The Historical Experience of Scaled-Down Nineteenth Century Drydock Technology

Alan Lemmers

Well then, the eye is bent to Onrust's Southern ground,
Where to its waterside so many keels are bound.
Where people toil and moil in unrest night and day,
Where sooty fumes and dust have chased the sun away,
Where light has turned to murk through filth and grime,
And everything is gray as in primeval time.
Here ships are broken down, bevelled and joined anew.
There burning rosin sets a hull in flaming hue.
On Java's beach the savage brutal chatter rings
Blown by the wind across the water as on wings.
Insatiably the paying-ladle is ablaze.
The sky is black with smoke, axes and adzes raze
Greedy for wood of the Oriental Paradise.
Mountains of Northern iron vanish before our eyes.
A sluggish stream of pitch and tar streams past the shore,
But still the island screams and howls and begs for more.
Rafter and beam and deal are lugged around,
And by the floating castles voices and tools resound,
As if the whole wide world were only here at work...

Jan de Marre, *Batavia, begrepen in zes boeken* (Amsterdam, 1740).

World's Fair, Paris 1867

At practically every nineteenth-century World's Fair, the Navy accounted for a large part of the Dutch exhibit. This was also the case in Paris in 1867, where the main source drawn upon was the Navy Model Collection of the Naval Ministry in The Hague.1 According to the French admiral E. Pâris, "la Hollande était, après l'Angleterre et la France, la nation...dont l'exposition offrait le plus d'intérêt." [2] Mr. Pâris was interested in Dutch progress in the field of armour plating and screw propulsion, and as head of the French naval model collection he had a keen eye for such topics.'

Nonetheless, in the reports of the jury on the subject of naval shipbuilding and ship's engines, no mention was made of the Netherlands.' France, Great Britain and the

The Northern Mariner/Le ***Marin** du* **nord, VIII, No. 3 (July 1998), 63-87.**

United States — the latter of which was not at the Fair — were considered by the jury to be leaders in these fields, whereas the Netherlands was still learning and hence had little to display. Only one subdivision of the Dutch Navy display drew full attention, and that was the department of drydocks.[5] The "modèle d'une partie d'un dock flottant en tôle, à Sourabaia" was the largest piece on show in the "Rue des Pays-Bas."[6] This same brass model, more than two metres in length, recently underwent a thorough restoration at the Amsterdam Rijksmuseum during the reorganization of the Department of Dutch History. (see figure 1)[7] It is a significant piece for technological as well as maritime history, and it offers ample food for thought on museological usage and the ethics of restoration.

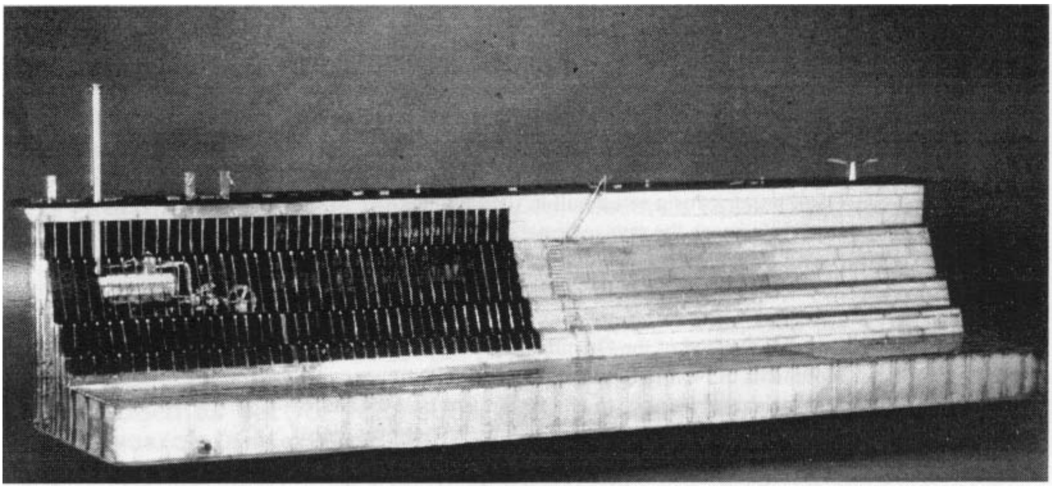

Figure 1: Model of the Onrust drydock, made by the Royal Factory in 1863-1864, in its present, restored condition.

Source: Rijksmuseum Amsterdam.

Iron Floating Drydocks

In the spring of 1860 the Dutch Minister of Colonial Affairs received a request from the East Indian administration for a new floating dock. The wooden floating docks used at Surabaja and Onrust could no longer cope with the ever-larger steamers. The Surabaja dock, dating from 1849, was sixty-four-metres-long, and only with the greatest difficulty could it service the second-class screw-steamers *Groningen* and *Vice-Admiraal Koopman*.[8] Although the dock on the isle of Onrust in the Bay of Batavia dated from 1856 and was somewhat longer, it still was not long enough for the bigger screw steamers. For the Navy, as well as the merchant companies, the situation was becoming urgent, since for major maintenance ships had to be sent all the way back to the Netherlands.[9] The growing use of iron, steam and screw propulsion made docks indispensable: "Il est donc aujourd'hui nécessaire d'être en mesure de mettre à sec rapidement et économiquement les plus grands bâtiments."10

The only question was whether the new floating drydock for the Naval Station at Onrust would be made of wood or iron. The East Indian authorities preferred iron, but in 1860 there were no iron drydocks in existence, although there was much interest in them and preparatory work was being done." Two years after the East Indian request the Minister of Colonial Affairs put the problem to the Minister of Naval Affairs, and together they agreed to build an iron drydock. This was practical because at that moment three such docks were being built in Britain: one for the Spanish Navy at Cartagena by Rennie and Sons in London; one for the French naval station at Saigon by the firm Randolph, Elder and Company in Glasgow; and a final one for the firm Cores de Vries in Java» Although none had yet been completed, they inspired confidence in the feasibility of such a project.

This would be the first time the Netherlands acquired an iron floating dock. Moreover, floating docks were still relative novelties. For centuries there had been various methods to make the underwater part of a vessel accessible for maintenance, especially careening, or keeling, which was the time-honoured method used for larger ships. The vessel was tilted until half the bottom was entirely exposed and could be cleaned or repaired from rafts. Indeed, in some harbours a special quay was built for this purpose." Yet a ship took quite a beating from the strains exerted on the rigging and hull in such an operation. An alternative involved hauling the ship up a slipway, but this was hard work and did not do the ship's frame any good either.

In the seventeenth and eighteenth centuries the first stationary drydocks were built, first in Britain and later elsewhere in Europe. At high tide a vessel could be sailed in, and when the tide turned the water ran out of the dock, which was then closed. In Flushing this type of tidal dock was built by an Englishman in 1704-1705.14 If the tidal difference was insufficient, then a dock was built that could be pumped dry. [15] But not all harbours at the mouths of rivers were suitable for the construction of this sort of dock. In Surabaja harbour, for instance, the soil was unsuited for a stationary dock and, as we shall see, Onrust had its own problems. [16] In the East Indies other means for ship maintenance had to be examined.

The Dutch had been lifting ships out of the water at home since the end of the seventeenth century. Large ships wanting to enter Amsterdam harbour from the Zuiderzee used to be put between two ship's camels which, when pumped dry, raised it enough to be towed across the Pampus shallows." It seems only a small step from this technique to a floating drydock. "It is incomprehensible that these camels have not earlier engendered the idea of building floating dry-docks," M.H. Jansen remarked in the nineteenth century. But the editor of Jansen's memoirs, S.P. L'Honoré Naber, countered that:

> Jansen's comparison between docks and camels is not quite correct. It is rather the floating dock invented by the Dutch engineer Corn. Meyer in 1685, that led to the construction of the camels in 1690. The time for those docks was not yet ripe, as long as ships could be careened easily... Even as late as 1858 the expert Obreen expected problems with the system, which presumably became practicable only after the latest development in iron construction.18

The oldest model of a floating dock in the Dutch Navy Model Collection at the Rijksmuseum dates from the end of the eighteenth century; the design had been brought from France by Jochem Pietersz Asmus (1756-1837), founder of the collection, on a study tour to the French Atlantic ports.[19] It appears never to have been built. Only in 1843 was J.D. Diets of Amsterdam to build a floating dock in wood, based on "very poor and incomplete drawings" from the US.[20] Although the technology thus appears to have come from abroad, from the start the Amsterdam docks were considerably larger than their American forebears. Diets acquired an international reputation for three floating docks in Amsterdam and his "entirely disinterested cooperation" in building a dock for the French Navy at Le Havre. When in the late 1840s the Dutch government planned a wooden dock for Surabaja, Pieter Schuijt Juniorszoon, chief engineer of the Navy, was ordered to use the floating dock at Le Havre as an example.[21] As these later two docks were to operate in salt water, they were sheathed with copper to protect them against shipworm. The logical next step in view of the construction strength now required was an iron dock.

