that a two-lens eyepiece $D$ and $E$ is adjusted.
>
> […] [In this situation], the images would be inverted. However, there is a very simple way to straighten them out; for this, it is sufficient to rotate prism $C$ and with it the eyepiece, around the line $mF'$ by a quarter revolution [Fig.8], perpendicular to the plane of Fig.9. The image formed at $F''$ will rotate on itself, in its own plane, around the line $nF''$, by double the angular amount, due to a fundamental property well known by all those who use reflection instruments; therefore, it will describe a half-revolution while the prism will have described its quarter of revolution, and in this position, the image will be straightened out like in ordinary terrestrial telescopes.
>
> This artifice, as can be seen, literally bends the optical axis of a telescope into three; it has something analogous to the process by which sound waves are bent in acoustic horns; hence the name *lunette-cornet* given by Mr. Porro to his spyglass. (Anonymous 1850: 287)

According to the same article, Porro

> […] wanted to give his telescope a valuable property in many cases, that of indicating distances when one knows the size of the objects, or the size of the objects when one knows their distance. For this, it was enough for him [Porro] to place at the focus of his telescope, in $F''$, a circular diaphragm equipped with five wires [arranged as in Fig. 10] […]. The interval $ab$ is twice the interval $cd$ and five times the interval $ef$. When one wants to evaluate the distance of an object, it is necessary that, when looking at this object, one can enclose between the wires $a$ and $b$, or between the wires $c$ and $d$, or finally in the interval $ef$, a known height. Then the sought distance will contain as many times one hundred meters as the height between the wires $a$ and $b$ contains meters, or as many times two hundred meters as one sees meters between the wires $c$ and $d$, or finally as many times five hundred meters as the wires $e$ and $f$ appear to contain meters. In many circumstances, one knows in advance one of the dimensions of an object, so that the distance will result, almost without calculation, from a simple reading made with the telescope. (Anonymous 1850: 287–288)

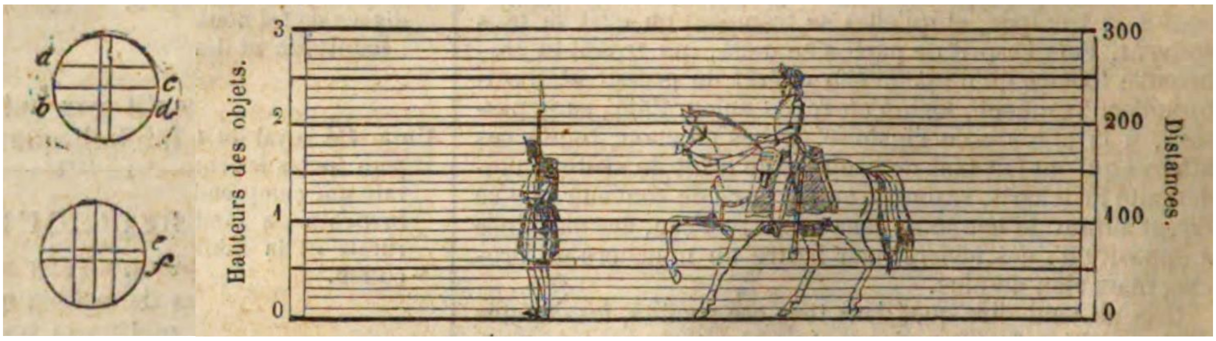

**Fig. 10** The two possible wire reticules (the second is simply the first one rotated by 90 degrees) and the comparison scale for measuring distance. (Anonymous 1850: 288)

Let us see two examples to clarify the usage of the instrument:

1. Let us consider the interval between wires $a$ and $b$. If the lower wire touches the horse's feet, while the other corresponds to the rider's shoulders, then the graduated scale immediately indicates that the cavalryman is 220 meters away from the observer.
2. Let us consider the interval between wires $e$ and $f$. If the lower wire cuts across the knees of the infantryman, while the other wire grazes the upper part of the bayonets, then the graduated scale indicates that the upper part of the bayonets corresponds to the distance 250, and the knee line to the distance 50. Therefore, there is a difference of 200: the real distance is thus 200 half-decameters, which equals 1,000 meters.

