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EARLY FRENCH HYDROGRAPHIC SURVEYS IN THE SAINT LAWRENCE RIVER

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The French role in establishing scientific cartography and improving navigation has been slow to gain recognition in the English-speaking world [1]. The unfavourable climate of historical opinion towards the French is well illustrated with respect to the St. Lawrence River where scientific surveys of its waters are sometimes thought to have begun only in 1759 with the arrival of the hydrographers of the British navy [2]. Accompanying this idea, or even giving rise to it, is the commonly held view that after 150 years of occupation of its shores, the French had acquired only the crudest knowledge of the river's navigation which they believed to be so dangerous as to deter their enemies from ever attempting to invade Quebec [3]. The presence of James Cook among the British masters and pilots in 1759, and the fact that his chart of the St. Lawrence River represents his first major hydrographic work has reinforced these general opinions. But Cook's development as the greatest marine surveyor of his own and later times, and his enshrinement in the pantheon of explorers is not the major reason for ignorance about his precursors in the St. Lawrence.

Three sources from 1759 have led to acceptance of a myth concerning the incompetence and ignorance of Canadian pilots. The first is John Knox's account of Thomas Killick, master of the transport *Goodwill*, in the rear of the British fleet [4]. Knox's doubtful assertion that French pilots were placed on board all the transports in the fleet suggests that the men in question were fishermen or common seamen for it is certain that there were insufficient numbers of experienced Canadian masters and pilots to place on all the British ships, and skilled Canadian pilots served in the major warships of the British van. The second source is the Marquis de Montcalm's journal and correspondence which contain several complaints that Canadian pilots were incompetent liars and boasters [5]. Montcalm's complaints are difficult to assess because of his tense relations with Cana-

dians from the governor-general down. The pilots and masters of Canada were also convenient targets for his own indecision, anger and frustration, and painful reminders to some that their advice concerning the maritime defence of Canada had been ignored. The final source is a letter written by the governor and intendant nearly seven weeks after the fall of Quebec when colonial authorities were searching for scapegoats to blame for the defeat. Several statements, for example, one that the French were unable to navigate ships of more than 100 tons burden through the Traverse, are false, and charges of incompetence leveled at pilots must be salted to one's own taste [6]. Combined with James Cook's later fame and the accomplishment of safely guiding the English fleet up several hundred miles of the river, the sources of 1759 ensured that knowledge of earlier French marine surveyors and Canadian pilots became lost.

The St. Lawrence River was well-known to the French. Its shores had long been charted, its waters sounded, and aids to navigation past its greatest dangers installed. The development of navigation in New France had two aims : the training of a group of colonial pilots and hydrographic surveying. Soon after Louis XIV assumed royal control of the colony in 1663, an effort began to produce a group of colonial masters and pilots. Until 1706 this instruction was provided by laymen: Martin Boutet, Jean-Baptiste-Louis Franquelin, Jean Deshayes and Louis Jolliet [7]. Jesuit priests gave instruction in hydrography during the intervals between the appointments of these men, and several times asked to be officially commissioned as teachers of navigation and pilotage. But only after assurances had been given to the naval minister that a young man, someone other than an elderly retired missionary, would be given the responsibility, did Jesuits obtain the appointment and during the remainder of the Old Regime in Canada theoretical navigation was taught in the Jesuit College at Quebec.

The same persons who taught navigation during the seventeenth century were also expected to carry out surveys of the St. Lawrence River, but their different skills, demands upon their time, and multiple interests were obstacles to achieving rapid success in the two distinct tasks of teaching and charting. Nevertheless a survey by one of these early hydrographers gave rise to the first published chart of the St. Lawrence River; it was so far in advance of the marine charts of its own time that it was a genuine precursor of the modern hydrographic chart. Fortunately, a manuscript copy of the report that accompanied the original survey has survived in the archives of the Seminary of Quebec, at Laval University [8]. Its contents reveal a wealth of information about the procedures that were followed and demonstrate that the St. Lawrence River came within the purview of French activity which was changing both astronomy and cartography from arts to sciences.

The author of the first printed chart of the St. Lawrence, Jean Deshayes, had long been active in French science before coming to Canada in 1685. Seventeen years earlier he had been asked by Jean-Baptiste Colbert to test a new method for calculating longitude that had been offered for sale by a foreign scholar, and the following year he presented his own "ingenious but complicated" system for computing longitude based upon the

measurement of lunar distances from the sun. Deshayes' system was rejected owing to the complexity of the required calculations, but in 1670 after making an unknown " large instrument ", he was sent to Acadia to test his system enroute [9]. Deshayes' experimental work was carried out on behalf of the Royal Academy of Sciences and after returning to France in 1671 he seems to have continued to work on navigational and surveying problems. Ten years later he published a work on the proportional compass [10].

By 1681, Deshayes was " Engineer to His Majesty for Hydrography ", and the same year was chosen along with two others to sail on an extended expedition to the Island of Gorée off Cape Verde, Africa, and to Martinique and Guadeloupe in the West Indies to determine longitudinal positions [11]. The expedition was carried out between March 1682 and March 1683. The most important information carried back to France did not concern the determined longitudes, but the behaviour of the pendulum clocks used to keep mean or local time during the expedition [12]. The need to shorten the pendulums of the clocks confirmed observations that earlier had been dismissed, and the effect was discussed by Newton who concluded that the shortened pendulums were necessary because of the bulging of the earth at the equator and the consequent diminished gravitational attraction [13].

Some time during the winter of 1684-1685 the Secretary of State for the Navy, the Marquis de Seignelay, selected Deshayes to undertake a scientific voyage to New France to make astronomical observations and to construct a hydrographic chart of the St. Lawrence River. Accompanied by instructions to the intendant and the new governor of the colony to assist him in every way, and armed with a commission as Royal Hydrographer, Jean Deshayes arrived at Quebec in August, 1685 [14]. Although he was in poor health owing to the recent sea voyage he accompanied Governor Denonville on a long voyage up the St. Lawrence to Lake Ontario, a distance of over 350 miles. In addition to tracing the course of the river and marking on his chart all of the inhabited locations, Deshayes made frequent landings in order to observe latitudes [15]. Hampered by illness so serious that the governor thought he was going to die, rushed for time owing to the governor's desire to reach Lake Ontario, and unable to establish stations for angles, Deshayes nevertheless obtained ten latitudes during the journey by sighting on the Pole star with a quadrant. Owing to this crude procedure he was only able to determine latitudes to the nearest five minutes at most stations, and at Fort Cataraqui on Lake Ontario he was reduced to reporting three observations owing to high winds. Although he distrusted these observations he was probably unaware that his reported locations were 5 to 25 minutes too far north [16].