The Isle of Onrust

At first ships needing underwater treatment in the East Indies had to be careened for lack of docking facilities.[22] But this was difficult for bigger ships, and steamers could not be careened unless their boilers and engines were removed (paddle steamers also had to have the wheels taken off). There were only two naval stations in the East Indies: the 1837 dockyard at Surabaja, where ships could not get to the quay and had to be keeled by means of a careening hulk, and on the isle of Onrust, where careening could be done at the wharf. "Onrust would always be preferable if it had not lived up to its great name of being one of the most insalubrious regions in the East Indies: far too many ships have paid the heavy toll to death and disease."[23] The unhealthy climate had earned the island its sobriquet of "sailor's graveyard" and it was avoided by many merchant captains.[24]

Onrust had been a maintenance yard for the Dutch East India Company since 1618. It was destroyed by the British in 1800-1810 and finally transformed into a naval station by Governor-General Van der Capellen in 1823.[25] At the suggestion of the Minister of Colonial Affairs, the digging of a stationary dock was started in 1841.[26] The labourers in the chain gang that was to do the excavation came down with marsh fever, and when the constructor Buys, who was in charge, succumbed in 1844, the activities were postponed indefinitely. In 1849, during an inspection tour, E.B. van den Bosch and two chief engineers from the Ministry of Public Works found the station in a dilapidated state. But Governor-General Rochussen was strongly opposed to the plans to develop Onrust as a naval station because it would make the island a site of great strategic value. Only when in 1849 the East Indian administration decided to turn the entire archipelago into a naval stronghold, and thus make Onrust defensible, did Rochussen yield.[27] But the second attempt to complete the dock failed as well. After a great number of deaths among labourers and administrative staff, the project was abandoned. A year later it was decided to supply Onrust with a wooden floating drydock, in imitation of the 1849 dock at Surabaja. In 1853 an order was placed with a private shipwright at Dassoon in the residency of Rembang. The dock was delivered in 1856 and for a number of years its performance was extremely satisfactory. In 1861, however, a leak was found and two years later the dock was returned to Dassoon for repairs, which took three years.

Between 1856 and 1861 merchantmen had also been sent to Onrust's floating dock, but this was prohibited after 1862.[28] The number of naval steamers in the East Indian service had increased dramatically: in 1860 there were ten screw steamers in the East, and just as many paddle steamers.[29] In that same year another twelve screw steamers were launched, most of which were intended for service in the East Indies.[30]

But if the situation had become extremely urgent for the Netherlands government, it was even more so for the merchant marine. In 1862 the firm Cores de Vries, which operated the packet service throughout the East Indies, had the Scottish firm Randolph, Elder and Co. build an iron floating dock for Batavia. Private enterprise would have stolen a march on the Navy if the dock had not sunk in 1863, even before it entered service." But for that misfortune, Batavia would have had two iron floating docks within two years: one for the merchant marine and one for the Navy. It is not known to what degree the East-Indian Administration had reached an understanding with Cores de Vries, but it seems unlikely: in 1862 the Dutch authorities had no information at all about the Cores de Vries dock then under construction.[32]

Public Contract

As we have seen, about 1860 the East Indian administration expressed its wish for a new iron dock for Onrust. Naval engineer C. Scheffer had even drafted a design, which was annexed to the request to the Minister of Colonial Affairs. Moreover, the East Indian administration had suggested that the Royal Factory of Paul C. van Vlissingen and Dudok van Heel should be entrusted with the construction. (see figure 2) Yet neither the Minister of Colonial Affairs nor his colleague in Naval Affairs was in favour. They wanted to submit Scheffer's design to the Commission for the Dockworks of Willemsoord, but they also preferred a public contract which, so they thought, would prove more profitable to the state.[33]

The directors of the Royal Factory were uncomfortable with the system of public contracts, which had been adopted in the Netherlands since the introduction of the new Navigation Laws and Free Trade in the 1850s. Open competition was not altogether favourable for Dutch firms, since they were often dependent on the import of raw materials. In a plea for the protection of Dutch industries, Paul van Vlissingen (Paul C. van Vlissingen's father and predecessor as director of the Royal Factory) stated that the difference in import duties for engines and raw materials put Dutch enterprise at a disadvantage, since it was cheaper for a foreign firm to import a complete engine than for a Dutch firm to import the raw materials.[34] Besides, it was the general opinion of the industrialists that the state underestimated the social importance of domestic industry, on which the livelihood of so many Dutch families depended. From 1600 employees in 1857, the Royal Factory had dropped to 900 by 1862, and many believed that this could have been prevented by a little more cooperation from the authorities.

But the Minister of Industry was convinced that "factories were started for the sole benefit of the directors," and he refused to grant Dutch firms more favourable terms when putting government contracts out to tender. In this fashion Dutch industry missed out both on the contract for new locomotive engines for the National Railways and on the concession of the steam-packet service in the East Indies. This latter issue deserves some attention as it concerned the same parties involved in the ordering of the drydock: the East Indian administration and the Royal Factory.

Figure 2: Paul C. van Vlissingen (1829-1906), director of the Royal Factory and son of the founder. After the takeover by J. van der Made in 1870, Van Vlissingen tried ranching in the US, but returned to the Netherlands virtually penniless at the end of the century. In the last years of his life he was caretaker at the Municipal Museum in Haarlem.

Source: Werkspoormuseum, Amsterdam.

From 1840 to 1862 the East Indian packet service had been in the hands of Cores de Vries, but when its contract came up for renewal in 1863 the firm made such exorbitant demands that new tenders were called. When the Englishman H.O. Robinson submitted a tender of one cent per nautical mile less than Van Vlissingen and Dudok van Heel, the Governor-General granted him the concession. Even after the Dutch firm declared a willingness to meet Robinson's price, the decision stood. Protests to the Minister of Colonial Affairs that this would hurt Dutch industry and citizens were to no avail. According to the historian M.G. de Boer, the consequences of this affair, which became known as "the cent of Paul van Vlissingen," were disastrous for the Netherlands as well as for the East Indies.[35] "The cent of Paul van Vlissingen" illustrates clearly how the Dutch government tried to obtain the cheapest deals while covering its back from possible international criticism for being protectionist.

Cores de Vries, on the other hand, had also turned to a British firm for the construction of its dock. As a private firm Cores de Vries was, of course, entirely free to do this. It is possible that either the inferior competitive position of Dutch firms or a lack of confidence in the abilities of Dutch industries led to this choice. In the meantime, Paul van Vlissingen and Dudok van Heel were itching to demonstrate their skill in drydock technology. Indeed, in February 1862 van Vlissingen and Dudok van Heel suggested to the Minister of Colonial Affairs that he "authorize the East-Indian Administration to commission their agents in Batavia, Messrs Dümmler & Co, to construct the iron drydock."[36] The question remains whether the idea of placing the order direct with the Amsterdam firm originated with the East Indian administration or with the firm itself. Regardless, the following May the Ministers of Colonial and Naval Affairs resolved to use a public contract; in their decision they were supported by the Commission for the Dockworks of Willemsoord as well as the Governor-General of the East Indies.[37]

Design

Naval engineer Scheffer's 1860 design failed to meet the specifications of the public tender.[38] In consultation with the Navy it was decided to ask the Commission for the Dockworks of Willemsoord to improve on it. In August and September 1862 naval engineer A.E. Tromp and hydraulic engineer J. Strootman of the Commission travelled to Britain to study drydock technology.[39] At the London World's Fair they studied a number of models. As a result of this trip in 1862 Strootman wrote an overview of the designs of iron floating docks.[40] He mentioned twelve designs, but the docks for Cartagena, Saigon and Cores de Vries, all then under construction, were conspicuously absent.[41] Eight designs described by Strootman were British and were dismissed as unsuitable for the East Indies; most had never been executed anyway. Three were old Dutch proposals, which had never been built either. Scheffer's design was the twelfth.

Scheffer himself had died in the interim. If we put his design, as depicted in Strootman's survey, and the eventual design of Tromp and Strootman side by side, it is obvious that the differences were minimal. The external appearance was exactly the same. Given the state of drydock technology, this design can only be seen as an entirely Dutch product.

When in November 1862 the final design had been approved, the contract was put out for tender; seventeen firms bid, many of which were foreign. This time the tender of the Royal Factory was significantly lower than its competitors and the Amsterdam firm landed the order to build the dock for 366,685 guilders. "This result proved, moreover, how much the State had profited from the public contract."[42] The Royal Factory at that time was in a dull period, but it is unlikely that it was forced to submit a tender at an impossible price.43 In fact, the firm delivered the dock little more than a year later at even less than the price agreed. The Factory knew a short period of prosperity in 1864-1865, owing to a number of important orders. We may assume that the construction of the drydock also contributed to this brief revival.44

Construction

The drydock was "the largest structure of sheet-iron hitherto made in our country."[45] The entire hulk of over a thousand tons was first built on the factory site, dismantled and shipped to Surabaja, where it was reassembled, and then towed to Onrust. On the site of the Amsterdam factory a foundation was made between the boiler plant and the workshop for iron shipbuilding, where in the course of years a thick layer of coal cinders had been dumped. A railway was built to the workshops, complete with the necessary turning tables. (see figure 3)46

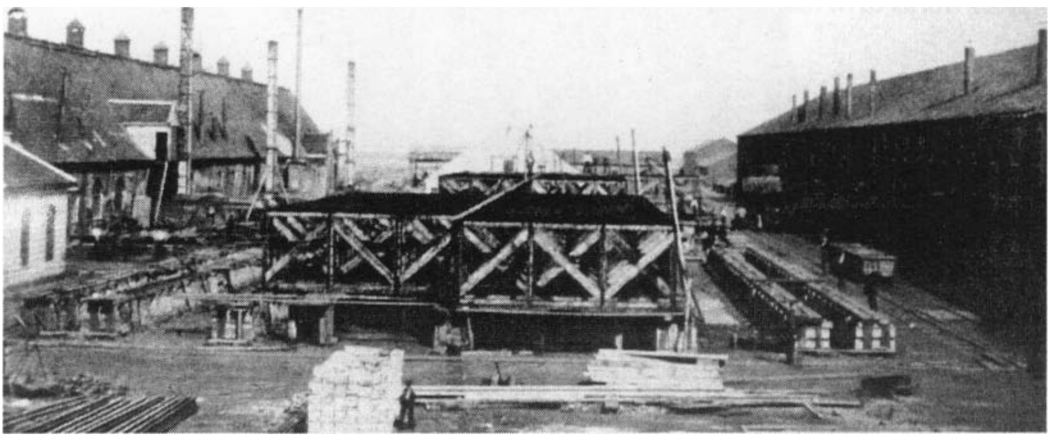

Figure 3: The drydock in construction at the Royal Factory of Paul v an Vlissingen and Dudok van Heel in Amsterdam, c. 1863.