## The (probable) users of the distance estimator

The distance estimator looks like a small spyglass, even though it does not have the typical elongated shape of the latter, resembling more the sturdy appearance of binoculars. Porro had designed his distance estimator to be an efficient tool, yet at the same time extremely portable and compact, having no draws. This because, in Porro's mind, the instrument was primarily intended for military use.

> We have seen that the light ray is, so to speak, broken into three equal parts, so that by this fact alone the length of the telescope is reduced by two thirds. The possibility of substituting a simple astronomical eyepiece with two lenses to the terrestrial eyepiece commonly used further reduces the length, which is definitively reduced to about a quarter, approximately, of that of a telescope with the same magnification, field of view, and clarity. This is certainly a very good result and would already be sufficient to strongly advocate for the preference of the *lunette-cornet*. How many travellers, soldiers, sailors, or even simple enthusiasts will be happy to have in their coat pocket a telescope perfectly adjusted, ready to function, magnifying objects on surface […], requiring no draws, and occupying no more space than an ordinary snuffbox! (Anonymous 1850: 287)

Hofmann himself intended the object in question for a similar use. In fact, in the magazine *Le Moniteur de l'Armée*, in addition to the previously mentioned advertisements, there are also two "inserts" in 1859 and another one in 1860 (Baudouin 1859; Baudouin 1860), where the object in question is explicitly and strongly recommended to officers, as

> This telescope, standing 10 centimeters tall, is remarkably powerful and wonderfully simple: it adjusts with just one hand and has no draws; equipped with a micrometer, it allows for the instant evaluation of either the distance or height of an object; enclosed in its case, it can be carried hang on the shoulder strap. (Baudouin 1860: July 31st)

The last part confirms the fact that the loops on the case were indeed used to attach the device to a belt. A specimen with the attached belt is preserved in the archive of the Jena Zeiss Museum (Hofmann 1867*).

On the other hand, the design and aesthetics of the instrument are reasonably in line with military use. Covered with a painted/varnished hemp cover, the device is clearly not an aesthetically refined, elegant or luxury object; therefore, it does not seem to be intended for recreational use by wealthy individuals, but rather has the sturdy, solid and essential appearance of military instruments.

## Authenticity, missing parts, and instruction manuals

As previously mentioned, the original crosswires attached to the instrument are missing. Moreover, it is reasonable to assume that the case is original: it perfectly fits the device and similar models in other private or museum collections have identical cases (Louwman & Zuidervaart 2013: 215; Zeun 2013: 85).

Although the device is quite manageable, it is not trivial to use it efficiently. Therefore, this fact naturally raises the question of whether there was originally a sort of manual providing instructions for its correct and effective use. In this regard, in the first devices crafted by Porro there was an “extended” version of the label that provided clearer instructions on the use of the instrument (Habegger 2019: 24). Furthermore, in 1857, Jean-Félix Salneuve (Paris, 1794 – Paris, 1862), professor of topography and geodesy at the École d’application du Corps royal d’état-major, wrote the volume *Course of Topography and Geodesy* (Salneuve 1857: 323–325), in which some useful indications could be found; the subsequent edition of the volume, published posthumously in 1869, contained even more details (Salneuve 1869: 323–325, 613–614). Moreover, Porro himself, in 1858, wrote the book *The tachymetry* (Porro 1858: 221) in which, among other things, the functioning of such a device was explained.

## Following the traces of the distance estimator: from Paris to the Deutsches Museum

At this stage of the research, another crucial question arises: if the distance estimator was produced in Paris, how and when did it arrive at the Deutsches Museum, where it is currently preserved? Fortunately, a few clues are known and can therefore be used to write some pieces of the biography of our object.

In 1894, Hofmann’s distance estimator was listed in the inventory of the Mathematical-Physical Collection of the Royal Bavarian State, in the “Geodesy” section (inventory no. 640, the same number that can be seen written in pencil on the objective plate), linked to the Bavarian Academy of Sciences.