Back at Quebec in October Deshayes began to prepare for his survey of the St. Lawrence. After observing an eclipse of the moon on December 11 he calculated the longitude between Paris and Quebec to be 4 hours, 48 minutes, 52 seconds, or 72°13', and between Quebec and La Rochelle, to be 4 hours, 35 minutes, or 68°41'. Again the values are too high, but the constant error of 1°23' probably was due to the instrument [17].

During the winter Deshayes discussed the problem of charting the St. Lawrence with Louis Jolliet, one of the greatest Canadian explorers and

mapmakers, who advised that the hydrographer be supplied with a bark (*) provisioned for 5 or 6 months, its boat, a canoe, and 7 crew members. Deshayes also established base lines for his later survey, and laid down the initial triangles with which he planned to cover the river. Finally, in May 1686, he departed and for the next six months remained at work on the St. Lawrence, alone except for his crew. His survey was incomplete when he sailed to France in November and plans were made for him to return the next year, but nothing of the sort occurred and Deshayes did not come back to Canada until 1702 when he took up the post of Professor of Hydrography at Quebec.

Deshayes' report of work carried out during the summer of 1686 was intended to accompany his fair-copy chart of the river, but its additional purpose was to aid teachers of hydrography and pilots in the colony to construct marine charts. His notes were a natural outgrowth of his Canadian survey and his previous experience on behalf of the Royal Academy of Sciences. Prefaced by a brief introduction, the report is divided into two main parts ; the first on the survey, and the second on drawing the fair-copy chart. The sailing directions are chiefly in the section on soundings, and " the rest ", he wrote, " is only to render witness to the fidelity of the measurements of this chart ". It is in " the rest ", which concerns linear measurement, angles, latitudes, azimuths and instrument corrections that the chief value of the report lies.

Jean Deshayes was neither a pilot nor master navigator ; he was a mathematician and surveyor. Unlike the former he was completely at home with the plane-table, indeed, the same year that he arrived in Canada, he reissued his book on the proportional compass and published a new work on surveying [18]. In addition, he was expert in the use of small telescopes and employed one of the most advanced surveying instruments of the times — a plane-table equipped with fixed and moveable telescopes. It was through employment of telescope-equipped instruments such as this that the French came to dominate topographical surveying and scientific cartography.

Under normal circumstances he would have charted the coast before returning to take soundings in order to locate them more accurately on his chart, but pressed for time the order that he followed was " more forced than natural and deliberate ". He alternated investigation of the waters of the river with trigonometrical operations on shore. Depending upon the importance of the place, he sometimes sounded while having in hand only a rough sketch of the shore, and at other times he continued sketching the shoreline for a considerable distance returning later to sound shoals, ledges and banks.

Charting the shoreline was Deshayes' first major task, and it is startling to learn that almost alone he constructed a series of 300 triangles along the north shore of the St. Lawrence from Quebec to Sept Isles, a distance of 350 miles. His first baseline of 1,560 *toises* had been laid out over the ice between "la pointe des roches " at Quebec and the second knoll

(*) *Editor's note.* — This vessel was most likely a schooner rigged two-masted vessel.

or " butte " of Point Lévis. Although the *toise* like every other unit of French measurement varied, Deshayes used the recently established royal *toise* of 6 *pieds*. (The *pied* of 12 *pouces* was equal to 12.789 English inches) [19]. A second base line of 608 *toises* was laid across the width of the river to the same point on the Quebec side, and a final line of 6 805 *toises* — nearly eight and one-quarter miles — was measured along the north shore opposite Isle aux Lièvres. During the spring several more secondary lines were laid down.

These base and secondary lines were the least accurate of Deshayes' measurements for he had only a *demi-pied de Roi* — a six-inch rule — with which to make a *toise,* which he used to measure a ten-*toise* length of line impregnated with beeswax. Although affected by heat and cold the waxed line was less subject to changes in humidity than ordinary line. Aware that linear measurements were useful only over small distances, Deshayes corrected for the error by using observed latitudes to shift the small sketches of various areas into their relative positions on his fair-copy chart.

Observed angles were extremely important but difficult to establish in the uninhabited region of the lower St. Lawrence where few convenient objects existed on which to take bearings. The great width of the river made accurate definition of objects on the opposite shore impossible and Deshayes had to sight on distant mountain summits in order to obtain guides to further stations. The possible error was very great, for although the hydrographer established stations and turned angles on all the headlands along the north shore, the mountains to the south were necessary to tie the stations together. The summits were irregular and the same point on any summit was not observed from any two stations. Deshayes replied to any criticism that he ought to have used his anchored bark as an intermediate turning point by pointing out that the vessel would neither hold the bottom securely nor remain steady even when moored with two or three anchors.

Much of the shoreline had to be located by compass bearings which introduced additional errors owing to magnetic declination, but Deshayes tried to correct these by incorporating spherical observations. Nevertheless, triangulation was impossible along the south shore in the Gaspé region, and the coast from Rivière de la Madeleine to Ile Percé was constructed from latitudes and azimuths. Deshayes' constant concern over errors and attempts to correct them reveals the pioneering nature of his venture. One is impressed not that Deshayes produced the first accurate chart of the St. Lawrence River, but that despite the errors his chart was such a model of scientific accuracy.

Difficulties also appeared when Deshayes began to sketch the shoreline. The first sketches were done during the winter when Deshayes made several long journeys along the south shore of the river as far as Rivière Ouelle, some 70 miles downstream from Quebec. He also travelled the north shore to Cap Tourmente and paced around Ile d'Orléans sketching the shoreline and orienting his sketches with a box-compass. He also kept a record of every 100 and 1 000 paces in order to provide an additional check on his estimated distances. In this manner, he was able to reduce the many small-scale sketches made on his journeys to a single scale on his fair-copy chart.

Deshayes had obviously recovered his health for he made these long winter journeys on snowshoes !

During the summer, when the many streams and rivers flowing into the St. Lawrence make walking almost impossible, Deshayes sketched from offshore. At first he employed the ship's boat for in-shore work, but soon switched to the canoe which was easier to beach when sudden squalls appeared and less likely to be swamped when running into a windward shore where no beach afforded a landing. Seated in the canoe, Deshayes rapidly sketched the shoreline as he passed, and constantly oriented his work with the box-compass that he kept ready at hand. He soon found himself able to estimate distances travelled by canoe with considerable accuracy, but he continued periodically to go ashore and pace off distances to check his estimates, particularly where sand bars, ledges, rocks and other obstructions to navigation were prominent.