Source: Nederlands Economisch Historisch Archief Amsterdam, special collection.

The technical details and expenses of the dock are available in an article by Tromp and Strootman published in 1865.[47] It was ninety metres long, twenty-four metres wide and 10.55 metres high, with a lifting capacity of 3000 tons. On either side a steam engine drove two Gwynne-designed centrifugal pumps for emptying the dock.[48] Over half a million rivets were used. Most of the iron came from a works at Charleroi, Belgium.[49] Tromp and Strootman supervised construction, and even while the dock was being built some alterations were made to the design, such as making the upper sections watertight to combat the heavy seas that tend to occur at Onrust area during the West Monsoon."

The building of the colossus drew attention in the Netherlands. When it was still on the factory grounds it was visited by several dignitaries, including the French prince Napoleon, Dutch Prime Minister J.R. Thorbecke and the Ministers of Naval and Colonial Affairs. The Royal Institute of Engineers came as a group in 1864. (see figure 4)[51] A year later the dock was dismantled and transported to the East Indies in five ships of the Dutch Trading Company. Since the Rotterdam industrialist and shipbuilder G.M. Roentgen (1795-1852) in 1838 sent the steamers *Etna* and *Hekla* to the East Indies as "kits" to be assembled on arrival, this had become standard procedure. After the drydock other large iron constructions were shipped regularly to the East Indies in this way, including a series of cast-iron lighthouses from 1867.52

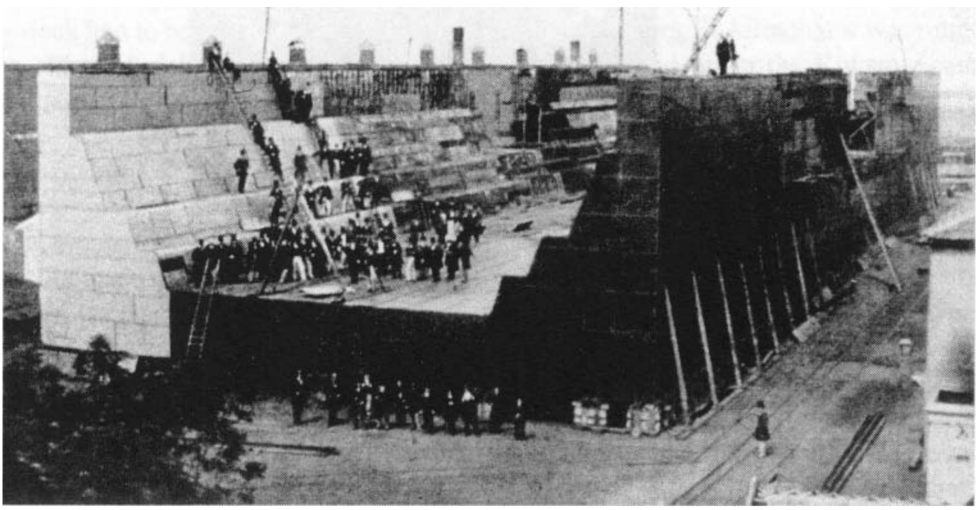

Figure 4: The Dutch Royal Society of Engineers visiting the drydock, 9 June 1864. Note the different coloured sections. The Royal Factory presented this picture to all who had been present.

Source: See figure 3.

In 1865 building supervisor B. van de Linde of the Royal Factory travelled to Surabaja, where a basin had been dug to reassemble the dock. This basin was kept dry by the steam engines of the dock itself. Parts of the dock had been painted in four different shades of lead paint to enable the eight sections to be distinguished; the parts had also been numbered. Although no fewer than four hundred workmen were involved, the reassembly took four years. At last, towards the end of 1869 the dock was ready to be towed to Onrust, where it was put into service immediately. Tromp and Strootman had provided elaborate operating instructions as well as testing procedures to be followed before each docking."

Attention should be drawn to the superb performance of the Royal Factory. In the Netherlands the dock had never floated, and there was no tradition or experience for the manufacturers to fall back upon. Nevertheless, without a hitch the dock embarked upon a long and active career. (see figure 5)

Figure 5: A vessel docked in the drydock in Tandjoeng Priok, Batavia harbour.

Source: Koninklijk Instituut voor de Tropen Amsterdam.

The Model

When in 1865 the dock was taken apart for shipment to Surabaja, the Royal Factory presented the Ministry of Colonial Affairs with a brass model of a section of the dock. The model was included in the price, and the Dutch authorities must have been pleased, for the costs in the end remained even below the estimate in the contract: only 366,410 guilders.'

The model was a promotional gift, much like the custom of shipyards to present a model to a shipowner upon delivery of a new vessel. Nothing is known of any practical function of the model. It represents one-half of two-thirds of the length, complete with steam engine, pumps, piping, sluices and valves. It is a piece of high-quality workmanship, executed in great detail, with sections of walls that open and shut to reveal the interior. The entire construction has been followed accurately: all the frames and bulkheads have been fitted, even in the parts that do not open and are inaccessible to the eye. Not all the rivets have been clinched, though thousands of tiny holes have been drilled through the brass sheets and frames. The model likely approaches the condition of the dock when it was temporarily assembled in Amsterdam rather than the finished product in the East Indies.

Colonial Affairs decided that the Navy Model Collection was the best place for the model: after all, it did represent a *Navy* dock.[55] And at the Paris World's Fair in 1867 the Navy displayed it as its own piece, not as a product of the Royal Factory. This deserves mention, as it could have been otherwise: the silversmith Van Kempen, for instance, asked for the temporary return of the silver tablepiece the firm had made in 1857 for the frigate *Admiraal van Wassenaer* (MC 1303) in order to exhibit it at the same Fair.[56] In the jury reports of the World's Fair, the model was put on a par with those of the drydocks at Saigon and Cartagena. As a consequence of the model Mr. Paris judged the Dutch Navy as one of the most advanced participants of the Fair.57

But the transports to and from Paris did not pass unscathed. Professor F. Kaiser complained that nautical instruments which he had put at the disposal of the exhibition had come back damaged, and the Navy Model Collection did not escape unscathed. The model of the dock had to be sent back to the Royal Factory for "repairs."[58] After that it was returned to the Navy Model Collection and thus, in 1885, it wound up in the Rijksmuseum in Amsterdam.

A **Restoration**

In 1994, one hundred and twenty-five years after the first iron dock came into operation off Onrust, its brass model was launched again at the Rijksmuseum. The model had not been public display since about 1925, and its progress through the depots, cellars and towers of the Rijksmuseum had left its marks. During the Second World War it was in all probability hidden in the coal cellars, where other parts of the collection had also been brought for safe keeping. Indeed, a thick crust of dirt testified to poor storage conditions, and much of the damage seems to have been caused by hurried and careless handling. (figure 6) As the model was now intended for permanent exhibition in the National History Department, it had to be restored thoroughly. In the museum world "restoration" is necessary if controversial: if a piece needs conservation or repair infractions cannot be avoided. Then, of course, the question arises as to how far an object, as a work of art or an historical item, retains its integrity.

The concept of authenticity is one of the most important aspects of historical as well as artistic experience. Authenticity is in essence a subjective rather than an objective experience.[59] But to objectively determine the authenticity of an object of art or history for restoration purposes or historical evaluation, five factors can be distinguished.[60] An object has material authenticity if no original materials have been replaced. Conceptual authenticity reflects how well it still conforms to the intention of the maker: in order to conserve or restore an object which has been damaged to its conceptual authenticity, it may be necessary to violate its material authenticity. Wear and tear are traces of the object's history and, if respected, can provide important historical information; this historical authenticity is denied if the object is restored to a state of newness, which is its ahistorical authenticity, although in many cases this coincides with its conceptual authenticity. Finally, an object's functional or contextual authenticity is a function of the conditions in which it is displayed and how that affects the viewer's conception of authenticity. The 1994 restoration of the model of the drydock may be used as an example to test modem restoration practices against the theory. In its dilapidated state the model was totally unsuitable for display, so restoration was absolutely necessary.