From a comparison with similar specimens, it emerged that the label/stamp sticked to the external part of the case is actually linked to the same Academy of Sciences, since the same label can be traced on several objects originally part of the Academy’s collection: it was probably applied at the time of the object’s acquisition.

Nevertheless, the question remains as to why the object bears the number 639 clumsily written on the objective lens plate, while in the inventory it appears registered as item 640. Could it have simply been an error in the initial cataloguing of the time (a hypothesis that could justify why the number on the plate was rudely engraved – a practice that, fortunately, is no longer in use – and then clumsily attempted to be removed, leaving that stain on the surface)? It may be so, but a definite answer, to date, is not available.

What is clear, instead, is how the object passed from the Academy to the Deutsches Museum. In fact, in 1905[5], the Bavarian State and the Bavarian Academy of Sciences donated 2,023 objects to the Deutsches Museum as part of the Founding Collection, of which Hofmann's distance estimator is a part.

Regarding, then, whether this object was ever exhibited at the Deutsches Museum (and, in the affirmative case, where and when), there is no definite information available. It seems plausible that this object would appear in the same section as Porro's, namely, Classical Optics section, but neither the virtual tour[6] nor the updated page of the Optics section[7] show Hofmann's instrument, exhibiting only Porro's monocular. Indeed, a truly mysterious object, even in this sense...!

If the most recent life of object 640 has been reasonably reconstructed, the challenging task now is to understand its history from the time of its manufacture (presumably, around 1859-1860) until its inclusion in the collection of the Academy of Sciences (1894). Where has it been during this approximate 35-year timeframe? Has it ever been used? And how did it make its way from Paris to Germany, and specifically to Munich? At this point, we can do nothing but embark on speculative paths that lead us towards possible scenarios. Before venturing down those paths, as a first step, some considerations can be made regarding certain characteristics of the object.

### 1. Possibility of exporting the device

The soldiers depicted on the case wear uniforms that are not specific to any nation. Additionally, the instruction label, as we have seen, is written in French, German, and English, unlike Porro's instrument, which had instructions only in French (Habegger 2019: 23). Was the instrument originally intended by Hofmann to be regularly exported outside of France, and particularly to Germany? To this regard, in the official catalogue of the French section of the International Exhibition of 1862, it is stated that, at the time, Hofmann exported 5% of his annual production (Commission Imperiale 1862: 111); and this percentage has most likely increased in the following years, as orders for instruments from non-French buyers grew (Braun 1868a; Braun 1868b; Mollan 1995: 36; Huggins 1909: 206). However, before carelessly taking the answer to be affirmative for granted, a crucial aspect must be highlighted concerning the unit of measure indicated on the label, that is, the meter. In France, the metric system of measure was first given a legal basis in 1795 by the French Revolutionary government, with the Article 5 of the law of Germinal 18th, Year III, and exclusively adopted with the law of July 4th, 1837. In Great Britain, the metric system was "permissive by law of 1864" (Barnard 1879: 223).

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[5] Founding Collection (or Academy Collection) of the Deutsches Museum: https://digital.deutsches-museum.de/projekte/gruendungssammlung/geschichte/ (19/06/2024).

[6] https://virtualtour.deutsches-museum.de/navvis/?fov=75.0&site=1893603346956088&vlon=0.42&vlat=-0.51&image=2111 (19/06/2024).

[7] Classical Optics section of the Deutsches Museum: https://www.deutsches-museum.de/museumsinsel/ausstellung/klassische-optik (19/06/2024).

Instead, in Germany, the situation was a bit more complicated. First of all, it should be noted that the unification process of Germany took place only after the mid-nineteenth century in two fundamental stages: first with the creation of the North German Confederation (in 1867), comprising the German states north of the Main River, and later with the establishment of the German Empire (in 1871), following the decisive Battle of Sedan on September 2nd, 1870, which saw the victory of the Prussian army over the French army. The victorious outcome prompted the southern German states to begin negotiations for their entry into the Confederation. On January 18th, 1871, in the Hall of Mirrors at the Palace of Versailles, the German Empire was born, with the King of Prussia, Wilhelm I (Berlin, 1797 – Berlin, 1888), being proclaimed emperor. The process of Germany's political unification also overlapped, in some ways, with the process of adopting the metric system. In fact,