Taking soundings gave rise to problems of a different order. Owing to lack of trust he remained with his crew while they sounded between Quebec and Les Escoumins below the mouth of the Saguenay, but afterwards he hurried downstream to advance the sketching, and ordered his crew to follow and sound waters. This was not a reliable procedure and on several occasions he had to return to assigned areas and repeat the soundings. The sailors often invented the figures they reported and, in at least one case when the size and intricacy of the Manicouagan Shoal intimidated them, they sailed beyond to Rivière Godebout to await the hydrographer. Lack of trust and events like this one eventually led Deshayes to indicate soundings taken by the crew in Roman numerals in order to distinguish them from his own. Deshayes took many soundings during the survey, but his chart shows only those that distinguish some dangerous area of the river bed, the contours of a sand bank, the point of a shoal or the middle of a channel.

As had been the case during his voyage to Lake Ontario latitudes were based on observations of the Pole star by which he located each of the camps set up during the survey. As before, the wind proved troublesome but after making a small tent from the boat's sail and observing the stars through an aperture in the top this difficulty disappeared. Deshayes reported 21 latitudes below Quebec. When compared with today's values for the same places his observations are between one and five minutes of arc too high.

Seventy years later Father Joseph Bonnecamps, S.J., the last Professor of Hydrography at Quebec, blamed Deshayes' instrument. Bonnecamps believed that Deshayes' reported latitude for Quebec of 46°55′ was too high ; " but ", he added,

> " if you had, as I do, the instrument that he used, your surprize would soon cease. It is a plane-table (*planchette de bois*) 8-2/3 inches in diameter and fitted with a copper edge divided into 360 degrees each of which is at least 5/6 [of a degree] out of line. Now, however experienced an observer might be, could he be responsible for 7′ or 8′ with such an instrument ? " [20].

Obtaining azimuths, or swinging an arc from the zenith to cut the north point of the horizon at right angles, was the most important and most

difficult of all of Jean Deshayes' tasks, for observed azimuths used in conjunction with star tables enabled him to determine longitude. Just before leaving Quebec in the spring Father Pierre Raffiex, S.J. asked Deshayes to trace a meridian line at Quebec so that in future the true magnetic declination could be calculated, and to provide an accurate base for measurement and division of the colony's lands. Assisted by the priest, Deshayes observed several positional angles from the belfry of the Jesuit chapel, sighting on " notable places " in the town. Then he spent two consecutive days observing the height of the sun from some of the same " notable places " where he also observed the rising and setting of the sun. When combined with the latitude observed in the garden of the Jesuits by Father Raffiex who used his own small quadrant (*quart de cercle*) these observations were used to establish Canada's first meridian from " Dupont's windmill " on Cape Diamond, through the center of the chapel belfry, to a mountain peak some twelve to fifteen leagues north of Quebec. " The observed azimuth ", Deshayes wrote, " is the foundation of the whole chart ". During the summer Deshayes observed azimuths at three additional locations but generally he determined compass variations by observations of the Pole star.

Most of Deshayes' instruments have been mentioned, simple and box-compasses, a simple circle, a quadrant and a plane-table. But Deshayes also employed a plane-table mounted with telescopes ; in 1686 it was one of the most advanced levels in existence. Deshayes' description follows.

> I had a plane table [*planchette de bois*] made by Buterfield (sic) only nine to ten inches in diameter on which was attached a brass arm divided into degrees [i.e. an alidade]. There were two telescopes for sighting, passing through the center [axis], the one mobile on the graduated side, the other fixed to the other side [21].

The level had no means to observe horizontal angles but Deshayes fitted his box-compass to the base of the instrument in the same alignment as the mobile telescope whenever he measured positional angles. Michael Butterfield who made the instrument was an Englishman who had gone to Paris as early as 1672 as a designer and mathematical instrument maker to Louis XIV. There he became known as one of the finest craftsmen of his day and in his large establishment he manufactured a wide range of mathematical and optical instruments [22].

When using the plane-table in conjunction with the box-compass Deshayes corrected for three errors ; the compass, the degree of index or alidade when the moveable agreed with the fixed, and the error of the elevations. He could not correct for the eccentricity of the central pivot. The telescope created special problems ; the first arose from the need to remove the lenses for cleaning and the difficulty of re-setting them in correct alignment ; and the second, from the lack of a tangent screw to center the telescope on any object under observation. Deshayes does not appear to have corrected for the error of refraction caused by the earth's atmosphere when observing stars below the zenith.

The ultimate object of Deshayes' labours, construction of the fair-copy chart was a separate task in which accurate determination of the

location of the mouth of the St. Lawrence was the most difficult. Owing to distance he could not extend his system of triangles from the north to the south shore and he was forced to estimate the distance from the north shore to Anticosti Island from the rate of speed of his bark, and to correct for drift. He repeated the procedure between Anticosti Island and the south shore, and related the whole area of the Gaspé peninsula to the north shore. All of this work forced unacceptable delays so that the preliminary copy of his chart, about five feet long, which he sent to the naval minister did not include either Anticosti Island or Ile Percé.

No copy of the chart accompanies Deshayes' report in the Quebec Seminary Archives, but one copy is in the Bibliothèque Nationale. It is titled : " Carte de la Rivière St. Laurens levée sur les lieux en 1686 ", and signed, " Deshayes " [23]. The north shore is well drawn with the shoals, reefs and anchorages carefully marked and accompanied by a continuous line of soundings from Tadoussac to Sept Isles. Evidence of a more detailed survey between Quebec and Tadoussac appears in two insets, one of the Traverse and the other of the mouth of the Saguenay River, for extensive soundings are recorded downstream from Ile d'Orléans and through the islands in the river. The whole area is the subject of sailing directions and advice to pilots.

Any comparison with other marine charts of the day leaves no doubt concerning its superiority. Deshayes' chart stands as a precursor of the modern hydrographic chart. Neatly set out on an equal angle projection, it shows only the area observed, including sailing directions, compass variations, both at Quebec and Anticosti Island, and tide tables giving the hours of high tide on the days of the full moon for 24 locations on the north shore.