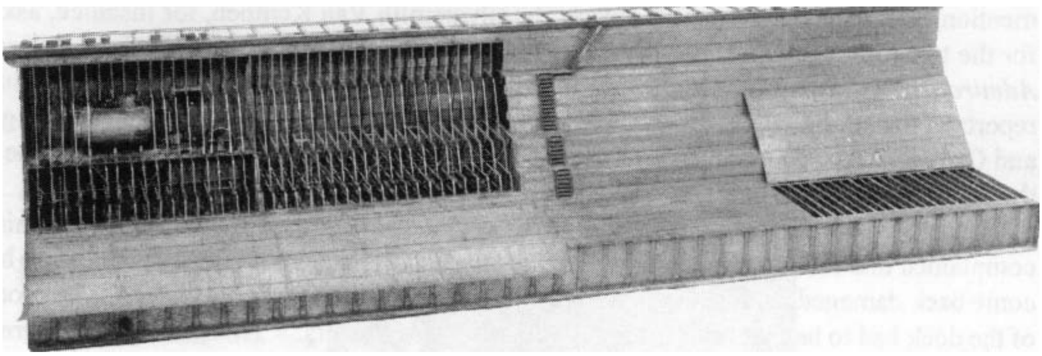

Figure 6: Model of the drydock of Onrust before restoration.

Source: See figure 1.

In principle the restoration consisted of the following operations: dismantling (as necessary); cleaning (removal of dirt), repairing (remaking of missing parts); assembling (of loose and remade parts); and conserving (applying a protective coating). For technical reasons the steam engine was dealt with separately. It was heavily damaged, and the frames behind which it sat had been wrenched apart and some even sawn off. As well, the engine and boiler had partly been torn from their foundations. (figure 7) And the piping was buckled and bent. Miraculously, the broken parts were for the most part still lying about. The cause of this damage is a matter of conjecture, but there is a strong suspicion that it was due to attempted larceny. When half-way through this demolition work the thief discovered that this was not a working model and probably lost interest.

The restoration of the steam engine meant first of all dismantling and cleaning. (figure 8) The surface cleaning was done using an ultrasonic device and the parts were immersed in a cleansing fluid. The special solution provided for this device proved too corrosive: it extracted zinc from the brass, which gave the surface a coppery colour. After consultation with the restorer of old clocks, another liquid with an ammonia base was tried, which yielded the desired effect.

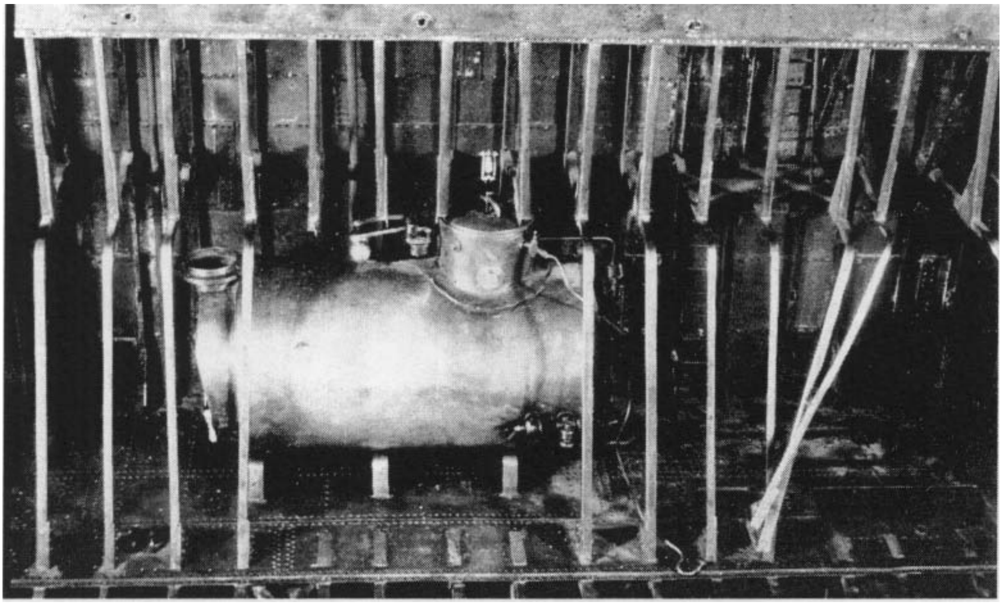

Figure 7: Detail of the model, showing the damage to the steam engine, which has been removed for restoration.

Source: See figure 1.

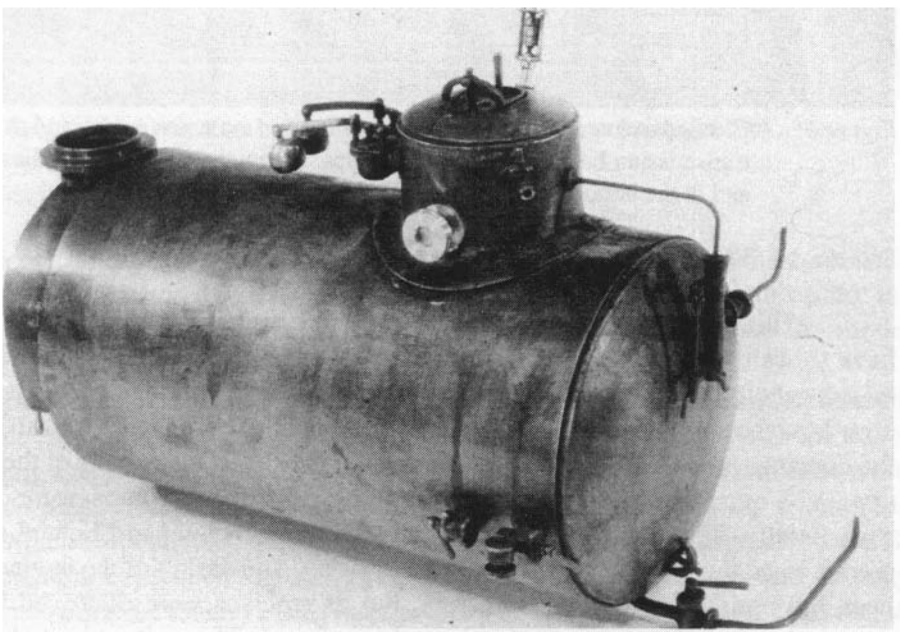

Figure 8: The boiler removed from the model before cleaning.

Source: See figure 1.

At various points traces of an earlier restoration came to light, especially of parts which might originally have been able to turn but which were now clumsily soldered together (the feed pump, hand pump and eccentric). To get the eccentric rotating again was tricky because the hot solder kept gluing the lot together again — this part alone is indicative of the enormous workmanship of the model makers. After cleaning and reassembly, the parts were lacquered with a special clear cellulose varnish, which not only enhanced the lustre but also kept it free of the dust. (figure 9)

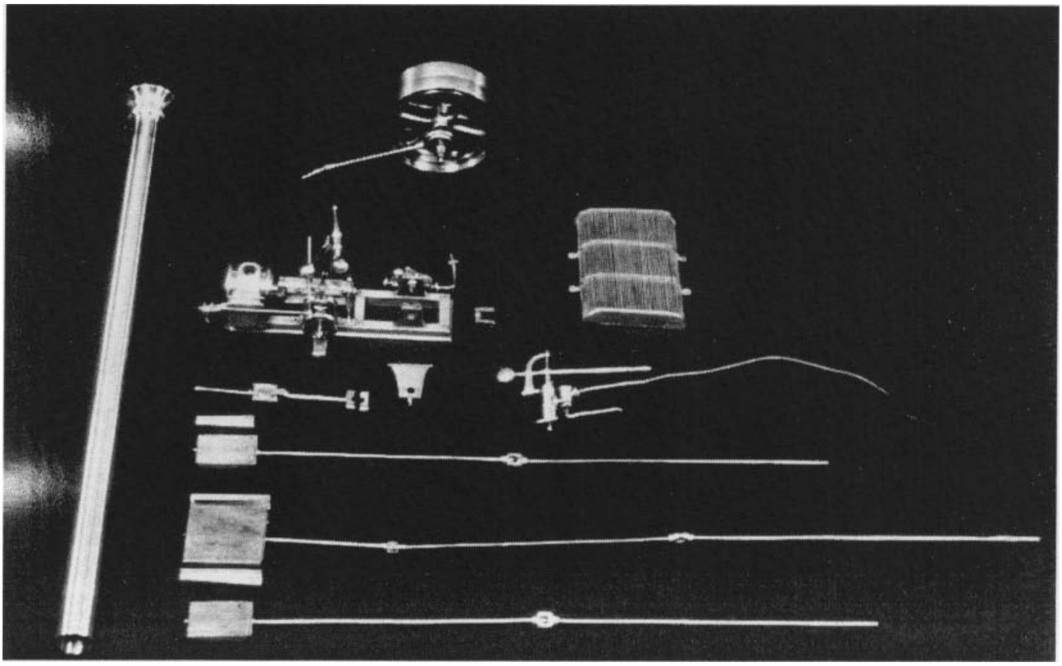

Figure 9: Cleaned and newly-fabricated parts. Above are the steam engine and the wheels for the transmission belts that drove the pumps. Below the sluice grating lies the hand pump and at the bottom, three sluices. The funnel to the left is new.

Source: See figure 1.