> A decree relative to weights and measures for the North German Union was promulgated [on] 17th August, 1868. This decree made the use of the metric system of weights and measures permissive from 1st January, 1870, and compulsory from 1st January, 1872. By a subsequent law of the German Empire, the same was reenacted and extended throughout the realm. Bavaria adopted it by a law of 29th April, 1869.
> […] In Rhenish Bavaria the metric weights and measures were introduced in the year 1840. Outside of the Rhenish provinces the system was non-metric until the metric system was declared optional from 1st January, 1870, and obligatory from 1st January, 1872.
> In Baden, the weights and measures made commensurable with the metric system by law of November, 1810, came gradually into use, until by order of 21st August, 1828, their use was made compulsory with the year 1831 […].
> In the Grand Duchy of Oldenburg, until the end of 1871, the system of weight and measures in different places differed. (Barnard 1879: 222).

Therefore, it is not so obvious that, in the 1860s, an instrument with instructions based on the metric system, even if written in German, could have been really appealing or useful for the German market.

## 2. Ever (or never) used.

Was object number 640 ever used for real? The scratches and abrasions do not suggest damage from real usage in a battlefield or on a military mission (since the instrument shows no dents), but rather seem to indicate wear from repeated placement on a hard surface and/or from improper storage of the device (perhaps stored on an inadequate shelf or handled by someone not very careful or delicate, maybe some old archivists of the Academy or the Museum). The instrument and the case are not dirty, but at the same time, the device does not appear to have been polished, as the eyepiece tube appears oxidized. It does not seem, therefore, that the object has been cleaned, but rather gives the impression that it has never been used for real; let us consider the abraded part where the straw cover is visible: the straw is essentially clean, light in colour, without the dirt traces one would expect from actual military or geodetic use. Furthermore, the golden lock (like the case itself) seems a bit too delicate for a battlefield or for concrete military use, closely reminding, instead, the typical case of opera glasses. Usually, military cases are rigid leather cylinders and often have a belt-type closure with a buckle, rather than being soft with a small “snap” closure like that of our device. In addition to this, there is not even a name engraved or scribbled by the supposed owner on the instrument, a practice that was instead quite common among late nineteenth-century soldiers. Therefore, it is not possible to answer with certainty the question regarding the potential concrete use of the object, but based on what has been said, we lean towards a negative response.

As already mentioned, the instrument is small and easily portable. While this characteristic undoubtedly constituted a significant asset for military use, it poses a considerable inconvenience for tracking its movements. The object can be easily carried around without attracting attention, making it almost untraceable. Having found no definitive documentation to this regard, we will make some plausible hypotheses, which, from the perspective of this study, can be articulated into a possible scenario.

## A possible scenario: the arrival in Munich through the Steinheil family

Some hints seem to be suggested by a letter found in the C.A. Steinheil archive of the Deutsches Museum, which includes a drawing of the distance estimator[8].

The letter was written by the German physicist Wilhelm Eisenlohr (Pforzheim, 1799 – Karlsruhe, 1872) to Carl August von Steinheil (Ribeauvillé, 1801 – Munich, 1870), on May 5th, 1859, from the city of Karlsruhe.

> Dear friend! In our army, there is a growing need for practical handheld telescopes with a [single] draw that is strong and securely locked […]. The […] telescope by Hoffmann [*sic*] in Paris seems certainly practical for them. I believe a good deal could be made, and I have offered to supply them with everything at the prices you like. Therefore, please send me buyers and prices, this search is also of great interest to me […]. (Eisenlohr 1859)

Steinheil was a German physicist, inventor, engineer, and astronomer. In 1835 he was appointed curator of the mathematical and physical collection of the Bavarian Academy of Science, and, at the same time, he was appointed professor of mathematics and physics at the University of Munich. He was elected an extraordinary member of the Bavarian Academy of Sciences in 1835 and a full member in 1837. After some years away from Munich, in 1852 he returned to Munich to his old position as curator of the mathematical and physical collections. In 1855, he founded the *C.A. Steinheil & Söhne*, an optical-astronomical company that built telescopes, spectroscopes and photometers (Repsold 1916).