Deshayes' chart did not remain in the naval archives. About fifteen years after he had returned to France his chart was published ; it was the first printed chart of the St. Lawrence River and one the finest examples of marine cartography of any area in the world outside Europe [24]. Several publication dates ranging from 1686 to 1715 have been suggested [25], but none are based on the following evidence. In April, 1699, Deshayes requested permission to publish his chart from the Secretary of State for the Navy, who in turn asked the Royal Academy of Sciences to assess its accuracy [26]. The Academy quickly gave the chart its imprimatur, and in June Deshayes received royal permission to engrave and publish his " marine chart " whenever he judged the time appropriate [27]. Sometime afterwards, most likely sooner than later, Deshayes' chart was published in Paris by Nicolas de Fer. The chart probably appeared before the end of 1702 when Deshayes was appointed Professor of Hydrography at Quebec with an annual stipend of 400 *livres* [28]. The published chart is also noteworthy for the very full sailing directions printed in the wide margins. They were chiefly the work of Pierre Lemoyne d'Iberville during the 1690's and their appearance filled a much-needed requirement for safer navigation in the St. Lawrence.

Jean Deshayes died at Quebec in 1706. It had been hoped that he would carry out surveys of the St. Lawrence during his residence in the colony but there is little evidence that he did so. He did not have the

up-to-date instruments that he had employed in 1686, and teaching and additional duties related to military engineering consumed much of his time [29]. In 1715, Deshayes' chart was re-issued and became a basic navigation tool of pilots and masters during the French regime in Canada and when, in 1757, the English map publisher, Thomas Jeffreys, published the first English chart of the Saint Lawrence, it was based upon Jean Deshayes' survey.

Growing naval and colonial interest in the St. Lawrence River was reflected in the reprinting of Deshayes' chart. During the recent war the navy had been more active in Canadian waters than before and lack of navigational aids became more apparent in official circles. The establishment of the first *Dépôt des cartes, plans et journaux* in Paris in 1720 reflected both a growing general concern for safe navigation and a new awareness in the navy of the scientific activities of the previous century. In Canada the new peace ended the physical threat to the colony and slowly improving economic conditions, which saw the development of trading concessions and seal fisheries along the Labrador coast and the erection of the fortress of Louisbourg, fostered hopes of participation in intercolonial trade and interest in navigational safety among Quebec merchants and colonial authorities. During the next decade elaborate plans were made to survey the waters of the St. Lawrence but little was actually accomplished.

One of the first naval charts appeared in 1714 when Sieur de Voutron, commanding the *Afriquain* made a quick running survey of the river from Ile d'Orléans to Kamouraska [30]. Voutron was unable to repeat his program the following year but in 1716 he drew a second chart of the river [31]. One of the officers who accompanied him placed the largest, most detailed proposal to survey the St. Lawrence before the Naval Council. The plan, which was approved by the Duc d'Orléans, called for a frigate and two smaller vessels to operate in the river for two years, but a shortage of ships and funds and the growing priority of Louisbourg led to its eventual cancellation [32]. In 1720 Voutron was still proposing that an expedition be sent to survey the waters of the St. Lawrence. By then he considered Deshayes' chart inaccurate and had nothing good to say concerning colonial pilotage [33]. Thirty-five years of Indian and colonial warfare, economic depression and inflation had taken its toll in Canada.

During 1723 another naval officer, Henri-François Desherbiers, Marquis de l'Etanduère, placed buoys in the river and the intendant sent off a lengthy account of the state of navigation in Canada [34]. Conditions had so deteriorated that the intendant initiated a small survey of the west shore of the Gulf of St. Lawrence and two years later recommended that a thorough program of hydrographic surveying be initiated in the St. Lawrence. The office of Port Captain (*capitaine de port*), which had been in the hands of a recently deceased Quebec merchant was to be given to a sea captain who was to carry out or supervise surveying the St. Lawrence [35]. The Secretary of State for the Navy quickly acted on these recommendations and in 1727 Richard Testu de la Richardière was given the naval rank of *capitaine de flûte,* appointed Port Captain of Quebec and placed in charge of Quebec's harbour and the navigation of the St. Lawrence [36]. The

urgency to initiate a new program of marine surveying was reinforced in 1729 when the naval transport, *Elephant,* was wrecked on the shoals off Cap Brûlé.

Beginning in 1730 and continuing for more than a decade, Testu de la Richardière, with the support of L'Etanduère who sailed to Quebec in 1730 and 1732, carried out the most detailed surveys of the St. Lawrence ever made. Each year one or two pilots from the warship that annually called at Quebec were left behind to acquire greater knowledge of the river by working over charts during the winter months and assisting La Richardière's marine surveys during the following summer. The charts that resulted from the initial surveys were never printed, but the presence of several copies in the British Museum and the French naval hydrographic collection indicate that numerous copies were made for use of French warships [37].

In 1735, La Richardière and a young pilot, Gabriel Pellegrin, surveyed the Strait of Belle Isle, which was known only to fishermen from St. Malo, and a year later they charted the islands in the Gulf of St. Lawrence. In 1737 the Port Captain took up the old idea of establishing navigation aids for ships entering the Traverse and aided by pilots, seamen and 10 Canadian woodsmen he cleared a strip, 100 feet wide and 1000 feet long, through Isle aux Ruaux. Two years later large wooden panels, 30 feet wide and 25 to 30 feet high, were erected on masonry foundations on Ile d'Orléans at two locations which were usually obscured in poor weather. These same two locations are indicated on James Cook's chart of the river. Surveying continued at the same time in the Gulf. Ile St. Jean [Prince Edward Island], Baie des Chaleurs and the Strait of Canso were all charted. By the time of La Richardière's death in October, 1741, the river was well known and its dangers to navigation well marked [38], and growing participation by Quebec merchants in French intercolonial trade during the 1730s had also increased the number of skilled masters and river pilots in the colony.

Had war and economic difficulties not followed Testu de La Richardière's death, the program of charting the river and improving the navigational safety of its waters might have continued, but no working appointment was made until years later. Of the last three Port Captains at Quebec, the first died at sea soon after his appointment, the second never appeared at Quebec at all, and the third, who was named in 1749, viewed his position as a sinecure [39]. A second port officer, Gabriel Pellegrin, was appointed in 1751, and it was he who continued La Richardière's tradition. Pellegrin had been one of the young naval pilots left in Canada during the 1730s and from 1735 onwards had worked on the river with La Richardière.