This did not yet mean that the steam engine could be put back in its place; it would have to wait not only for the rest of the model to be cleaned but also until there was no mistake about the pipework diagram of the engine. Owing to the damage it was no longer clear how the various pipes had run, nor were there any useful sources available. Although the drawings made by Tromp and Strootman in 1865 depict many parts of the dock in detail, strangely enough the steam engine and the centrifugal pumps were only depicted superficially. The "real" centrifugal pumps had been bought in England ready-made, it seems, to be mounted into the dock without delay. The design of the engine had probably been left entirely to the Royal Factory, but its archives were destroyed by fire and no descriptions of the steam engine have been found. The unit consisted of a boiler, a horizontal double-acting steam engine, a feed pump and a hand pump; the centrifugal pumps were driven by transmission belts, which were lacking in the model. The lay-out of the pipework and the specific installation of such a machine differed per unit. The connections of the boiler as well as of the steam engine and pumps demanded a lot of brainwork, which was also the case with the safety valves, operation levers, manometer and other accessories. Incidentally, the exact location of the engine caused some doubt about the identification of the model, since nineteenth-century photographs show the engine sitting on the upper deck and not built into the side compartments. (figure 10) Fortunately, J.L. Meyer informed the museum that in the East Indies the engines were moved to the upper deck because the heat in the engine rooms in such a climate made work inside impossible.

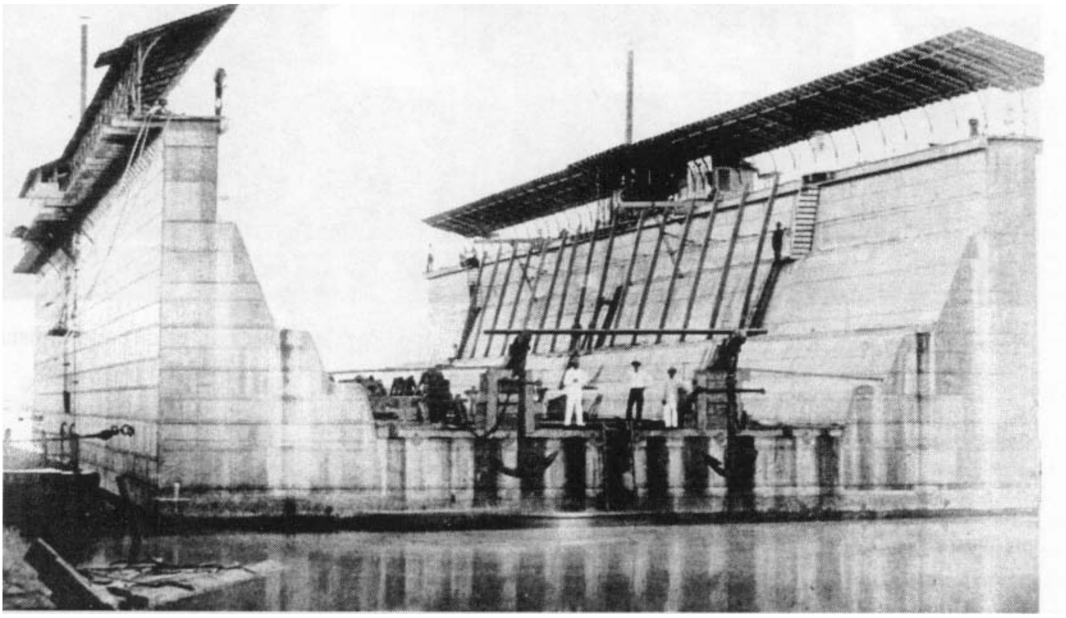

Figure 10: The drydock in the East Indies. Note the steam engine on the upper deck.

Source: See figure 1.

The replacement of the steam engine had to wait until the model of the dock itself had been cleaned and restored. Ultrasonic cleaning was out of the question this time: the model was simply too big. Electrolysis could not be used either because the model contained not only brass but also other metals, such as iron and tin.

Meanwhile the nature of the thick grey crust of dirt had not yet been established. (figure 11) The rock-hard cake could not be removed by polishing, except with the aid of caustic cleansing agents that corroded the surface of the metal. The thousands of little rivet-holes had been plugged with silt, which made it likely that we were dealing with an old wax-coating which had collected quite a lot of dirt. The restoration department of metals was called, and after experimenting on some parts a rather non-noxious solvent for fatty substances turned out to be effective (this detergent can be bought at any paint dealer's). A large bath was constructed, and after the little holes had all been pierced, the dock was left to soak for ten days. (figure 12) After being rinsed thoroughly, the surface was treated with a weak solution of acetic acid, rinsed again, delicately rubbed with brass polish, rinsed again, and finally washed with soap and water to remove the remnants of the polish (and, of course, rinsed again). The treatment of the interior presented another problem, as it was practically inaccessible. But eventually a solution was found by blasting the inside with walnut grains, which are softer than the metal itself.

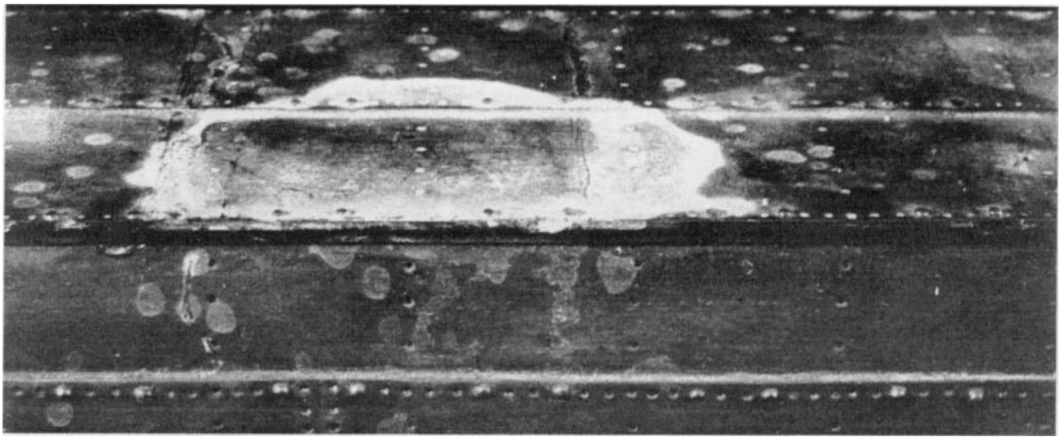

Figure 11: Detail of the model of the dock before cleaning, showing the layer of dirt and moisture stains on the upper deck.

Source: See figure 1.

Once the dock was clean, the necessary repairs could be undertaken. Many protruding parts had been bent or broken, and in many cases detachable parts, such as scuttle covers, had disappeared. The mounting of soldered parts caused constant problems because the original sequence of assembly could not be followed, with the result that when soldering one part, adjacent parts might get so hot that they came off again. This necessitated hard soldering, a technique that did exist at the time the model was made. (figure 13) Hard soldering is done at a much higher temperature than normal soldering, so that later the same part can be soldered at a lower temperature without the hard soldering becoming unstuck.

The funnel of the boiler was missing, as well as the capstan and the winches of the sluices. These parts were remade on the basis of the Tromp and Strootman drawings. Eventually the steam unit was put back in its place, the pipework reconstructed and fitted and new frames put in front of it. A number of steam experts approved this reconstruction of the piping lay-out. (figures 14 and 15)

On top of the model came a wooden deck, which for years had been filed only as an "Unidentified Historical Object." It was identified during the restoration. Although broken and incomplete, it could be repaired. When the repairs were complete, the dock was provided with protective coating: synthetic wax on the inside, synthetic varnish on the outside. The entire restoration took five months. It had required the collaboration of three restoration workshops and the assistance of a number of experts. As is customary today, every step of the process was recorded and documented carefully.

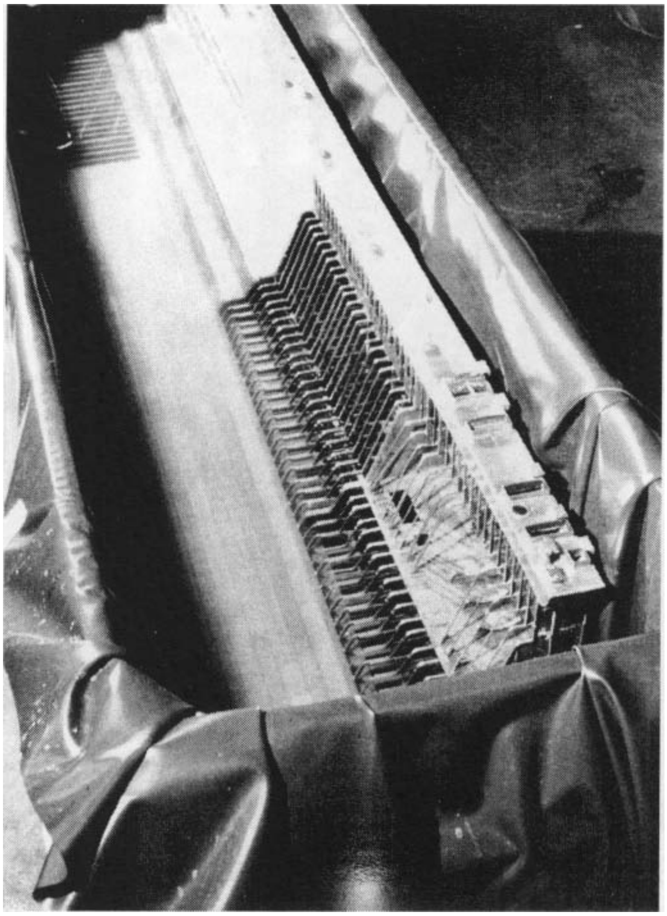

Figure 12: The model of the dock sitting in its bath, as yet only half filled.