Also his son Hugo Adolph Steinheil (Munich, 1832 – Munich, 1893) was interested in optics and astronomy. After a period abroad, in 1852 he returned to Munich, where he devoted himself entirely to optics. In the following years, Hugo actively supported his father in founding and expanding the company. In 1862 he took over management of the company. Since 1888 he was an extraordinary member of the Bavarian Academy of Sciences.

If the 1858 letter written by Hofmann and found in the archive of the Deutsches Museum (Hofmann 1858) is somehow related to item 640, the distance estimator might have been bought directly by Carl in 1859-1860. This would coincide with the hypothesis of its non-use in military contexts, explaining the absence of evident damages

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[8] The letter is part of a collection of documents that also includes pencil sketches and diagrams of the internal structure and functioning of a device with a two-prism system, very similar to the one used in the distance estimator. However, in our opinion, some of the sketches are more likely referred to the *longue-vue-cornet de jour et de nuit*, a marine telescope invented by Porro (Anonymous 1850: 288) or to the *lunette marine bi-prismatique sans tirage*.

attributable to battlefield use, and it would also align with the period when Eisenlohr's letter was written (mid-1859).

It is interesting to note that Hugo died in 1893, and, in 1894, the instrument appeared – or, better, was reported – in the archives of the Academy. Was it donated by Hugo's heirs, or had it already been donated by Carl or by Hugo while they were still alive? Whoever was in the Steinheil family who donated the object, in any case, the hypothesis that the distance estimator arrived in Munich, and, then, at the Deutsches Museum, thanks to the Steinheil family seems the most plausible. Firstly, because there are tangible documents to support this perspective, and secondly, because the temporal period considered for the possible purchase of the device coincides with the hypothetical dating of our object (1859-1860).

From this perspective, Steinheil might have purchased the object (for himself, perhaps in the period just after the letter found in his archive), maybe even to study it and try to produce similar specimens or instruments based on a similar two-prism system; hence, the sketches of the internal constitution and functioning. He kept it with him and then donated it to the Academy, at his death, or at the death of his son. As a scientific curator, he may have also purchased it explicitly for the Academy, but in this sense the datings are more difficult to reconcile, and there are no documents clearly pushing in this direction.

Regardless of its inevitable flaws, working on this scenario has allowed to reconstruct some details, sometimes based on solid and certain foundations, while sometimes – as it often happens – founded instead on personal conjectures and suppositions, albeit reasonably plausible ones. However, as Christian Huygens (The Hague, 1629 – The Hague, 1695) wrote in his *Kosmotheōros*, "conjectures are not useless simply because they are not certain" [Huygens 1698: 10]. A sentence that I fully endorse, and for which, I hope, the readers will judge me kindly at the end of this essay.

## Conclusion: onward and upward, an unfinished quest

Like in every biography of an artifact, numerous questions remain unanswered at present time, and many aspects still await clarification, either wholly or partially. Regarding the specific object under study, although various insights have been brought to light, there remains a great deal yet to be discovered about both its maker and its journey from Paris to Munich.

Nevertheless, from what has emerged up to now and reported in these pages, it is quite evident that Hofmann was so renowned and significant in his time to believe that only a handful of traces remain of him and of his instruments. It is reasonable, and indeed appealing to me, to believe that much information, currently forgotten, still exists and is simply concealed within some archive, document, or even within the instrument itself. I envision them there, awaiting discovery and disclosure, along with the mystery they harbour, which has been unveiled only to a small extent within these pages.

## Acknowledgements

Reconstructing the history and writing the biography of an object is not a solitary journey, but rather a scientific investigation that greatly benefits from collaboration and exchange with other inquiring "detectives". I thus wish to express my heartfelt gratitude to all the people who have shared this journey through history with me.

Firstly, my group mates (Lorenzo De Piccoli, Katharina Stuhrberg and Hannah Tatjes), with whom this investigation began and started to take shape.

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