In 1755 he came to the attention of Admiral Dubois de la Motte who had escorted a large squadron of transports carrying troops to Quebec. Two of his ships, *Alcide* and *Lys,* were captured off Newfoundland, and with an enemy force awaiting his return to the Atlantic the admiral turned to Pellegrin to pilot the French naval force through the relatively unknown Strait of Belle Isle. Pellegrin was richly rewarded for his services, and while in France during the winter of 1755-1756 he constructed two charts of the full length of the St. Lawrence River and submitted a long critique

of charts recently printed by Nicolas Bellin — the first published charts to appear since Deshayes' [40]. During the next three years Pellegrin continued to work for the navy. In the spring he turned to Quebec along with the Marquis de Montcalm and his staff, and that fall he was given command of a newly built frigate and carried dispatches to France. Before leaving France he was appointed *capitaine de brulot* and after reaching Quebec he was named royal hydrographer. These rewards, promotions and appointments were bound to arouse the animosity of the Port Captain who was a Canadian noble and viewed his own post as a sinecure. The failure of the governor and intendant to obtain naval rank for the Port Captain increased the enmity between him and Pellegrin [41].

Within weeks of his return to Canada in 1757 Pellegrin met with Montcalm, who had formed a favourable impression of the navigator, and in October, accompanied by the senior artillery officer and Colonel Bougainville, inspected the north shore from Quebec to Cap Tourmente. There they discovered an emplacement for a battery of four cannon and two mortars safe from assault and so close to the navigation channel that enemy ships attempting the passage to Quebec could be brought under fire for nearly a quarter of an hour [42]. During the winter Pellegrin continued to develop defensive plans that are distinguished by their practicality and consideration of several contingencies. In the late fall of 1758, Colonel Bougainville carried several defensive plans of the river that could only have come from someone familiar with the St. Lawrence. Pellegrin is the most likely candidate, for Bougainville had no knowledge of the river himself and advised that any ships engaging the enemy ought to be run aground at locations indicated by Pellegrin. He also recommended that the colonial authorities be ordered to consult Pellegrin on all matters affecting the river in defence of Canada [43], but nothing was ever done about this or any other downstream defensive recommendation.

At the same time as Bougainville was reporting to the court, Montcalm endorsed and sent a report on defence proposals drawn up by Pellegrin to Governor Vaudreuil [44]. Although the colonial authorities were instructed by the naval minister to employ Pellegrin, the latter's advice and services were ignored [45]. In April Montcalm complained to the war minister that in addition to his own letters those of the engineer, Pontleroy, and Pellegrin continued to be ignored ; a month later, after learning that British ships were in the St. Lawrence, Pellegrin was not even called to the council of war when it was proposed to sink ten of the largest ships in the colony in the Traverse. This decision was based on ignorance but if implemented would have profited the owners whose vessels were chosen as block ships. The absent Pellegrin was busy taking up marker buoys in the Traverse and substituting false aids to navigation. On his return to Quebec on May 26 he argued that it was impossible to block the Traverse, and six days later the French abandoned any idea of struggle in the St. Lawrence when they sent all but a few provision ships and frigates 50 miles above Quebec to Batiscan. Pellegrin spent the early part of June sounding the waters off the Beauport beaches to determine how close enemy warships could sail to shell the shore, but thereafter his offers of service were rejected [46].

Gabriel Pellegrin had more accurate knowledge of the St. Lawrence

River than anyone in Canada, but he was the victim of his own probity and zeal, the jealousy of his immediate superior and perhaps the vested maritime interests of influential persons close to the governor and intendant. At the end of June, the anonymous author of the " Journal of the Siege of Quebec " expressed his concern :

> I cannot in truth understand why Mr. Pellegrin is not employed ; one hundred and one times he has offered his services and his knowledge. It appears that they absolutely do not want either. He is a perfectly upright man. If I dared, I would say that it is this quality which prevents him from having any employment. In addition I think that there are persons very near the "Cabinet" whence orders that are very pernicious to the good of the state are mainly issued, which means that very often in the councils the false is adopted for the true [47].

Pellegrin's Canadian career draws attention to the most underrated factor in the British conquest of Canada, the unopposed arrival of the British fleet before Quebec, and casts a small but significant side-light on the complex internecine struggles accented by bitterness and envy that occurred during the last years of the French regime in Canada.

Although it is now clear that Canadian pilots and hydrographers were a skilled group of men who had long acquired a detailed and accurate knowledge of the St. Lawrence River, a brief notice of the Canadian pilots of the British expedition will complete this account. The well-known story of the successful ruse employed by Admiral Durell's advance squadron to obtain a few river pilots has been told by nearly every historian since Parkman [48], but it has obscured our knowledge of other Canadian pilots who were drawn from English prisons and forced to serve in the British fleet. During the fall of 1758 at Halifax, Rear-Admiral Philip Durell collected at least 17 pilots familiar with the Gulf and River St. Lawrence from Louisbourg, Gaspé, Mont Louis and Grand Rivière for the coming compaign [49]. But the most important pilots came from England where they had been languishing for several years. In January, 1759, several of these men were sent to Portsmouth and put into Vice-Admiral Charles Saunders' fleet. Three months later after arriving at Halifax Saunders requested the governors of New York and Massachusetts to send him any pilots familiar with the St. Lawrence [50]. That Canadian prisoners were included in the request is suggested by Rear-Admiral Lord Colville late in 1759 when he reported that 11 French pilots at Halifax, 5 at Boston and 3 at Louisbourg were to be paid 15 pounds for their services during the recently concluded campaign [51]. But the services of these men were minor if we compare their rewards with those granted the two major Canadian pilots of the expedition, Augustin Raby who served in Saunders' flagship, the *Neptune* (90 guns), and Théodore Denys de Vitré who served in the *Princess Amelia,* flagship of Durell's advance squadron [52]. Raby — in Saunders' words, " the principal pilot of our fleet " — was a victim of circumstance and received a life pension of 5 shillings *per diem,* but Denys de Vitré, a collaborator, was rewarded with an annual life pension of 250 pounds [53]. Irony has the final word, for while Governor Vaudreuil and his cronies refused to employ the services of the most knowledgeable pilot in Canada,

the English displayed no such reluctance in drawing on the services of their enemies. But it is perhaps unfair that as a result, the work of earlier masters and hydrographers in Canada and their contributions to navigation and cartography became enshrouded in fiction. Jean Deshayes, Richard Testu de la Richardière and Gabriel Pellegrin deserve a better fate.

FOOTNOTES

[1] BROWN, L.A., *The Story of Maps,* (Boston, Little and Brown, 1949), is the first English language work to clearly acknowledge French dominance of scientific cartography late in the seventeenth century. See also J.W. OLMSTEAD, " The Voyage of Jean Richer to Acadia in 1670 : A study in the Relations of Science and Navigation under Colbert ", *Proceedings of the American Philosophical Society,* CIV, (1960), Sec. 6, p. 612, n. 2 who makes this point.