Source: See figure 1.

Authenticity

This project is a clear example of restoring an object to its "ahistorical authenticity:" the object has been brought back, at least visually, to its condition when it first left the Royal Factory. All traces of its "past life" (damages, former restorations) have been removed. This is where restoration ethics become an issue. Objections may be raised to the removal of historical traces. But if one aims at "historical authenticity," that is, preserving traces of its past life, which traces should be preserved? Generally, the answer is that they have to be historically informative or add to the aesthetic appeal of the object, and the latter especially is very subjective.

The "historical traces" on the model were of three kinds: general neglect (dirt and damage), an attempted theft (the steam engine), and former restorations. Of these only the last might have had some historical relevance, since it can be linked to the 1867 World's

Fair. But the 1868 restoration, if that is what the traces are, was clearly a hasty job, with no respect for the meticulous craftsmanship that went into the manufacture of the model. It is obvious that the Royal Factory, which carried out this restoration but by that time had run into serious financial problems, no longer had any real interest in the model.

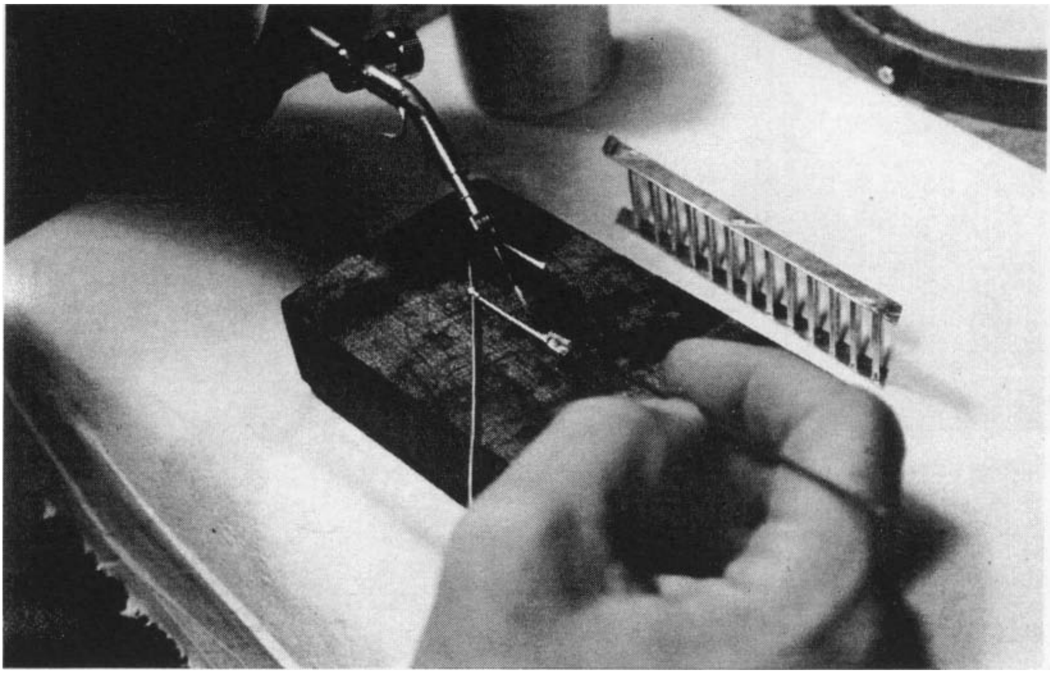

Figure 13: Hard soldering is done with a hydrogen flame and silver.

Source: See figure 1.

The decisions whether to respect historical traces and, if so, which ones, are closely related to what is intended in terms of preservation and exhibition. Being an extremely evocative exhibition object, this model provides links to a diversity of historical themes, ranging from the position of Dutch industry in the nineteenth century to the technical level and prestige of the Navy and the theme of defence technology in the colonies. In these the model only played a part in a state of shiny newness, as a present of the Royal Factory to the state and as part of the World's Fair. Besides, in linking the model with some of these historical themes one has to bear in mind that it in fact is a model — a representation of another historical reality, the dock itself. The real dock in the course of time underwent some minor changes, which means the model reproduces the dock only in its design phase.

In evaluating the damages we can safely conclude that they represented only losses. Restoration at the very most could recover the visual image and perhaps in the process provide some insights due to the necessity of deductive reconstruction, as with the steam engine. In such a case the gain lies in communication with the past.

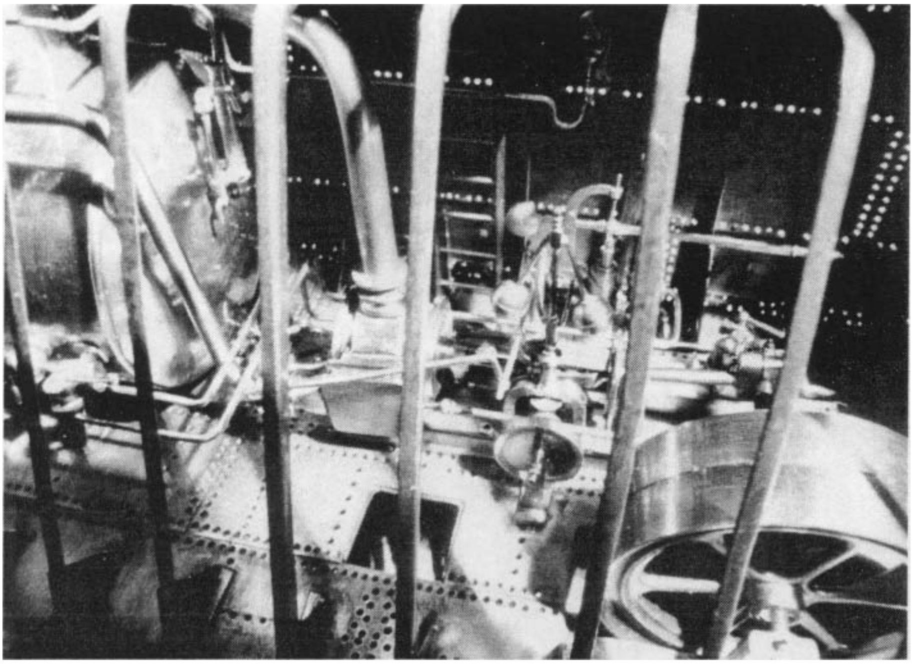

Figure 14: Detail of the steam engine in place again. Note the manometer above against the back wall.

Source: See figure 1.

Another issue was the addition of missing parts, which evidently allowed important interpretation factors to creep in. Of the funnel, capstan or sluice winches, no original examples had survived, not even a past photograph of the model, so that their reconstruction could only be based on the construction drawings of the real dock. How the model maker at the Royal Factory fashioned them in 1864 is unknown. The careful documentation of the restoration process guarantees the reversibility of these additions, and thus the historical integrity of the object. But those who have read this article or who have witnessed the restoration will always feel slightly discomforted when regarding the funnel or the capstan: they are not "real," but are 1994 reconstructions. In this sense the "material authenticity" of the model has been affected, as it has in the use of modem soldering techniques as well.

Of course, the possibility of leaving the "gaps" in the model just as they were was also considered, but once the model had been cleaned and stood, incomplete, on the table, completion seemed logical. The damages and omissions were in such glaring contrast to the gleaming perfection of the polished brass that integral visual restoration seemed desirable. Another choice offered, though, was the materials in which these additions were to be executed. It was decided to blend the additions into the model, using the same materials (brass and wood), for it was felt that the choice of contrasting materials would put too great an emphasis on the restoration and would obstruct rather than promote the recovery of the visual image.

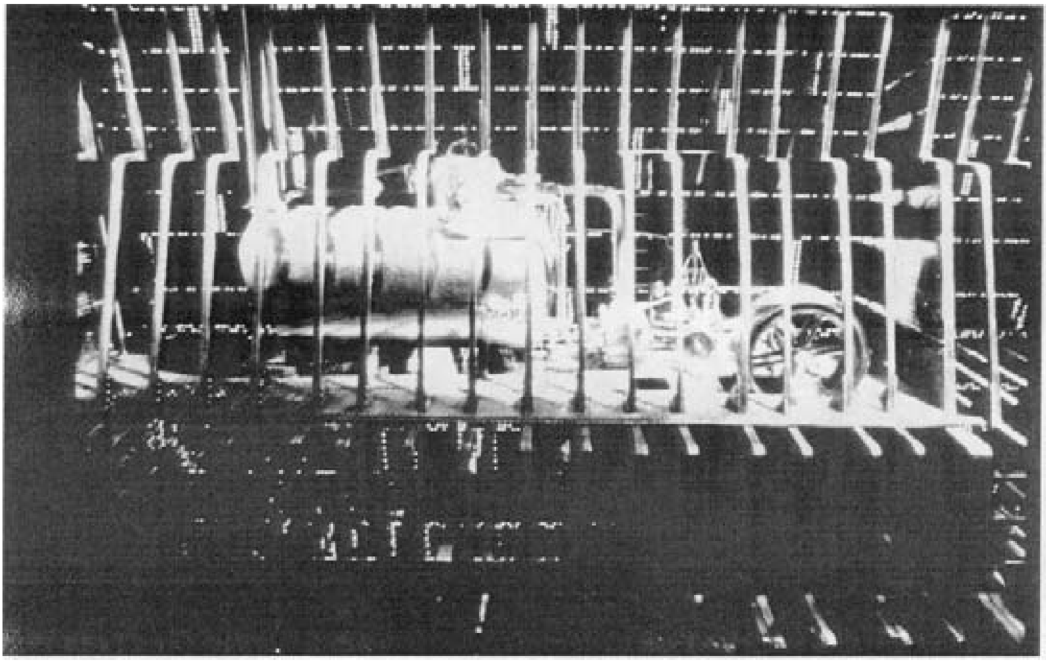

Figure 15: The steam engine and boiler back in place.