[2] E.g. STACEY, Charles P., *Quebec, 1759 : The Siege and the Battle,* (Toronto, Macmillan, 1959), p. 42 ; also Duncan Grinnell-Milne, *Mad, is He ? The Character and Achievement of James Wolfe* (London, Bodley Head, 1963) p. 192 who refers to the " great uncharted river ".

[3] E.g. PARKMAN, Francis, *Montcalm and Wolfe,* 2 vols. (London, J.M. Dent, n.d. [1884]), II, 126 ; and GRAHAM, G.S., *Empire of the North Atlantic : The Maritime Struggle for North America,* 2nd ed. (Toronto, University of Toronto Press, 1958), p. 79.

[4] DOUGHTY, Arthur G., ed., *An Historical Journal of the Campaigns in North America for the years, 1757, 1758, 1759 and 1760 by Captain John Knox,* 3 vols. (Toronto, Champlain Society, 1914-1916), I, 371.

[5] CASGRAIN, H.R., éd., *Journal du Marquis de Montcalm durant ses campagnes en Canada de 1756 à 1759* (Québec, Demers et Frères, 1895), pp. 556, 557, 558, 560, 570.

[6] Archives Nationales, Archives des Colonies [hereafter Colonies], Série $C^{11}A$, 104, f. 3, Vaudreuil and Bigot to Berryer, 22 October, 1759, quoted in Parkman, *Montcalm and Wolfe,* II, 132, n. 1.

[7] See *Dictionary of Canadian Biography,* Vol. I, *1000 to 1700* (Toronto, University of Toronto Press, 1966), pp. 119, 392-98 for brief sketches of Boutet and Jolliet and Vol. II, *1701 to 1740* (1969), pp. 184-85, 228-30, for Deshayes and Franquelin.

[8] Archives du Séminaire du Québec, Université Laval, Polygraphie 2, no. 34, " Carte marine de la Rivière de Québec par le Sr Deshayes, 1686. Ou recueil de ce qui sert à la navigation particulière de cette rivière et de ce qui peut contribuer à la metode (*sic*) générale de lever et dresser les cartes marines. " [hereafter Deshayes, " Recueil "].

[9] See OLMSTEAD, " The Voyage of Jean Richer ", for a detailed account of this voyage. The author casts some doubt (p. 622) on whether the Deshayes who accompanied Richer was the same as the hydrographer, but there seems no reason for this doubt.

[10] *L'Usage du compas de proportion de D. Henrion* (Paris, 1681) ; second edition (Paris, 1685).

[11] The expedition was in the planning stage for some time for it came to the attention of Edmund Halley in January, 1681 ; see E.F. MACPIKE, ed., *Cor-*

respondence and Papers of Edmund Halley (Oxford, 1932), p. 49. Halley to Robert Hooke, January, 1681.

[12] See " Observations faites en Afrique et en Amérique ", in *Les éléments de l'astronomie vérifiez par M. Cassini par rapport de ses tables aux observations de M. Richer faites en l'isle de Caienne, avec les observations de M.M. Varin, Des Hayes, et de Gloss faites en Affrique et en Amérique* (Paris, Imprimerie royale, 1684).

[13] See BROWN, *The Story of Maps*, pp. 220-24 for an account of the voyage and its significance.

[14] Colonies, Série B, 11, ff. 298 and 300, Seignelay to Denonville and Demeulles, June 17, 1685 ; and Colonies, C^{11}A, 7, f. 87. Denonville to Seignelay, November 13, 1685.

[15] The original of this chart is located in the Ministère des Affaires Etrangères, Plans et Cartes, no. 7420 and reproduced in A.L. PINART, *Recueil de cartes, plans et vues relatifs aux Etats Unis et au Canada* (Paris, E. Dufosse, 1893), nos. 21-22.

[16] Reported latitudes in Deshayes, " Recueil ", f. 13 and compared with the present latitudes of six of the observed positions.

[17] Present longitudes are taken from *The Times Atlas of the World, Mid-Century Edition*, ed. John BARTHOLOMEW (London, 1955).

[18] *La Théorie et pratique du nivellement* (Paris, 1685) ; second edition (Paris, 1685).

[19] DAUMAS, Maurice, *Les Instruments scientifiques aux* XVII^{e} *et* XVIII^{e} *siècles* (Paris, P.U.F., 1953), pp. 173-4. The *toise de roi* divided into *pouces, lignes* and *dizaines de ligne* was based on the *toise de fer*, an iron bar sealed in the wall of the Chatelet in 1668.

[20] GOSSELIN, A., " Encore le P. de Bonnecamps 1707-1790 ", *Transactions of the Royal Society of Canada*, 2nd Series, XII (1897), section 1, p. 98.

[21] DESHAYES, "Recueil", f. 17.

[22] DAUMAS, *Les Instruments scientifiques*, pp. 107-8 ; also E.G.R. TAYLOR, *The Mathematical Practitioners of Tudor and Stuart England* (Cambridge, The University Press, 1954), p. 267.

[23] Bibliothèque Nationale ; Archives service hydrographique, portefeuille 126, no. 1, pièce 4.

[24] *Carte de l'embouchure de la Rivière de St. Laurens, levée de cap en cap jusqu'à Québec : vérifiée par plusieurs observations avec les sondes et les remarques pour les passages de sujétion, plus le cours de cette rivière au-dessus Québec jusqu'au Lac Ontario par le Sieur Deshayes Hydrographe.* Several copies are in the Map Division of the Public Archives of Canada as well as in the Bibliothèque Nationale.

[25] MARCEL, G., *Cartographie de la Nouvelle France, supplément de l'ouvrage de M. Harrisse* (Paris, 1885), p. 31, no. 83 suggests 1686 ; J.E. ROY, *Rapport sur les archives de France relatives à l'histoire du Canada* (Ottawa, 1911), p. 652 also gives 1686 ; H.R. HOLMDEN, *Catalogue of maps, plans and charts in the map room of the Dominion Archives* (Ottawa, 1912), no. 1215 gives 1695.

[26] Archives de la Marine, Série B^{2}, 140, f. 111 Jérome de Pontchartrain to Abbé Bignon, April, 1699.

[27] The Academy's certificate appeared in the annual report for 1699, *Histoire de l'Académie royale des sciences, 1699* (Paris, 1702), p. 86 ; reprinted in

Bulletin des recherches historiques, XXXVIII, (1932), p. 281. Deshayes' permission is noted in Archives de la Marine, B^2, 140, f. 329. Pontchartrain to Deshayes, June 3, 1699.

[28] *Ibid.,* 156, f. 639. Pontchartrain to Bégon, June 13, 1702.

[29] See Governor Beauharnois to Pontchartrain, November 1702 printed in *Bulletin des recherches historiques,* 51, (1945), p. 302 ; Colonies, B, 23, f. 218. Pontchartrain to Beauharnois, June 20, 1703. Also Colonies, $C^{11}A$, 24, Vaudreuil and Raudot to Pontchartrain, November, 1706 for lack of equipment. P.G. Roy, " Jean Deshayes : hydrographe du roi ", *Bulletin des recherches historiques,* 22, (1916), 129-33 consists chiefly of an inventory of Deshayes' effects made 4 days after his death and reveals his lack of instruments.

[30] Bibliothèque Nationale, Archives du Service Hydrographique, Portefeuille 126.

[31] Archives de la Marine, Série B^1, 8, f. 127 Voutron to Naval Council, 7 December, 1715 ; and *ibid.,* 9, f. 602 same to same, 2 and 5 December, 1716.

[32] Colonies, $C^{11}A$, 37, pp. 76-81. Proceedings of the Naval Council on a letter from La Galissonière regarding the proposal of Sieur de la Brosse, 3 February, 1717.

[33] *Ibid.,* 42, p. 227. Voutron to Naval Council, 9 December, 1720.

[34] For Desherbiers de l'Etanduère see *Dictionnaire de biographie française,* X ; also Colonies, $C^{11}A$, 45, pp. 183-4 Bégon to Maurepas, 14 October, 1723.

[35] Colonies, $C^{11}A$, 48, p. 81, Beauharnois and Dupuy to Maurepas, 30 October, 1726 ; *ibid.,* p. 237 Dupuy to Maurepas, 14 October, 1726.

[36] Colonies, $C^{11}A$, 50, p. 58, Beauharnois and D'Aigremont to Maurepas, 1 October, 1728.

[37] E.g. "Carte du Fleuve de St. Laurent depuis Gaspé et Mingan jusqu'à Québec, prise sur tout ce qui a été reconnu bon dans les anciennes cartes et mémoires et sur les observations particulières que que (*sic*) Mr. de l'Etanduère, Capitaine de Vaisseau, a fait dans les campagnes de 1730 et 1732 et sur celles des Sieurs de la Richardière et Gallocheau et des plus experimentez pilotes", in British Museum, Add Ms. 15, 332 (F, 1-3) and (G) ; a more complete copy of the same chart is in Bibliothèque Nationale, Cartes et Plans, Service Hydrographique, Portefeuille 126, div. 1, pièce 18.

[38] See PRITCHARD, J., " Testu de la Richardière ", *Dictionary of Canadian Biography,* Vol. III, *1741-1770* (Toronto, University of Toronto Press, 1974), p. 620-622.

[39] See PRITCHARD, J., " Ailleboust de Cerry ", *Dictionary of Canadian Biography,* Vol. IV, *1771-1800* (to appear).

[40] Archives de la Marine, 6 J J, Portefeuille 126 ; and *Report of the Public Archives of Canada, for 1905,* Vol. I, see v. p. 5 ; also Colonies, B, 103, f. 13, Minister to Vaudreuil and Bigot, 1756.

[41] PRITCHARD, J., " Pellegrin ", *Dictionary of Canadian Biography,* Vol. IV (to appear).

[42] CASGRAIN, éd., *Journal de Montcalm,* p. 307.

[43] DE BOUGAINVILLE, L.-A., " Mémoires ", in *Rapport de l'archiviste de la province de Québec pour 1923-24* (Québec, 1924), pp. 21-3, 27-8, 29.

[44] " Lettre du Sieur Pellegrin, capitaine de port (*sic*), officier de marine expérimenté, à M. le Marquis de Vaudreuil, communiquée et concertée avec le Marquis de Montcalm ", 13 January 1759, in *Lettres et pièces militaires,*

instructions, ordres, mémoires, plans de campagne et de défense 1756-1760, éd. H.R. CASGRAIN (Québec, 1891), pp. 91-4.

[45] See Colonies, C^{11}A, 103, f. 234. Vaudreuil to Minister, 6 October, 1758, denying that Pellegrin's observations were of any consequence.

[46] CASGRAIN, éd., *Journal de Montcalm*, pp. 525, 526, 535.

[47] FAUTEAUX, A., éd., *Journal du siège de Québec du 10 mai au 18 septembre 1759* (Québec, 1922), p. 26.

[48] PARKMAN, *Montcalm and Wolfe*, II, 130.

[49] LITTLE, C.H., ed., *Despatches of Rear-Admiral Philip Durell, 1758-1759, and Rear-Admiral Lord Colville, 1759-1761* (Halifax, 1759), p. 5. Durell's letter of 5 November, 1758.

[50] LITTLE, C.H., ed., *Despatches of Vice Admiral Charles Saunders 1759-1760 : The Naval Side of the Capture of Quebec* (Halifax, 1758), p. 7. Saunders letter of 10 March, 1759.

[51] LITTLE, ed., *Despatches of ... Rear Admiral Lord Colville*, p. 13 for Colville's letter of 22 December, 1759 ; see also LITTLE, *Despatches of ... Saunders*, p. 29 for letter of 5 January, 1760 that he returned to England with 8 additional French pilots.

[52] See PRITCHARD, J., " Raby " and " Denys de Vitré ", *Dictionary of Canadian Biography*, Vol. IV (to appear).

[53] *Acts of the Privy Council of England, Colonial Series*, Vol. IV, *1745-1766* (London, 1911), p. 665 for Order in Council, 20 July, 1763, acting on memorials from Raby and Denys de Vitré supported by Admiral Saunders.

APPENDIX

" On Corrections of the Instrument to take angles " (*)

By Jean DESHAYES, 1686

When one has only a moderately good instrument one can still use it with passable accuracy if one knows how to recognize and correct all its shortcomings, though this may not be without [expending] time and labour that would be more usefully employed on other things if the instrument was better.

I had a wooden plane-table by But[t]erfield only nine or ten inches in diameter on which was mounted a brass rim divided into degrees. There were two telescopes for sights, both passing through the center, one moveable on the graduated side and the other fixed to the other side. No compass was attached but when I took positional angles I had a box

(*) From Archives du séminaire de Québec, Université Laval, Polygraphic 2, no. 34, " Carte Marine de la Riviere de Quebec par le S^{r} Deshayes, 1686. Ou recueil de ce qui sert a la navigation particuliere de cette riviere et de ce qui peut contribuer a la metode generale de lever et dresser les Cartes marines ", ff. 17-18. Folio 18 is reproduced by permission of the Seminary of Quebec. I would like also to acknowledge the assistance of Dr. P. Stephen Day, of the Department of French, Queen's University, who aided with the translation.