Source: See figure 1.

My own appreciation of the model, my subjective experiencing of its authenticity, has become somewhat upset. I had known the model for years in its battered and extremely squalid state, and sympathetically I had always taken its dilapidated condition for granted. Restoration meant detachment from, and in a way renunciation of, the object as I had known it. But with hindsight I realize that my nostalgia for this battered object has replaced the desire to restore it, which 1 felt when it was still in its miserable condition.

With the restored object I have meanwhile entered into a new relationship through handling it in exhibition circumstances and during photo sessions. Which condition I now regard as the most authentic has become somewhat vague for, to be honest, it was never intended without a funnel. It has thus been restored as much as possible to its conceptual authenticity. We can trust that the historical image has been repaired in a way, and we may even hope that the restoration has yielded historical information through the reconstruction of the steam engine. But most important is that the glamour of which the model had been deprived has been given back to it, restoring it to its very first function: to shine at some exhibition.

Conclusion

In spite of its new dock the establishment at Onrust was gradually surpassed by the naval base at Surabaja, which in conception was more capacious, and which from the start was equipped to repair iron steamers and to construct and recondition steam engines.

Nevertheless, for the time being Onrust remained the centre of docking activities. Although at first it was also intended that merchantmen could use its services, in practice nothing much seems to have come of this: in 1871 the merchant navy's need for a dock was as great as in 1862.61

The Atjeh War (1873-1904) intensified naval activities in the East Indies, a fact that compelled the Navy in 1876 to procure a second iron dock. This was also built by the Royal Factory in Amsterdam and put into service at Onrust.[62] Construction and passage to the East occurred in much the same way as the first dock. One size bigger than the 1864 dock, it was delivered promptly: in October 1880 the ironclad *Koning der Nederlanden* was successfully serviced in it. The Navy Model Collection has a similar but bigger model of this dock, which was exhibited at the World's Fair in Paris in 1878. (figure 16) But that is another story.

In 1879 the merchant navy got its own dock in Batavia.[63] In 1888 the naval base in Onrust was closed and the 1876 dock was moved to Surabaja together with the equipment and stores of the Navy depots of Batavia. The smaller dock was disposed of, but continued to function far into the twentieth century for a private firm in the East Indies.64

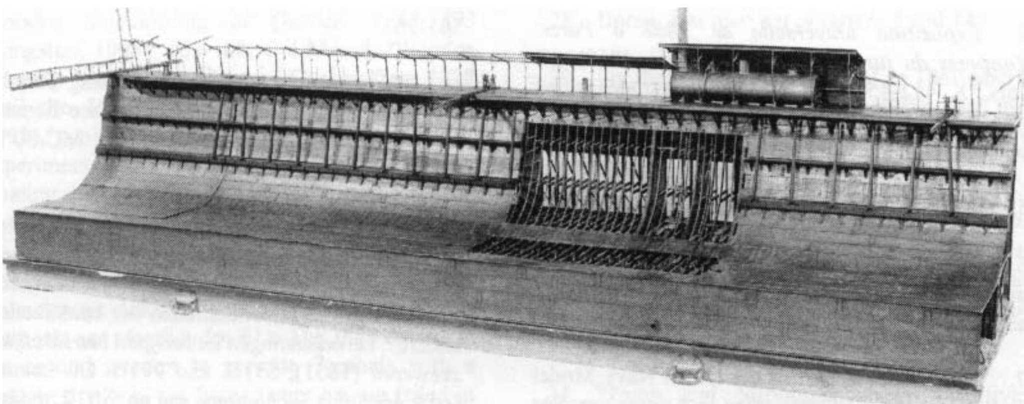

Figure 16: Model of the 1876 floating drydock of Onrust, as yet unrestored.

Source: See figure 1.

NOTES

1. *Catalogue officiel de l'exposition universelle* (Paris, 1867), 1089. The Dutch Navy Model Collection, comprising about 1600 scale models and other objects, was transferred by the Dutch Navy to the Rijksmuseum in Amsterdam in 1883-1889; recently a complete catalogue has been published on CD-ROM, See A. Lemmers (ed.), *Maritime Technology in the Rijksmuseum Amsterdam: Multimedia Catalogue of the Dutch Navy Model Collection, 1698-1889* (Lisse, 1995).

2. E. Pâris, *L 'art naval à l'Exposition Universelle de Paris en 1867 augmenté des derniers perfectionnements et inventions maritimes jusqu 'en 1869* (Paris, [1869]), 2 vols., I, 370-371; for an evaluation of level, criticism and self-vision of Dutch participation in nineteenth-century World's Fairs, see H. Baudet, "De dadels van Hassan en de start der Nederlandse industrialiteit," in *Bedrijf en samenle-ving. Economisch-historische studies over Nederland in de negentiende en twintigste eeuw, aangeboden aan Prof. dr. I.J. Brugmans bij zijn aftreden als hoogleraar aan de Universiteit van Amsterdam* (Alphen-aan-den-Rijn, 1967).

3. Among other things the Dutch Navy also exhibited models of East Indian vessels, floating batteries and screw steamers. On Admiral Paris' interests, see E. Paris, *Essaie sur la construction naval des peuples extra-européens, ou la collection des navires et pirogues* (Paris, 1841-1843); Paris, *Traité de l'hélice propulsive* (1855); Eric Rieth (ed.), *Le voyage de la Favorite, 1830-1832* (Paris, 1992).

4. *Exposition universelle de 1867 à Paris. Rapports du jury international* (Paris, 1868), 13 vols., X, 412-450. The only Dutchmen mentioned was Smit from Kinderdijk, in the merchant navy section, 375.

5. *Rapports du jury,* X, 359-371.

6. *Catalogue officiel,* 1089. "On remarquait un modèle d'un dock en fer," is all that Pâris wrote about it; see Paris, *L'art naval,* I, 370-371.

7. The model is part of the Dutch Navy Model Collection of the Rijksmuseum in Amsterdam. See Lemmers (ed.), *Maritime Technology,* cat. no. 1187-1.

8. A.E. Tromp and J. Strootman, "IJzeren drijvend droogdok voor de dienst der Marine in Oost-Indië," *Verhandelingen van het Koninklijk Instituut van Ingenieurs (1865-1866),* 10-18.

9. G. Fabius, quoted in F.C. Van Oosten, *Schepen onder stoom. De geboorte van het stoomschip* (Bussum, 1972), 80. This is confirmed by Navy data from the era before the wooden floating docks; after a number of years' service in the East Indies, all the early paddle steamers - such as *Phoenix* in 1844-1848, *Hekla II* in 1845-1847, *Bromo 1* in 1848-1849 and *Merapi I* in 1848-1849 - returned to the Netherlands to be overhauled.

10. Iron is far more susceptible to fouling than the copper-sheathed skin of a wooden ship. For that reason, the firm Cores de Vries in later years returned to wooden ships. Steamers cannot be careened unless the engines are removed; screw repairs also required docks. The quote is from *Rapports du jury,* X, 358.

11. J.W.L. Van Oordt, "Over de zamenstelling der drijvende drooge dokken," *Verhandelingen van het Koninklijk Instituut van Ingenieurs (1849),* II, 15-36, refers to some forerunners; in the *Register op de werken van het KIVI* (The Hague, 1875), a reference is made to Wild's "Patent Iron Repair Docks" from 1851-1852; unfortunately, I have as yet been unable to verify this reference.

12. The Cores de Vries dock was designed by R.W. Thomson; *Register 1875.* Randolph, Elder and Co. and Rennie and Sons also exhibited models of their docks in Paris in 1867; see *Rapports du jury,* X, 361-363.

13. There are two models of careening wharfs in the Dutch Navy Model Collection; see Lemmers (ed.), *Maritime Technology,* cat. nos. MC 30 and MC 1091.

14. A.E. Tromp, "Aanleg en gemaakte veranderingen aan het dok der Marine te Vlissingen en de daar voor liggende grote zeesluis, met vermelding van belangrijke bijzonderheden der constructie en andere," *Verhandelingen en berigten betrekkelijk het zeewezen* (1851), 531 ff. and 791 ff. Cf. Lemmers (ed.), *Maritime Technology,* cat. no. MC 2, model of the drydock at Flushing.

15. The first drydock to be operated by pumps was the dock at Toulon, constructed after a design of the French engineer Groignard; see Lemmers (ed.), *Maritime Technology,* cat. no. MC 4. The Dutch Navy docks at Hellevoetsluis (1802) and Willemsoord (1825) were powered by steam-engines by Watt; see R. Haubourdin, et al., *De Physique Existentie deezes Lands. Jan Blanken Inspecteur Generaal van de Waterstaat (1755-1838)* (Amsterdam, 1987).

16. D.I. Wolfson, "Over de maritieme werken te Soerabaia," *Verhandelingen van het Koninklijk Instituut van Ingenieurs* (1853-1854), 58-65.