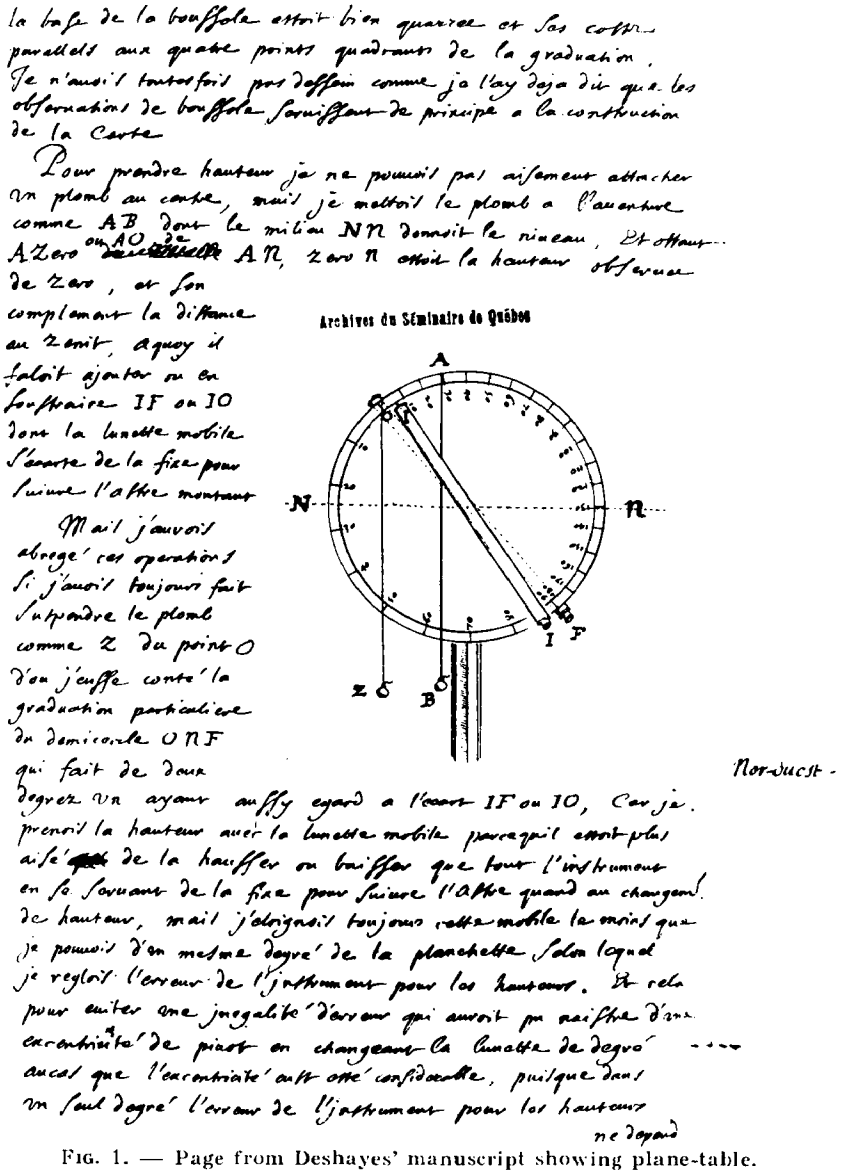

FIG. 1. — Page from Deshayes' manuscript showing plane-table.

compass that I placed on one of the alignments along the straight edge [which carries] the moveable telescope, having checked previously whether the compass was well recovered and [that] its graduation [coincided] with that of the plane-table : that is to say, if the ruler of the telescope was quite parallel to the axis of the telescope, and if the axis of the index parallel to the axis of the telescope passed right through the center of the plane-table or how much it fell short and if (f. 18) the base of the compass was truly squared and its sides parallel to the four quadrant points of the graduation. I did not intend, as I have already said, to have the compass observations serve as the basis for the construction of the chart.

To take elevations I could not easily attach a plumb to the center, so I put the plumb at random as at AB, whose mid-point Nn gave the level.

[And] taking away A Zero or ZO from An, Zero n was the observed elevation of Zero, and its complement the distance to the zenith, to this must be added or subtracted IF or IO, [the amount] by which the moveable telescope deviates from the fixed [one] in order to follow the ascending star.

But I shortened these operations if I always had the plumb suspended as at Z from point O from which I could count off the particular graduation of the semi circle OnF which compressed two degrees [into] one allowing also for the deviation IF or IO, for I took the elevation with the moveable telescope because it was easier to raise or lower it than the whole instrument, [which entailed] making use of the fixed [telescope] to follow the star with respect to the change of elevation. But I always disturbed the moveable one as little as possible, to the same extent as the plane-table according to which I adjusted the error of the instrument for [the] elevations. That was in order to avoid an unequal error that could have arisen from an eccentricity of the pivot while changing the telescope by degrees, in case [that] the eccentricity was considerable, since in a single degree the error of the instrument for elevation (f. 19) does not really depend on the eccentricity or concentricity of the pivot, but on how the axis of the index parallel to that of the telescope deviates to both sides of the center of the graduation, which does not vary even a degree.

As regards the changing error that would arise from an eccentricity of the pivot and which would alter variously the changing positional angles all around the horizon, I confess that I have not found a way to seek it out. Also there should not be one, since it is probable the artisans always use the pivot of the alidade completed first to trace and divide the circles of the rim. However, the surroundings of any one station retaken at different times at different places on the rim, gave me differences of several minutes [of arc]. That can also have occurred in part because the body of this instrument, being of wood, can change its shape according to the weather, dry or humid, and consequently do violence to that of the rim and cause it to approach more or less an ellipse. [And] that being so, it would probably be superfluous to want once and for all to observe and to make a table of all these disparities to correct.

Therefore, there were four things to verify, the eccentricity of the pivot, the compass, the degree on the index when the moveable telescope agreed with the fixed [one], and the error of elevations.

I omitted the first of these verifications. I made the second once for all and that was enough, and I made the others several times because changes were often needed, whether because the lenses were not always well fixed in the telescopes, or when they had to be cleaned, or in the end owing to other accidents.

In finishing this chapter I shall give my opinion on one small convenience lacking on all the instruments that I have seen for taking positional angles. After having turned the alidade nearly to the object at which one wishes to point, we would do so more easily and quickly if we could put the finishing touch to the alidade's position by advancing or retracting some kind of screw.