17. The Dutch example was followed, for example, in Venice and in Russia.

18. S.P. L'Honoré Naber, *Het !even van een vloothouder. Gedenkschriften van M.H. Jansen (1817-1893)* (Utrecht, 1925), 61. The reference to Obreen concerns the 1858 catalogue of the Dutch Navy Model Collection; see J.M. Obreen, *Catalogus der verzameling modellen van het Departement van Marine* (The Hague, 1858).

19. Lemmers (ed.), *Maritime Technology,* cat. no. MC 6, French model of a wooden floating drydock, 1787.

20. Van Oordt, "Over de zamenstelling der drijvende drooge dokken," refers to Le Compte's description of the Amsterdam floating drydock and to J. Swart's translation of a treatise of a Mr. Wood, member of the commission of Maritime Affairs of the US, about drydocks, in which John S. Gilbert's floating drydock scored highest. In Québec, floating docks had been operative since 1827; see Eileen Reid Marcil, *The Charley-Man: A History of Wooden Shipbuilding at Quebec, 1763-1893* (Kingston, 1995), 163-168; and Marcil, "Wooden Floating Docks in the Port of Quebec from 1827 until the 1930s," *Mariners' Mirror* (November 1995), vol. 81, 448-456. Since the 1830s, experiments had been carried out in the US with floating docks and other means of lifting ships out of the water; see *Rapports du jury,* X, 360-361.

21. Van Oordt, "Over de zamenstelling der drijvende drooge dokken;" and L'Honoré Naber, *Het leven van een vloothouder,* 61n. The 1849 dock was the second attempt to provide Surabaja with a floating drydock, the first attempt having failed in 1841. The first vessel to be serviced in the 1849 dock was the screw-steamer *Samarang;* see Van Oosten, *Schepen onder stoom,* 79-80.

22. Van Oosten, *Schepen onder stoom,* 74-75; J.L. Meyer, "De geschiedenis van het eiland Onrust inde periode 1818-1907," in *Symposium Onrust* (Amsterdam, 1990), 14-16.

23. P.A. Bloys van Treslong, "Stoomvaart en het kielen van het eerste stoomschip in Neérlands Indië," *Tijdschrift toegewijd aan het zeewezen,* 2de reeks, IV (1844), 243-256, During careening of the paddle steamer *Phoenix* in 1842, Bloys van Treslong lost three crew members to the dreaded "marsh fevers" of Onrust. As a coral island, Onrust does not have any marshes; the bad air was supposed to be blown from the mainland. Asiatics seemed to be immune to this malady, which is why it was also attributed to the inadequate hygiene of Europeans.

24. Meyer, "De geschiedenis," 14.

25. *De Indische verlofganger,* 23 April 1926; E.H. Boom, *lets over het plaatsen van een drijvend dok in de nabijheid van Batavia* (Utrecht, 1871); S. Scholtus, "Kort overzicht van de geschiedenis van Onrust, 1618-1981," in *Symposium Onrust,* 79-80.

26. The following section is based mainly on Meyer, "De geschiedenis." See also Van Oosten, *Schepen onder stoom,* 79.

27. In 1848 there apparently already were plans to resume work on the graving dock. In that year the compound steam engine of the former steam vessel *Hekla* (built by G.M. Roentgen in 1838 and later called *Banda)* was destined for the drydock. See Van Oosten, *Schepen onder stoom,* 73.

28. Boom, *lets over het plaatsen, 5* and 14.

29. For these data a photocopy of an 1860 plan for naval strength from the Naval Archives was used. The photocopy unfortunately has no reference number.

30. Data derived from A.J. Vermeulen, *De schepen van de Koninklijke Marine en die der gouverne* (The Hague, 1962); and G.J.A. Raven (ed.), *De kroon op het anker* (Amsterdam, 1988).

31. Tromp and Strootman, "IJzeren drijvend droogdok," I In. In 1880 Bruno Johannes Tideman, *Memoriaal van de Marine, bevattende opgaven betrekkelijk de afmetingen, constructie... van Nederlandsche oorlogsschepen en omtrent enige havens, dokken, sluizen, werven enz* (Amsterdam, 1876-1880), 151 ff, suggested raising and repairing Cores de Vries dock.

32. In his notes on the model of the dock for Onrust in the Rijksmuseum, MC 1187-1, J.M. Dirkzwager mentions General State Archives, (GSA), Ministry of Colonial Affairs, Index 1862, 1183, referring to 24/03/1862 N22, which proves that in 1862 the Navy had no information about the Cores de Vries dock.

33. Tromp and Strootman, "IJzeren drijvend droogdok," 11.

34. M.G. de Boer, *Honderdjaar machine-industrie op Oostenburg (Gedenkboek Werkspoor)* (Amsterdam, 1927), 48-49.

35. *Ibid.,* 51-58; and van Oosten, *Schepen onder stoom,* 78-79.

36. Notes of J.M. Dirkzwager, mentioning GSA Ministry of Colonial Affairs, Index 1862, p. 1188c, referring to 10/05/1862 N81, concerning a letter from Paul C. van Vlissingen and Dudok van Heel received on 26 February 1862.

37. *Ibid.;* and Tromp and Strootman, "IJzeren drijvend droogdok."

38. Notes of J.M. Dirkzwager, mentioning GSA Ministry of Colonial Affairs, Index 1862, p. 1188c, referring to 26/04/1862 N45.

39. *Ibid.,* mentioning GSA Ministry of Colonial Affairs, 1254, instruction of 16/10/1862.

40. J. Strootman, "Over de verschillende middelen om het ingedompelde deel van schepen na te zien," *Uitreksels uit vreemde tijdschrijten* (1863-1864), 8-25.

41. See note 32. Neither Randolph, Elder and Co. nor Rennie and Sons exhibited their models until 1867 in Paris, when the former showed the model of the Saigon dock and one of a dock for Callao, but no model of the Cores de Vries dock was mentioned; *Rapports du jury,* X, 362-363.

42. Tromp and Strootman, "IJzeren drijvend droogdok," 11.

43. De Boer, *Honderdjaar machine-industrie,* 48.

44. *Ibid.,* 59-60.

45. Tromp and Strootman, "IJzeren drijvend droogdok," 18.

46. *Ibid., 11.*

47. *Ibid.*

48. For Gwynne's pumps, also see *Notulen van de Vergadering van het Koninklijk Instituut van Ingenieurs* (1857-1858), 67 (10 Nov. 1857) and 143 (15 April 1858), in which Overduyn makes observations about Gwynne's plans to use his pumps for ship's propulsion.

49. Tromp and Strootman, "IJzeren drijvend droogdok," 11-12n. The sheet-iron was purchased from the Société anonyme...de Marcinelle et Couillet, and its quality was highly satisfactory; the cast-ironwork was made partly in Britain and partly by the Royal Factory.

50. *Ibid.,* 13.

51. There is an account of this visit in the *Notulen van de Vergadering van het Koninklijk Instituut van Ingenieurs* (1863-1864), 267; see also Tromp and Strootman, "IJzeren drijvend droogdok," 18. Both Tromp and Strootman, as well as Scheffer when he was still alive, were co-founders of the Royal Society of Engineers; see *Register op de werken van het Koninklijk Instituut van Ingenieurs 1847-1869* (The Hague, 1875).

52. Liesbeth Crommelin and H. van Suchtelen, *Nederlandse vuurtorens. Bouw en organisatie* (Nieuwkoop, 1978).

53. Tromp and Strootman, "IJzeren drijvend droogdok," 16.

54. *Ibid.,* 17. The total expenditure was somewhat higher due to extras not included in the contract and costs of transport and administration.

55. GSA, Ministry of Naval Affairs, 1813-1940, 4009 (Gen. Index 1865). In February 1865 Colonial Affairs had already intimated its wish to deposit the model in the Navy Model Collection; only in November-December did the Royal Factory announce completion of the model. The exact ratio of ownership of the actual dock between Colonial Affairs and Naval Affairs is not clear. According to the archives. Tromp and Strootman's journey to England was paid for by Colonial Affairs.

56. GSA, Ministry of Naval Affairs, 1813-1940, 4018 (Gen. Index 1868).

57. See *Rapports du jury,* X, 359-371, for a general evaluation of drydock technology in 1868.

58. GSA, Ministry of Naval Affairs 1813-1940, 4018 (Gen. Index 1868).

59. See David Lowenthal, *The Past is a Foreign Country* (Cambridge, 1985).

60. Nicole Ex, *Zo goed als oud. De achterkant van het restaureren* (Amsterdam, 1993).

61. Boom, *lets over het plaatsen,* 5-6.

62. Meyer, "De geschiedenis," 16. The Royal Factory in the interim had changed hands and was now called the "Royal Factory of J. van der Made."

63. Tideman, *Memoriaal van de Marine,* 151ff.

64. Meyer, "De geschiedenis," 1990; and J.L. Meijer, oral communication. In the 1880s Bruno Johannes Tideman designed another floating dock for the East Indies, built in the UK and which sailed to the East Indies under its own steam. The 3000-ton dock was actually moved to Surabaja in 1885, the 5000-ton dock in 1887. The 3000-ton dock was disposed of in 1891, when it was transferred to Tandjong Priok (Batavia harbour); in 1898 it went to Sabang harbour at the north-western tip of the island Sumatra, where it was used in private shipping until well into the twentieth century.